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Christina Wiederer

Overcoming logistics-related barriers to higher-value exports – a decision framework to identify policy measures

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ABBREVIATIONS

3PL	Third-party logistics provider
AI	Artificial intelligence
AMDL	Agence Marocaine de Développement de la Logistique (Moroccan Agency for Logistics Development)
CAREC	Central Asia Regional Economic Cooperation
CILT	The Chartered Institute of Logistics & Transport
EAEU	Eurasian Economic Union
EDI	Electronic data interchange
ERR	Economic rate of return
FDI	Foreign direct investment
FIATA	International Federation of Freight Forwarders Associations
GDP	Gross domestic product
GNI	Gross national income
GPS	Global Positioning System
GVC	Global value chain
HS code	Harmonized Commodity Description and Coding System (international standardized system for commodity classification, used, e.g., in customs)
ICD	Inland container depot
ICT	Information and communications technology
IoT	Internet of Things
IPP	Integrated product policy
IRR	Internal rate of return
ISIC	International Standard Industrial Classification
Kbps	Kilobits per second
LPI	Logistics Performance Index
LSP	Logistics services provider
Mbps	Megabits per second

ONCF	Office National des Chemins de Fer du Maroc (Moroccan National Railway Operator)
PME	Petites et moyennes entreprises (Small and medium-sized enterprises)
PPP	Public-private partnership
PPP	Purchasing power parity
RFID	Radio frequency identification
SC	Supply chain
SCM	Supply chain management
SMEs	Small and medium-sized enterprises
SITC	Standard International Trade Classification
SNTL	Société Nationale des Transports et de Logistique (a Moroccan LSP)
SPS	Sanitary and phytosanitary
TCE	Transaction cost economics
TEU	Twenty-foot equivalent unit
UNCTAD	United Nations Conference on Trade and Development
WDI	World Development Indicators
WITS	World Integrated Trade Solution (software to query trade databases)
WTO	World Trade Organization

ABSTRACT (ENGLISH)

Logistics is key to a country's trading opportunities. Poor trade logistics performance, measured in the cost and complexity of importing and exporting, precludes many countries from diversifying their economies and can hamper trade, growth and employment. This is acutely relevant for developing countries, where a frail logistics environment, i.e., the combination of logistics infrastructure and services, is often a factor in weak trade. While trade consists of imports and exports, exports are crucial to a country's development due to their potential to increase income and employment. Supply chain delays increase transportation costs and hence product costs, thus decreasing the competitiveness of exports. They force companies to hold higher inventory to avoid production stoppages due to delays in procuring preliminary products. While logistics services are mostly provided by private actors, governments play a key role in ensuring a well-functioning logistics environment, for example, through providing public infrastructure, customs procedures, or vocational training. Given limited resources, identifying and prioritizing investments are crucial tasks for developing nations.

This dissertation develops a decision framework for the public sector as to which logistics interventions to carry out in a country wishing to facilitate higher-value exports. Higher-value exports here refer not just to a higher amount of exports, but to a higher value added of exports. The framework is applied to three product categories: automotive products, perishable agricultural products, and high-tech manufacturing. It is then applied to Vietnam, Morocco, and Kyrgyzstan, three middle-income countries representing different geographies, population sizes, and industrial structures. Methods to develop the framework include structured and semi-structured interviews, data analyses from public sources, and a review of the literature.

The results include product-category-specific logistics requirements, gap analyses for the three countries, and policy recommendations for

measures to improve logistics for high-tech manufacturing in Vietnam, automotive products in Morocco, and perishable agricultural goods in Kyrgyzstan. Although the suggested logistics measures are applicable to the three case study countries, the framework's first part (target set-up of the logistics environment and logistics requirements) can be applied to other countries wishing to facilitate exports in the three product categories. Guidelines on potential measures to improve the logistics environment for the three product categories are included and can be used by policymakers in other countries. The framework developed here can also be applied to other product categories. It uses a structured approach that enables identifying recommended policy measures even with a narrow empirical base of public country-level, logistics-related data and insights from interviews with logistics stakeholders.

ABSTRACT (GERMAN)

Logistik ist der Schlüssel zu den Handelschancen eines Landes. Eine niedrige außenhandelsbezogene Logistikleistung, gemessen in Kosten und Hindernissen von Importen und Exporten, hindert viele Länder daran, ihre Volkswirtschaften zu diversifizieren, und kann Außenhandel, Wachstum und Beschäftigung hemmen. Dies gilt insbesondere für Entwicklungsländer, in denen ein schwieriges Logistikumfeld, d. h. das Zusammenspiel von Logistikinfrastruktur und Logistikdienstleistungen, oft ein Faktor für schwachen Außenhandel ist. Während Außenhandel sowohl aus Exporten als auch aus Importen besteht, sind Exporte aufgrund ihres Potenzials zur Steigerung von Wohlstand und Beschäftigung von entscheidender Bedeutung für die Entwicklung eines Landes. Verzögerungen in der Lieferkette erhöhen die Transport- und damit die Produktkosten und beeinträchtigen die Wettbewerbsfähigkeit von Exporten. Sie zwingen Unternehmen, höhere Lagerbestände zu halten, um Produktionsausfällen aufgrund von Verzögerungen bei der Beschaffung von Vorprodukten vorzubeugen. Obwohl Logistikdienstleistungen hauptsächlich von privaten Akteuren erbracht werden, spielen nationale Regierungen eine Schlüsselrolle bei der Gewährleistung eines gut funktionierenden Logistikumfeldes, z. B. über öffentliche Infrastruktur, Zollabfertigung oder Berufsausbildung. Angesichts begrenzter Ressourcen sind das Ermitteln und Priorisieren notwendiger Investitionen entscheidende Aufgaben für Entwicklungsländer.

Diese Dissertation entwickelt ein Entscheidungsmodell für den öffentlichen Sektor, welche handelslogistischen Interventionen in einem Land durchgeführt werden sollten, um Exporte innerhalb höherwertiger Produktkategorien zu ermöglichen. Höherwertige Exporte beziehen sich hier nicht nur auf eine höhere Exportmenge, sondern auch auf eine höhere Wertschöpfung der Exporte. Das Entscheidungsmodell wird auf drei Produktkategorien angewendet: Automobilprodukte, leichtverderbliche Agrarprodukte und Hightech-Produkte. Sodann wird das Modell

auf Marokko, Kirgisien und Vietnam angewendet, drei Länder mit mittelhohem Einkommen, die unterschiedliche Weltregionen, Bevölkerungsgrößen und Industriestrukturen repräsentieren. Die zur Erstellung des Entscheidungsmodells verwendeten Methoden umfassen strukturierte und semistrukturierte Interviews, Datenanalysen aus öffentlich zugänglichen Quellen und Literaturanalysen.

Die Ergebnisse beinhalten produktkategorie-spezifische Logistikanforderungen, Lückenanalysen für die drei Länder sowie Handlungsempfehlungen für Regierungsmaßnahmen zur Verbesserung der Logistik für Automobilprodukte in Marokko, leichtverderbliche landwirtschaftliche Güter in Kirgisien und Hightech-Fertigung in Vietnam. Obgleich die vorgeschlagenen Logistik-Maßnahmen nur für die drei Fallstudienländer gelten, kann der erste Teil des Entscheidungsmodells (die Idealkonfiguration des Logistikumfeldes sowie produktkategorie-spezifische Logistikanforderungen) auf andere Länder angewendet werden, die Exporte in den drei Produktkategorien fördern möchten. Ebenfalls enthalten sind Leitfäden für die Regierungen anderer Länder bezüglich möglicher Maßnahmen zur Verbesserung des Logistikumfelds der drei Produktkategorien. Das hier entwickelte Entscheidungsmodell kann auch auf andere Produktkategorien angewendet werden. Es bedient sich einer strukturierten Herangehensweise, die es ermöglicht, empfohlene staatliche Maßnahmen auch auf einer schmalen empirischen Basis aus logistikbezogenen Daten und Erkenntnissen aus Interviews mit Logistikakteuren herauszuarbeiten.

1 INTRODUCTION

1.1 Problem area

This dissertation deals with the role of governments in fostering logistics to support international trade, in particular exports. Exports are understood to help countries grow and prosper.[1] What is not fully understood is how to best foster exports in countries with low trade volumes and little integration into the world economy. A country where policymakers want to promote exports needs to be competitive. The competitiveness of a country's private sector is determined by several factors, for example, macroeconomic policies, infrastructure, product quality, innovation, and the cost of labor.[2]

Another enabler of trade and competitiveness is logistics, in particular a country's trade logistics performance. Logistics deals with the flow of goods and information.[3] Trade logistics performance—measured as the cost, time, and complexity involved in import and export activities—influences a country's options to trade.[4] Even if a country produces high-quality, competitively priced goods for which there would be ample demand abroad, those goods will not make it to their destination if logistics performance is low. In contrast, high logistics performance enables better market access and can thus promote trade.[5] Hence, logistics can be thought of as the backbone of international trade. If all goes well, it stays invisible; if it does not go well, most trade slows down.

A sound logistics environment helps countries become part of global production networks that span not just multiple companies, but multiple countries. International firms eager to reach new markets or lower production costs will locate in countries with favorable cost structures,

[1] cf. Clark et al. 2004, 1; Hausman et al. 2013, 236
[2] Raballand et al. 2006, 1
[3] The full definition of logistics as used in this dissertation is provided in section 1.3.
[4] Hausman et al. 2013, 236
[5] Carruthers et al. 2004, 77

which are partly driven by favorable logistics cost structures.[6] A country's logistics environment provides the infrastructure and spatial connectivity that firms need to connect with customers, nationally and internationally.[7]

Being able to connect to customers and markets abroad is becoming more vital, especially for middle-income countries, which are the focus of this dissertation. Middle-income countries are defined by the World Bank according to national income: In 2020, those with a gross national income (GNI) per capita of between US$1,026 and US$12,375 counted as middle income.[8] Among the changes that these countries face are shifts in industrial production.[9] Such shifts increase and alter demand for logistics services. This is because increasing division of labor and higher degrees of specialization cause production to be spread out geographically, raising the need for goods transportation.[10] Population growth, urbanization and rising income in middle-income countries further increase the need for a well-functioning logistics environment.[11]

Shortcomings of a country's logistics environment can have large ramifications: Major trade policy-related advancements such as the accession of a country to the World Trade Organization can fail to have noticeable effects if a weak logistics environment is unable to sustain an increase in trade.[12] Factors that influence a country's logistics capabilities include its infrastructure; laws and regulations; customs and border manage-

[6] cf. Straube and Pfohl 2008, 12

[7] Banomyong et al. 2015, 24

[8] For the 2020 fiscal year (July 1, 2019, to June 30, 2020), middle income economies as defined by the World Bank are those with a 2018 GNI per capita of more than US$1,026 but less than US$12,375 (using the World Bank Atlas method). Lower middle income and upper middle-income economies are separated at a GNI per capita of US$3,995. Source: https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups, accessed on Dec. 30, 2019.

[9] cf. GTZ 2010, 12. The example is cited as a challenge for cities rather than countries, but the one cited here applies to the national level, too.

[10] GTZ 2010, 12

[11] A rationale for focusing this dissertation on middle-income countries is included in section 4.4.2.

[12] Carruthers et al. 2004, 78

ment; and the availability, skills, and knowledge of its labor force. Most of these factors are non-excludable and non-rivalrous, thus meeting the criteria for public goods.[13] Private-sector provision of these goods often leads to market failure and public-sector participation is therefore warranted in certain areas. At the same time, no reform of the logistics environment can succeed without the input of the private sector. As a third stakeholder beyond the private and public sector, international development finance institutions with their mandate as knowledge brokers can act as go-betweens and as financiers.[14]

This dissertation will explore the role of national governments in improving a country's logistics environment, i.e., the combination of its logistics infrastructure and services, with the goal of facilitating exports. While international trade consists of imports and exports, exports are especially crucial for a country's development. The main links between exports and a country's development are expansion of employment options (for those in export-oriented manufacturing industries or services) and increase of income (via exports for those who trade). Exports can help countries create jobs, compensate for a lack of domestic demand, diversify their economies, and manage external shocks. Countries with a broad industrial and services base are less prone to economic downturns than those with a narrow industrial and services base. This dissertation focuses on exports, however, it should be noted that imports are important in their own right and are needed as inputs for exports.

The focus will be on logistics as a facilitator of higher-value exports. Higher-value exports here refer not just to a higher quantity of exports, but to a rise in the value added of exports, i.e., a shift in the export basket of a country away from low-added-value products, such as raw materials and commodities, towards higher-added-value ones, for which value-adding processing takes place inside the country prior to exporting, either for raw material or parts and components imported earlier.

[13] Memedovic et al. 2005, 371
[14] cf. Memedovic et al. 2005, 371

Examples of higher-value exports include capital- and technology-intensive products, such as automobiles, heavy machinery, and computers; but also products in comparatively basic sectors, such as agriculture, if they include value-adding activities within the exporting country. Examples include processed meat or berries that need special packaging and handling. The motivation for focusing on these types of exports is that countries graduating from commodities as their main export to basic manufactured products using imported inputs tend to see the largest increases in economic growth.[15]

Although this dissertation focuses on the role of government in shaping a country's logistics environment, it should be noted that several aspects of the logistics environment are outside the reach of a country's government. Geography, for example, can hardly be altered, yet immensely influences a country's transport infrastructure. A landlocked country has more difficulty in accessing cost-effective maritime transport than a coastal country. Border disputes between neighboring countries can stifle trade and transit. Similarly, intra-company logistics processes are mostly outside the reach of government action. Yet many aspects of a country's logistics environment can be influenced by interventions from national governments. It is on those measures that the dissertation focuses.

1.2 Purpose of the dissertation

The purpose of this dissertation is to enable countries to identify policy measures to improve their logistics environments with the goal of facilitating higher-value exports. National governments have limited resources for improving the logistics environment to support industrial diversification and the ability to export, and this can include limitations in the knowledge and experience required to identify the policy measures necessary to correct weaknesses in the logistics environment. To fill this knowledge gap, the dissertation develops a decision framework guided by theory and insights from selected countries that enables policymakers

[15] World Bank 2019, 3

to identify logistics interventions that improve the logistics environment for product categories that lend themselves to higher-value exports.

The framework is applied to three product categories: high-tech manufacturing, automotive, and higher-value perishable agricultural goods. The framework defines what "adequate" logistics in these three product categories requires in terms of an enabling environment. These requirements are matched with policy interventions that national governments can implement. Such interventions could, for example, be infrastructure investments, regulatory reforms, or education schemes. The focus on government action implies that intra-company processes are mostly excluded, except for those that governments can influence through regulations and incentives. The framework can be expanded to other product categories; the logic underlying the framework has been designed to do this quickly, and section 4.3.3 provides guidance for researchers and country practitioners on how to expand the framework.

The rationale for developing the framework is the dearth of tools for evidence-based policymaking regarding logistics. Most of the literature refers to intra-company logistics rather than to the macro logistics environment.[16] Yet national governments play a key role in shaping the logistics environment, e.g., by providing logistics infrastructure, setting regulatory boundaries, overseeing border management, and providing a level playing field for all logistics actors. Havenga et al. (2020) underline the need for decision aids in logistics: "Furthermore, infrastructure investment requirements in developing countries are significant and models that can direct spending are required."[17] The framework developed in this dissertation uses a structured approach that enables identifying recommended measures (both for infrastructure spending and other policy measures), even with a narrow empirical base of public, country-level, logistics-related data and insights from interviews with logistics stakeholders. Having a tool to help policymakers identify investments is

[16] See section 1.6 for a definition of "macro logistics".
[17] Havenga et al. 2020, 132

helpful in logistics, in which reliable cross-country performance indicators (e.g., lead time, clearance time, level of fees, or logistics costs) are not uniformly available across countries, or available only as perception-based data (e.g., the World Bank's Logistics Performance Index).[18] With resources limited, identifying and prioritizing reform areas are critical tasks for developing nations.

Logistics is an interplay between public and private actors: Although a government can lay the institutional foundations and provide some of the logistics infrastructure, the evolution of a competitive logistics services sector depends on capable domestic and international firms. By examining which logistics needs of selected product categories a government can meet, this dissertation aims at providing a structured procedure for formulating sound policy actions to improve a country's logistics environment, foster exports, and contribute to economic development.

1.3 Definition of key terms and concepts

DEFINITION OF LOGISTICS

Process-oriented logistics, as defined by Straube (2004), is the planning, steering, execution, and control of all information and material flows within and between companies, from customer to all suppliers and sub-suppliers as well as other value-adding partners.[19]

The Council of Supply Chain Management Professionals (2013) provides the following definition of logistics:

> The process of planning, implementing, and controlling procedures for the efficient and effective transportation and storage of goods including services, and related information

[18] Arvis et al. 2012, Arvis et al. 2014, Arvis et al. 2016, Arvis et al. 2018

[19] Straube 2004, 31; translation from German to English by the author. The German original version in Straube (2004, 31) is "Die prozessorientierte Unternehmenslogistik als Grundlage dieser Arbeit umfasst somit die Planung, Steuerung, Durchführung und Kontrolle aller Informations- und Materialflüsse innerhalb und zwischen Unternehmen von den Kunden bis zu allen Lieferanten und Vorlieferanten und anderen Wertschöpfungspartnern."

> from the point of origin to the point of consumption for the purpose of conforming to customer requirements. This definition includes inbound, outbound, internal, and external movements.[20]

Rushton et al. (2017) suggest a narrow definition of logistics:

> Logistics = Materials Management + Distribution[21]

In recent years, digitalization has had an impact on many aspects of manufacturing and industrial activity, including logistics, and this influence can be expected to continue over the next decades.[22] Digitalization enables logistics to become "smart." "Smart logistics," as defined by Straube (Ed., 2019), is

> […] the holistic, customer-oriented planning and control of highly integrated and automated, modular, self-steering flow of information and goods in the customer order and innovation process of value creation networks where relevant information and data are shared in real-time with stakeholders.[23]

In this dissertation, the definition of logistics by Straube (2004) as cited above will be used, enhanced by the focus on the impact of digitalization on logistics as suggested in the definition of smart logistics by Straube (Ed., 2019), also cited above.[24] This definition was chosen to ensure that the definition of logistics used in this dissertation is holistic and reflects all logistics functions that are relevant for private firms. "Adequate" logistics, from the point of view of private companies and following the above definitions, is given under the mandate that all functions are fulfilled as stated in the definition, i.e., in real-time (where possible) and under the assumption that all supply chain actors collaborate.

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[20] Council of Supply Chain Management Professionals 2013, 117
[21] Rushton et al. 2017, 4
[22] According to Brennen and Kreiss (2014, unpaginated), "digitalization" refers to "the way in which many domains of social life are restructured around digital communications and media infrastructures".
[23] Straube (Ed.) 2019, 1
[24] Straube 2004, 31 and Straube (Ed.) 2019, 1

The above definition covers the function and importance of logistics in the context of private companies. As this dissertation deals with the role of national governments in facilitating logistics for international trade, logistics needs to be covered from the point of view of the public in addition to the private sector, and with a view towards international trade, in particular exports. This includes both the intra-company and inter-company processes that are covered by Straube (2004) and Straube (Ed., 2019), but also the functions with relevance to logistics that a national government controls or partly controls, e.g., public infrastructure (both transport and ICT infrastructure) as well as administrative and customs procedures.[25] These functions are partly captured by the definition of trade logistics by Korinek and Sourdin (2011):

> Trade logistics include the range of services and processes that are involved in moving goods from one country to another: customs and administrative procedures, organization and management of international shipment operations, tracking and tracing, and the quality of transport and information technology infrastructures.[26]

Korinek and Sourdin (2011) specify that:

> Only logistics services that are directly related to international trade and the transport of goods from one economy to another are covered; the analysis does not pertain, for example, to logistics that are directly related to end-user distribution subsequent to goods' arrival in the destination country. The analysis here should therefore not be regarded as a complete view of the full producer-to-consumer logistics chain but only to trade-related logistics.[27]

This dissertation will adopt the same restrictions for trade logistics as outlined by Korinek and Sourdin (2011).[28] In addition to the aspects of trade logistics covered by Korinek and Sourdin (2011), that is, customs as well as transport and ICT-related infrastructure, this dissertation will

[25] Straube 2004, 31 and Straube (Ed.) 2019, 1
[26] Korinek and Sourdin 2011, 4
[27] Korinek and Sourdin 2011, 5
[28] Korinek and Sourdin 2011, 5

put emphasis on four other aspects of logistics that need to be covered to ensure "adequate logistics" from the viewpoint of national governments: (1) the regulatory environment related to logistics; (2) education, skills, and professional training related to logistics professions; (3) the organization of the logistics environment; and (4) business practices for high-quality logistics services, to the extent that a national government can influence them via incentives and regulations.[29]

Modifying the general logistics definition by Straube (2004) for exports, logistics for exports encompasses the efficient and effective planning, directing, implementation and control of the flow of information and goods across borders.[30] Based on the previous elaborations, the definition of "adequate logistics for exports" from the point of view of national governments that will be used in this dissertation is given in the box below.

Adequate logistics for exports from the perspective of national governments is characterized by low cost while maintaining a high degree of reliability and flexibility.[31] This entails reliable transport- and trade-related infrastructure, efficient customs practices, adequate ICT infrastructure, an efficient organization of the logistics system, a regulatory environment that ensures fair competition in logistics services, an education and professional training system that supplies well-trained logistics specialists, and business practices that enable high-quality logistics services. Taken together, these characteristics enable a holistic, integrated, customer-oriented version of logistics

[29] cf. Korinek and Sourdin 2011, 5
[30] cf. Straube 2004, 31
[31] Flexibility here refers to the capability to change based on a set of defined contingency scenarios (cf. OECD 2013, 50). It covers the concepts of agility and adaptability. Reliability here refers to the degree of lead time uncertainty, where lead time refers to how long it takes for goods to arrive at the purchaser after the order has been placed (cf. Hausman et al. 2013, 241). More broadly, according to Bundschuh et al. (2003, 2), reliability refers to "the probability that a system or a component performs its specified function as intended within a given time horizon and environment". In distinguishing the reliability of the supply chain as a system from the reliability of an individual supplier, Bundschuh et al. (2003, 2) define "supply chain reliability" as "the probability of a supply chain to completely fulfill the demand of a final product without any loss of supply resulting from failures of suppliers."

that provides on-demand visibility and traceability of international information and material flows. Adequate logistics considers the network character of logistics and international trade, where numerous stakeholders collaborate to achieve an efficient and effective flow of goods and real-time information across borders.

Except for the focus on customs practices, the definition above can be used for "adequate logistics" from the point of view of governments as a whole, that is, even without a focus on international trade and exports. Yet customs practices have been included in the main definition as the focus of this dissertation is on exports.

The role of national governments in ensuring adequate logistics is chiefly that of facilitators for the private sector, as most logistics services are provided by private entities. The above definition of adequate logistics is independent of the product being exported and holds for all three product categories that will be examined later in this dissertation, that is, high-tech, automotive, and perishable agricultural goods.

DEFINITIONS OF OTHER TERMS

"Logistics environment" in this dissertation will denote the combination of a country's logistics infrastructure and logistics services as related to international trade. The goal of logistics is to minimize the duration and cost of flows related to international trade (goods, services, information).[32] Following the definition of Hausman et al. (2013), "logistics performance" will signify the cost, time, and complexity involved in carrying out import and export activities.[33] As for competitiveness, this term will be used in the sense of the "attractiveness of a region or country regarding business location decisions and/or foreign direct investment (FDI)."[34]

[32] cf. OECD 2015, 18
[33] Hausman et al. 2013, 236
[34] Celebi and Ojala 2015, 6

Regarding the difference between logistics and supply chain management (SCM), parts of the literature see logistics and SCM as synonymous, e.g., Simchi-Levi et al. (2000) and Göpfert (2002), whereas Cooper et al. (1997) do not see a direct link between SCM and logistics.[35]

Ivanov et al. (2019) define SCM as follows:

> Supply chain management is a cross-department and cross-enterprise integration and coordination of material, information, and financial flows to transform and use the SC resources in the most rational way along the entire value chain, from raw material suppliers to customers.[36]

The Council of Supply Chain Management Professionals (2013) provides the following definition:

> Supply Chain Management encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third-party service providers, and customers.[37]

Based on a review of SCM literature up to 2004, Larson and Halldorsson (2004) identified four perspectives on how logistics and SCM are related:

1. Traditionalist: Logistics is viewed as encompassing SCM.
2. Unionist: SCM is viewed as encompassing logistics.
3. Re-labeling: Logistics is replaced by SCM.
4. Intersectionist: Logistics and SCM overlap to a certain extent, but both fields retain some independence, i.e., they contain parts that the other field does not cover.[38]

[35] Simchi-Levi et al. 2000, 1; Göpfert 2002, 30; Cooper et al. 1997, 2
[36] Ivanov et al. 2019, 7
[37] Council of Supply Chain Management Professionals 2013, 187
[38] Larson and Halldorsson 2004, 19

As an example of a logistics function that is not covered by SCM, Larson and Halldorsson (2004) cite picking and packing in warehouses.[39] In this dissertation, SCM and logistics will be regarded as synonymous. Of the two terms, the term "logistics" will be used predominantly, with the understanding that it covers a holistic view of logistics and SCM.

1.4 Research question and sub-questions

The main research question is:

Which country-specific logistics measures should governments of middle-income countries take to foster exports in three selected product categories that lend themselves to higher-value exports?

Two research sub-questions can be derived from the main research question.

Research sub-question 1: What are the logistics requirements of three product categories whose expansion would enable more higher-value exports in a given middle-income country?

The three product categories examined will be: (1) high-tech products, (2) automotive products (parts and components as well as finished automobiles), and (3) higher-value perishable agricultural goods. The focus will be on logistics needs that a country's government can address. The product categories were chosen based on two characteristics:

1. potential of the product category to support higher-value exports (in the sense of higher value added exports rather than merely a higher export volume);
2. stated goals in the selected countries' National Development Plans or National Logistics Strategies regarding which product categories to foster.

[39] Larson and Halldorsson 2004, 21

Research sub-question 2: Which country-specific constraints are prevalent in Vietnam, Morocco, and Kyrgyzstan in the logistics environment of three product categories whose expansion would enable more higher-value exports in these countries?

For Morocco, logistics constraints will be assessed for automotive products. For Kyrgyzstan, the focus will be on logistics constraints for higher-value perishable agricultural goods. While this research sub-question focuses on specific countries, the answer to the main research question will include country-specific and non-country-specific elements. For Vietnam, logistics constraints will be explored for high-tech manufacturing.

1.5 Expected results

The dissertation's main result consists in the development of a decision framework to identify measures that policymakers can adopt to overcome logistics-related barriers to higher-value exports using a structured approach that enables identifying recommended measures using limited and relatively easy-to-obtain data. The decision framework has been fleshed out for three product categories and applied to three countries as part of this dissertation.

Three results emanate from the overall framework. The first entails the formulation of the requirements of a well-functioning logistics environment for three product categories: (1) high-tech goods (section 5.4.4), (2) automotive products (section 6.4.4), and (3) higher-value perishable agricultural goods (represented by fruit and vegetables, section 7.4.4). This first result will enable national governments to conduct a gap analysis between the ideal set-up of the logistics network of a particular product category and the state of logistics in their country, and to infer recommendations for improving their logistics environment with the aim of fostering higher-value exports. The full requirements are included in appendices 10.5.4, 10.6.4, and 10.7.4.

The second result comprises a set of recommended measures to help policymakers address reform needs in logistics in three countries: Vi-

etnam (for high-tech goods, section 5.4.6), Morocco (for automotive products, section 6.4.6), and Kyrgyzstan (for higher-value perishable agricultural goods, section 7.4.6). The full sets of recommended measures are included in appendices 10.5.6, 10.6.6, and 10.7.6. The third result consists of guidelines for policymakers in middle-income countries other than the three countries examined regarding which measures to focus on to improve the logistics environment for the three product categories (section 8.1.6). This section also includes meta-measures identified for each of the three product categories.

Logistics performance is determined by several factors, some of which are exogenous and beyond the scope of this dissertation. The framework focuses on interventions to improve a country's logistics environment that lie within the power of national governments, yet several other factors influence a country's logistics environment, chief among them intra-company decisions. Other determining factors of logistics performance that are not treated here include the occurrence of natural disasters, cyber-attacks, political unrest, corruption, and exchange rate fluctuations. Further limitations of the framework are included in section 4.4, and questions for further research are listed in section 9.2.

1.6 Area of application

"Logistics" in the course of this dissertation will refer to macro logistics (in contrast to the micro level), that is, logistics viewed at the country level rather than at the level of the individual firm. Havenga et al. (2020) define macro logistics as the "optimization of the time and place discrepancy on a national level."[40] They point out that a widely accepted definition of macro logistics is lacking.[41] Macro logistics covers relevant government ministries (e.g., Transport, Infrastructure, or Trade), policy actors (e.g., regulators and spatial planners), users (e.g., logistics services providers (LSPs) and their customers), and logistics infrastructure.[42]

[40] Havenga et al. 2020, 110
[41] Havenga et al. 2020, 116
[42] Havenga et al. 2020, 173

Owing to the growing importance of global value chains, in which production is spread across various countries, imports (and thus their facilitation through logistics) are important as well as exports.[43] Yet the activity that enables countries to benefit more from increased trade is exporting, in which firms in countries add value to either raw materials or imported parts and components, and then sell them abroad.[44] The dissertation will therefore focus on exports rather than imports, and more specifically on the question of how an adequate logistics environment can facilitate higher exports.

As mentioned in section 1.1, the main research question and both subquestions are confined to those aspects of a country's logistics environment that a national government can influence. Taking an entire country as the unit of analysis in an examination of logistics is becoming more difficult as trade is organized along complex supply chains, where intermediate inputs cross multiple borders, sometimes even several times back and forth. This is particularly true for manufactured products, to which two of the three product categories examined in this dissertation belong. Although more international cooperation in facilitating trade via high-quality logistics would be desirable, logistics policymaking still mostly happens at the level of individual countries, and this may justify the dissertation's focus on single countries as the unit of analysis.

The dissertation includes case studies with applications of the framework for three countries: Vietnam, Morocco, and Kyrgyzstan. The three countries were chosen to be representative regarding as many as possible of the following variables: world region, geography (coastal versus landlocked), population size, and size of economy. Logistics must have featured at least somewhat prominently in national policymaking for the period 2010 to 2020, i.e., the period immediately prior to publication. For each country, the case study focuses on one product-category-specific logistics environment. Section 4.4 includes details on the repre-

[43] cf. World Bank 2019, 24
[44] cf. World Bank 2019, 3

sentativeness of the decision framework and on the selection of countries and product categories.

In terms of their logistics needs, high-tech products are representative of goods with a comparatively high value-to-volume ratio; ample competition, particularly in East Asia; and need for multimodal facilities, especially to facilitate road-to-maritime and road-to-air transport. Automotive products are representative of manufactured items that rely on just-in-time or just-in-sequence production, with a comparatively high-complexity, make-to-order philosophy (rather than make-to-stock) and transmission of responsibility for quality assurance shifted from manufacturer to supplier or to third-party logistics providers (3PLs). Fruit and vegetables (representing perishable agricultural goods) are illustrative of other perishable export goods that rely on a continuous cold chain, on the full traceability of inputs and final products, and on elaborate quality assurance mechanisms such as testing facilities. Owing to their fragility, they require more careful handling and more packaging than other products.[45]

The decision framework is divided into six levels (see 4.3.3 for details):

Level 1: Target set-up of the logistics environment for a particular product category;

Level 2: Logistics concepts prevalent in the logistics of the product category;

Level 3: Product-category-specific logistics trends likely to impact logistics in middle-income countries in the next decade, i.e., until approximately 2030;

Level 4: Logistics requirements of the product category;

Level 5: Gap analysis: Difference between the product category's requirements and the status quo of the logistics environment;

Level 6: Suggested policy measures to fulfill the product category's requirements.

[45] cf. McKinnon 2001, 164

The results of the framework are applicable at different degrees. Levels 1 to 4 of the framework (target set-up, logistics concepts, trends, and logistics requirements) are product-category-specific, not country-specific. This was designed so that they can be applied across countries, with the need only for the last two levels to be tailored to the country, to enable a widespread and easy application of the framework. This reflects the fact that the requirements of an adequate logistics environment, such as efficient regulation, smooth customs procedures, and a high skills base for a given product category, are not dependent on the country of production but on the product category. To illustrate: A country wishing to improve its logistics performance to facilitate exports in high-tech manufacturing could apply levels 1 to 4 of the framework for high-tech manufacturing and carry out levels 5 and 6 on its own.

Levels 5 and 6 (gap analysis and logistics measures), as developed in the applications of the framework described in chapters 5.4.5, 6.4.5, and 7.4.5, are product- and country-specific and are only applicable to Vietnam, Morocco, and Kyrgyzstan. However, the results from levels 5 and 6 regarding these applications may serve as a starting point for policymakers in other countries trying to identify reforms. To illustrate: A country other than Vietnam wishing to facilitate high-tech exports would have to carry out levels 5 and 6 separately, as the current application (in section 5.4) focuses on Vietnam. In addition, non-country-specific suggestions for measures in the three product categories are included in section 8.1.6.

The general structure of the framework (i.e., formulation of target set-up, logistics concepts, trends, logistics requirements, country-level gap analysis, and suggested policy measures) can be applied to various product categories. This entails a country wishing to improve its logistics performance to facilitate exports in a product category that is not covered by this dissertation possibly using the framework to work through the six levels on its own. Section 4.3.4 includes a non-product-category-specific description of how to complete each level.

The results of the framework's levels 1 through 4 will primarily be applicable to middle-income countries, as defined by national income.[46] High-income countries have usually surpassed the development stage of middle-income countries, which tends to be reflected in their logistics performance and level of industrial diversification. Low-income countries, in contrast, often exhibit development stages of their logistics environments that warrant more basic interventions than those relevant to middle-income ones. Middle-income countries are not a homogenous group. In 2020, 107 countries around the world were classified as middle-income by the World Bank, accounting for 75 % of the world's population and one third of global GDP (data as of 2019; see Appendix 10.1 for a country list).[47] Section 4.4.2 explains the selection of countries and includes a list of countries that are similar to Vietnam, Morocco, and Kyrgyzstan, based on selected features.

1.7 Structure of the dissertation

The dissertation is divided into nine chapters as depicted in Figure 1-1. Chapter 1 introduces the topic and presents the research questions, while chapter 2 explains the methodology used. Chapter 3 presents the conceptual background on the link between logistics and exports. In chapter 4, a decision framework is developed to identify measures that national governments can take to overcome logistics-related barriers to higher-value exports. The framework identifies the requirements for the logistics environment for three product categories and focuses on needs that a country's government can address. This forms the answer to research sub-question 1 ("What are the logistics requirements of three product categories whose expansion would enable more higher-value exports in a given middle-income country?").

[46] https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups, accessed on Dec. 30, 2019.
[47] https://www.worldbank.org/en/country/mic/overview, accessed on July 30, 2020

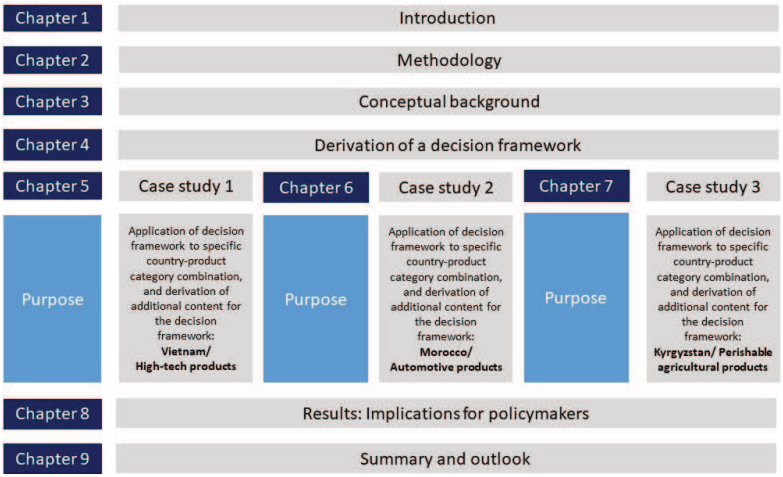

Figure 1-1: Structure of the dissertation[48]

To illustrate how the framework is applied at the country level, the subsequent three chapters include applications of the decision framework, each focusing on one combination of country and product category. In chapter 5, the framework is applied to Vietnam and high-tech manufacturing; chapter 6 focuses on Morocco and automotive products; and chapter 7 explores Kyrgyzstan and perishable agricultural goods. These chapters generate additional content for the framework. They present a gap analysis for each country by juxtaposing a product category's logistics requirements with the current logistics environment in the respective country. This forms the answer to research sub-question 2 ("Which country-specific constraints are prevalent in Vietnam, Morocco, and Kyrgyzstan in the logistics environment of three product categories whose expansion would enable more higher-value exports in these countries?").

Chapter 8 includes suggestions as to the logistics interventions on which to focus on in the three countries to foster higher-value exports, as well as implications for policymakers in other countries. This forms the an-

[48] Source: author

swer to the main research question (“Which country-specific logistics measures should governments of middle-income countries take to foster exports in three selected product categories that lend themselves to higher-value exports?”). Chapter 9 concludes with a summary and areas for further research.

2 METHODOLOGY

2.1 Research methods

2.1.1 Overview

The dissertation's approach is empirical-inductive rather than theoretical-deductive. This approach was chosen based on the dearth of empirical data on logistics performance at the country level, especially studies with a focus on the logistics environment for specific product categories, rather than the overall logistics environment. This lack of country data made it seem worthwhile to add further empirical findings—for three countries, at least—to the scientific discussion. A second reason for choosing an empirical-inductive approach was to account for the applied research nature of the dissertation's anticipated results, which are intended for application by researchers and policymakers alike.

To account for the heterogeneous research subject of logistics at the country level, a mixed-methods approach is applied. The approach combines qualitative research methods (structured and semi-structured interviews) with primary and secondary data analyses as well as literature reviews. Advantages of the mixed-methods approach include the ability to examine complex research questions and the opportunity to gather stronger evidence compared with a single-method approach.[49] The mixed-methods approach was chosen to reflect qualitative and sometimes perception-based data, e.g., the views of logistics stakeholders on weaknesses in their countries' logistics environment, and quantitative data, e.g., key performance indicators of customs procedures or the capacity of a country's logistics infrastructure such as port capacity. Figure 2-1 and Figure 2-2 provide an overview of the methods used in the dissertation.

[49] cf. Yin 2018, 63

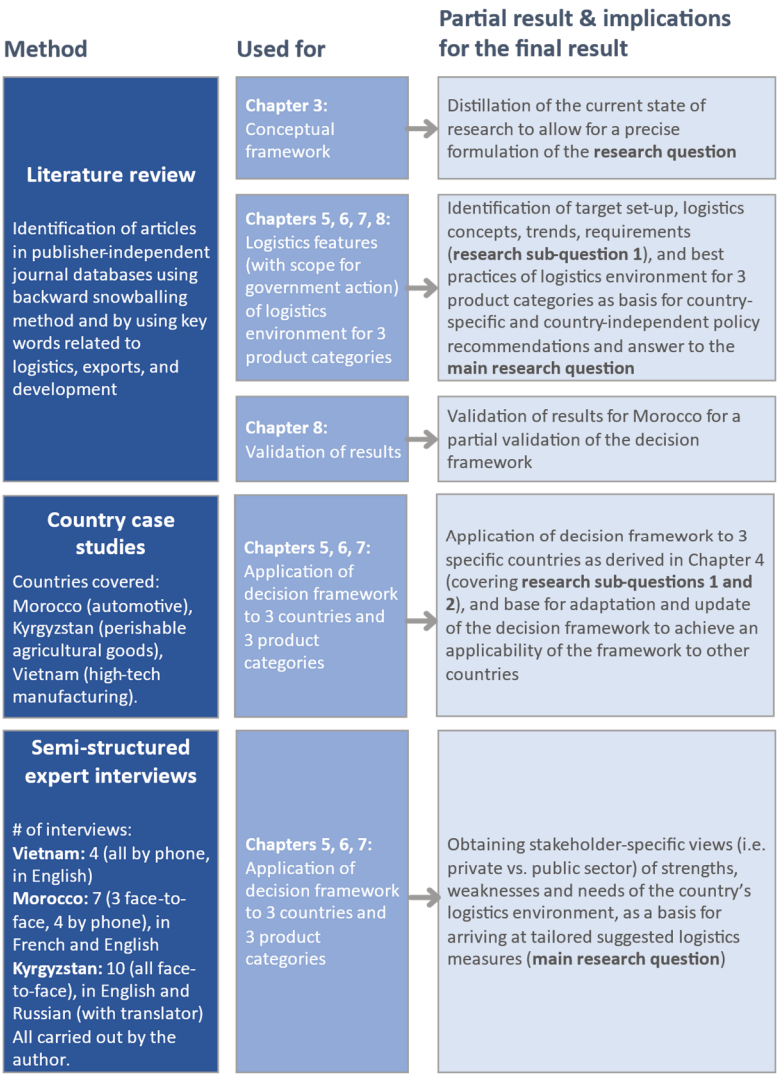

Figure 2-1: Overview of methods used, Part 1 of 2[50]

[50] Source: author

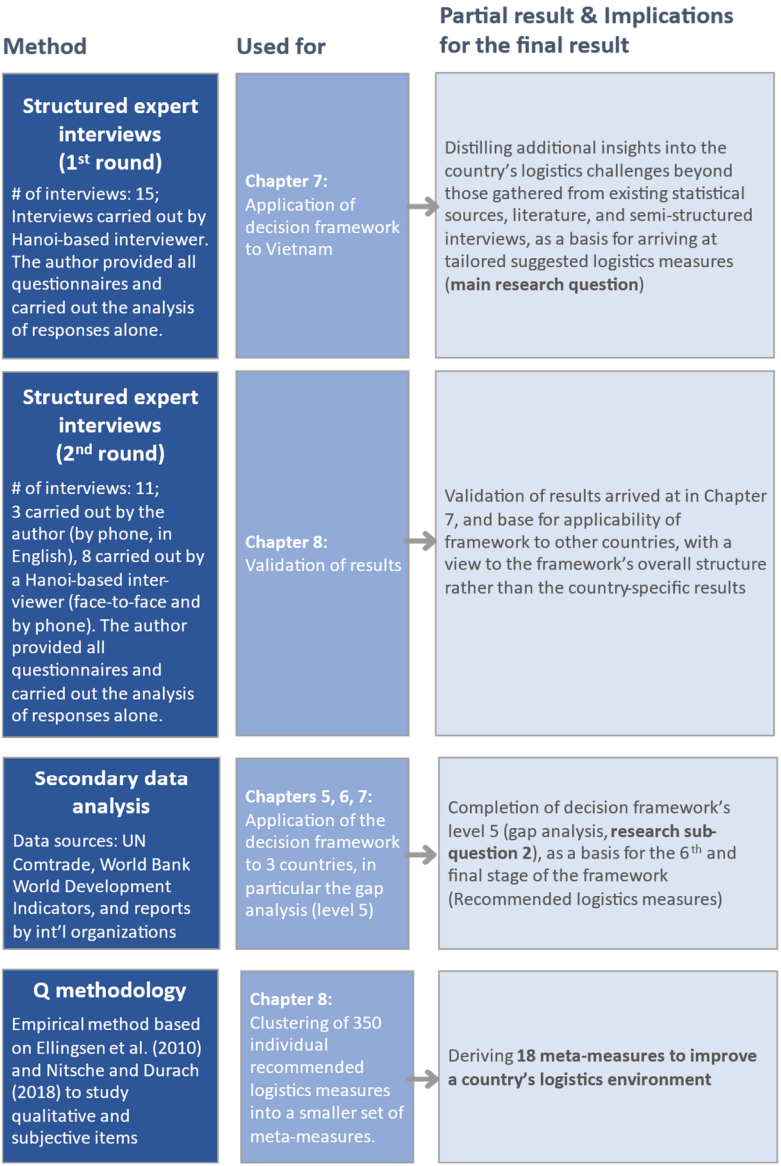

Figure 2-2: Overview of methods used, Part 2 of 2[51]

[51] Source: author

2.1.2 Literature review

A literature review (included in chapter 3) was carried out to distill the current state of research in the areas of:

1. logistics as a pillar of international trade and development;
2. measuring the effect of logistics performance on exports;
3. the role of logistics in facilitating a country's participation in global value chains;
4. the logistics needs of internationally operating firms;
5. the importance of "soft" logistics infrastructure relative to "hard" infrastructure;
6. measuring logistics performance at the country level;
7. logistics costs and their impact on international trade.

These topics were selected to provide an overview of areas related to logistics performance at the country level, with a focus on logistics needed for international trade. The topics were further chosen to shed light on the question of which policy areas national governments can focus on to improve the logistics environment in their country if the goal is to foster exports. Articles included in the literature review for chapter 3 were identified by using the backward snowballing method. According to Wohlin (2014), snowballing denotes "using the reference list of a paper or the citations to the paper to identify additional papers."[52] In backward snowballing the reference list of a given paper is checked for relevant other articles, while in forward snowballing new literature is found by searching for articles that cite a given paper.[53] Further articles were identified by using keywords related to logistics, exports, and development. Snowballing was chosen as the primary method as the number of keywords and their variations for the chosen topic (the importance of logistics to facilitate exports in developing countries) was high and thus the risk of omitting important articles was judged significant.

[52] Wohlin 2014, 1
[53] Wohlin 2014, 3

Other literature reviews were carried out to identify the target set-up and the requirements of the logistics environment for the three selected product categories as well as best practices, trends, and logistics concepts prevalent in those categories. The reviews were carried out in publisher-independent journal databases using keywords related to logistics and SCM in the three product categories (high-tech manufacturing, automotive products, and perishable agricultural goods). This method was chosen to reflect the current state of knowledge in the logistics and supply chain literature. Backward snowballing (see above) was used to supplement the material for these sections. The results are included in the application of the decision framework to the three case study countries (sections 6.4, 7.4, and 5.4).

2.1.3 Case studies

Chapters 5, 6, and 7 contain case studies on three different countries. The decision framework is applied to each of the countries, with the aim of gathering additional insights for the decision framework. The results—in the form of suggestions for logistics measures for policymakers—are summarized in chapter 8. Following Eisenhardt (1989), a case study is a "research strategy which focuses on understanding the dynamics present within single settings."[54] The settings here refer to the logistics environments of the three countries with a focus on one product category each—high-tech goods in Vietnam, automotive goods in Morocco, and perishable agricultural goods in Kyrgyzstan. The core result that Eisenhardt (1989) focuses on as the objective of case study research is theory building. While building a theory is not a core objective of this dissertation, it nonetheless develops a framework to be applied in different countries, and it attempts to synthesize the findings from the case studies into implications for policymakers in countries not treated in the case studies. For the purpose of drawing policy implications as well as for the purpose of theory building, Eisenhardt's (1989) focus on basing

[54] Eisenhardt 1989, 534

outcomes on empirical data is paramount.[55] In formulating the research questions (section 1.4), it was possible to decide which data to collect and to identify the stakeholders to be interviewed in the case studies.[56]

Case study research can support both deductive and inductive approaches.[57] Whereas deductive approaches start with a theory that is fitted onto the data being collected, inductive approaches entail collecting data as a first step; identifying patterns and generating findings for generalization is a second step. In this dissertation, an inductive approach was chosen. The rationale is that the decision framework, though guided by the theory of transaction cost economics as the theoretical underpinning, has a practical nature. Thus, the research was designed in an empirical-inductive rather than theoretical-deductive way, with empirical data on the quality of the logistics environment for one particular product category being collected in each country. The case study approach was chosen owing to its practical basis, which was deemed well-suited to a work of applied research. A second reason to use the case study approach is its ability to illustrate how the decision framework can be used for policymaking at the country level.

As defined by Yin (2018), a case study "relies on multiple sources of evidence, with data needing to converge in a triangulating fashion."[58] Empirical data were collected on the logistics environment of the case study countries through semi-structured interviews as well as reviewing public statistical information, databases, and reports. Following Eisenhardt (1989), using multiple data collection methods enables strengthening the basis of a theory or, in this case, strengthening the evidence on which to draw conclusions in the final stage of the decision framework.[59] The combined use of qualitative and quantitative logistics data, as in the

[55] Eisenhardt 1989, 532
[56] cf. Eisenhardt 1989, 536
[57] cf. Hilmola 2003, 45–46
[58] Yin 2018, 15
[59] cf. Eisenhardt 1989, 533

three case studies, supports a "synergistic view of evidence."[60] Quantitative data are used regarding, for example, customs delays and trade infrastructure capacity, whereas qualitative data are used on perceived logistics bottlenecks for exports of products in the selected categories.

By omitting the formulation of hypotheses at the onset of the research, case study research enables retaining theoretical flexibility.[61] For the research on the three country's logistics environment, this entailed asking open rather than closed interview questions that permitted the conclusions to take various shapes. The semi-structured format of the interviews allowed for follow-up questions to deepen certain topics, which illustrates the iterative nature of case study research that Eisenhardt (1989) mentions.[62]

Drawbacks of the case study approach include concerns about the representativeness of the cases selected and the applicability of the findings to other cases. The representativeness problem is addressed in section 4.4. Concerns about the applicability of the different stages of the decision framework are addressed in section 4.3.3. A third potential drawback of case study research is the risk of losing focus, thereby obscuring the key features of the research. As case study research does not employ techniques such as regression analysis, it is more difficult to assess which of the findings are the key drivers and which are particular to a single case.[63] The risk of losing focus was mitigated by focusing the questionnaires on the data needed to answer the research questions. These disadvantages of the case study approach were accepted because using country examples was judged to be the best way to apply the decision framework developed, rather than leaving it as a purely theoretical construct. Owing to the effort associated with each case study, which included several interviews each, the number of cases was limited to three. Eisenhardt (1989) puts the optimal number of case studies at between

[60] Eisenhardt 1989, 533
[61] Eisenhardt 1989, 533
[62] Eisenhardt 1989, 546
[63] cf. Eisenhardt 1989, 547

four and ten, at least if—unlike in this dissertation—the main goal is to generate theories.[64]

2.1.4 Semi-structured interviews

Semi-structured interviews were used as the main method to obtain insights about the logistics environment of the countries explored in the framework applications: Vietnam, Morocco, and Kyrgyzstan. This method was chosen because it enabled a closer look at the countries' logistics challenges and thus supported an explorative approach. Comprehensive data on logistics performance, especially related to a particular product category, are difficult to obtain at the country level, particularly for developing countries. Interviews enable efficient collection of empirical data.[65] By conducting interviews with a sample of logistics stakeholders in each country in a semi-structured way, follow-up questions were possible in cases where the interviewee's expertise permitted deepening the topic covered by the initial question. Thus, insights about each country's logistics challenges were gathered that could not have been extracted from statistical sources or literature.

At the same time, this method can suffer from selection bias, in the sense that not all relevant stakeholders are included. Retroactive sensemaking can be another shortcoming of interview data.[66] A further potential drawback of the interview method is representation bias, i.e., that interviewees might not be objective but instead represent particular interests. These shortcomings of the interview method were mitigated by defining the stakeholder groups to be targeted and selecting interviewees such that each group was represented. Eisenhardt and Graebner's (2007) bias-reducing mitigation strategy for interviews was followed by interviewing several highly-informed stakeholders from different hierarchical levels, functional areas, and geographies.[67] By choosing semi-

[64] cf. Eisenhardt 1989, 545
[65] Eisenhardt and Graebner 2007, 28
[66] Eisenhardt and Graebner 2007, 28
[67] cf. Eisenhardt and Graebner 2007, 28

structured interviews as the main method to obtain insights, the above-mentioned disadvantages were incurred, but they were accepted as the method (in combination with secondary data analysis) presented the highest chance of delivering the holistic picture of the gaps in the logistics environment that was required as an input to the decision framework applications. Section 2.2.1 includes details on the design of the semi-structured interviews.

2.1.5 Structured interviews

To add an additional level of insight for Vietnam, the largest and logistically most complex country studied in this dissertation, a round of structured interviews was carried out in addition to the semi-structured interviews. The methodological approach for structured interviews follows the one for the semi-structured ones (see Figure 2-3), except that no follow-up questions were possible. The rationale for choosing the method of structured interviews was similar to that for choosing semi-structured interviews: structured interviews enable access to additional insights into the country's logistics challenges that could not be gathered solely from statistical sources or literature.

Choosing structured interviews carries the same risks as semi-structured ones, that is, selection bias, in the sense that not all relevant stakeholders are included, and representation bias, in the sense that interviewees might not be objective but, rather, could represent particular interests. These shortcomings of the structured interview method were mitigated by first defining the stakeholder groups to be targeted and then selecting interviewees such that each group was represented. Section 2.2.1 includes details on the design of the structured interviews.

2.1.6 Secondary data analysis

In addition to the primary data analysis from the interviews, secondary data were used to analyze trade patterns and to assess the Vietnamese, Moroccan, and Kyrgyz logistics environments. Data on the countries' logistics environments were collected from public trade and transport

statistics as well as from public reports by researchers and international organizations. Data sources included UN Comtrade (an international trade statistics database), the World Bank's World Development Indicators, and reports by international organizations, e.g., Asian Development Bank, OECD, UNCTAD, and the World Bank. An effort was made to select data sources with a broad coverage of middle-income countries to facilitate the expansion of the framework to a broader set of countries and to enable policymakers in other countries easily to adapt the framework to their needs.

Secondary data analysis as a method was used for three reasons: (1) to verify figures stated by respondents during the structured and semi-structured interviews, (2) to supplement data gaps left by the interview method, and (3) to arrive at a rounded picture of the logistics environment of each country depicted. Shortcomings of this method include the occurrence of data gaps as well as the risk of using inaccurate or non-comparable information. An example for the latter is the computation method for logistics costs, which varies across countries; that is, numbers for the countries studied might not be comparable and thus may be unsuitable for benchmarking. The risk of data gaps was mitigated by using as many reputable data sources as possible, including data from international sources and from national statistical offices. The risk of using inaccurate or non-comparable information was mitigated by using, as often as possible, data from cross-country datasets, the sources of which included complete documentation of how the data were obtained, and ensuring that the data used were collected or calculated using a unified methodology.

2.1.7 Q methodology

Q methodology was employed to cluster the policy measures suggested for improving a country's logistics environment, as determined from the application of the decision framework, and to arrive at a set of meta-measures, i.e., higher-level measures synthesized from several individual policy measures. Q methodology is an empirical method that enables

studying subjective items, such as statements and opinions, using qualitative and quantitative elements.[68] Such statements or opinions can be gathered during interviews or in focus groups, or can be drawn from the literature, as was done here.[69] One of the method's advantages is that it enables the researcher to draw conclusions using only a few interviews, preferably semi-structured, or other sources.[70]

In section 8.1.6.2, the meta-measures are arrived at using a structured synthesis process that is based on Nitsche and Durach (2018), whose process builds on Ellingsen et al. (2010). The process involved sorting 350 logistics measures into 18 meta-measures.[71] A pre-sorting of the 350 measures had already taken place by matching the measures with different product-category-specific logistics requirements.[72] As in Nitsche and Durach (2018), the sorting aimed at attaining homogeneity within each group of meta-measures, and heterogeneity between groups.[73]

There are several drawbacks to this method. Q methodology is not well suited to representing the precise distribution of opinions across a population of interviewees or authors.[74] Another drawback is the risk of a lack of objectivity: As only one researcher (the author) carried out the Q methodology, the results might differ if performed by other researchers. These drawbacks were accepted because Q methodology offered the chance of obtaining a quick overview of the main issues, which may not have become visible when looking at the longer list of recommended measures for each country (sections 10.5.6, 10.6.6, and 10.7.6).

Q methodology can include a rank ordering of statements; this was not pursued here, as the goal was not to rank individual clusters of measures

[68] Ellingsen et al. 2010, 395
[69] cf. Ellingsen et al. 2010, 397
[70] cf. Ellingsen et al. 2010, 397
[71] 80 measures came from the framework application to automotive goods, 124 from the one to perishable agricultural goods, and 146 from the one for high-tech manufacturing.
[72] 29 logistics requirements were formulated for automotive products, 40 for perishable agricultural goods, and 33 for high-tech manufacturing, thus 102 in total.
[73] Nitsche and Durach 2018, 8
[74] cf. Ellingsen et al. 2010, 406

against each other, but to attain a set of possible meta-measures.[75] The relative importance of each cluster and of each individual measure for a country can only be ascertained using a more thorough investigation into a country's specific logistics challenges. The goal of the clustering process was to arrive at a set of meta-measures that policymakers in countries other than those studied in the case studies can deploy to improve a country's logistics environment. This does not replace a full-scale application of the decision framework, which includes a country- and product-category-specific gap analysis, but it can be used as a guidepost for policymakers. The results of the clustering of measures using Q methodology are included in section 8.1.6.2.

2.1.8 Validation of results

The validation of results serves to check whether the results of this dissertation (i.e., the decision framework proposed in section 4.3 and its outputs) contribute to the dissertation's goal of enabling governments to identify the logistics measures necessary to facilitate higher-value trade in the selected product categories. The ideal method for validation of the decision framework would have been to implement all of the measures suggested in the countries examined (Vietnam, Morocco, and Kyrgyzstan), observe the trajectory of exports in the relevant product categories in the subsequent five to ten years, and eliminate all confounding variables that could have contributed to rising export numbers, for example, economic growth, sector effects, or developments in neighboring countries. For timing, financial, and practical reasons, that is beyond the scope of this dissertation.

Instead, as a first way to validate the outputs of the decision framework (i.e., the measures suggested to improve a country's logistics environment for a certain product category), eleven interviews were carried out with Vietnamese stakeholders between November 2019 and January 2020. Vietnam, in preference to Morocco and Kyrgyzstan, was chosen

[75] cf. Ellingsen et al. 2010, 399

to serve as the focal country for the validation round based on the fact that its logistics problems are the most complex of the three countries owing to its size and importance in global trade. With a population of close to 100 million people and a GNI of US$225.9 billion in 2018, Vietnam surpasses both Morocco and Kyrgyzstan in terms of population and economic size.[76] Moreover, with merchandise trade making up 196 % of the country's GDP in 2018, Vietnam is unusually open to trade, and more so than Morocco (where merchandise trade makes up 67.5 % of GDP) and Kyrgyzstan (88.1 %).[77] Although performing validation in all three countries would have been preferable, the validation in Vietnam was seen as the most crucial one given the pressure that the country's logistics environment is under to facilitate such high levels of trade. Section 2.2.1 includes details on the design of the validation interviews, and section 8.2.2 includes the results of the validation interviews.

To further validate the decision framework's results, a review of the Moroccan trade press (covering logistics, transport, and trade) as well as publications and press releases by the Moroccan Agency for Logistics Development (AMDL) was carried out to gather logistics measures introduced in Morocco between January 2016 and December 2019. The publication review's start time of January 2016 was chosen because data collection for the Morocco case study had taken place in November 2015. The end period, December 2019, was determined by the date that the publication review was carried out, towards the end of the dissertation's drafting phase.

The policy reforms and public investments planned for or carried out in Morocco that were described in these publications were compared against the recommended logistics measures that were derived in this dissertation by applying the decision framework to Morocco (see the case study results in section 6.4.6 and the suggested measures in Appendix 10.6.6). The measures taken or planned by the Moroccan authorities

[76] World Bank 2020; calculated using Atlas method (current US$)
[77] World Bank 2020. All numbers refer to 2018.

were analyzed with regard to their alignment with the ones recommended by the decision framework to gauge whether they would meet the goal of improving the logistics environment for the automotive sector.

This validation method assumes that the policy measures planned for or taken by the Moroccan authorities respond to the requirements of the Moroccan logistics environment, and for the automotive industry in particular, whose importance to Moroccan policymaking is underlined in official publications.[78] The review of the trade press and AMDL publications was also used to update the gaps and recommended measures in the case study on Morocco.

This method to validate the results suggested for Morocco is not comprehensive as the only measures suggested by the decision framework that could be validated were those that matched one of the logistics-related policy reforms announced by the Moroccan authorities in the trade press, although the decision framework came up with several more measures. The high number of suggested measures was in response to the shortcomings identified for the Moroccan logistics environment, as relevant to automotive goods, by the gap analysis (section 6.4.5) based on interviews with Moroccan logistics stakeholders.

APPROACHES TO QUANTIFYING THE EFFECTS OF PUBLIC INVESTMENTS

As this dissertation deals with investments and policy reforms by national governments, another method exists that lends itself to validating the results of the decision framework. The concept of economic rate of return can be employed to assess the benefit of improvements in a country's logistics environment. Using this, the measures suggested by the decision framework (sections 6.4.6, 7.4.6, and 5.4.6) could be validated. The validation was not carried out here as the variables needed for the calculation are unknown—they require exact costing of all suggested

[78] See e.g., Ministère de l'Equipement et du Transport du Maroc 2010, 28

measures and monetary assessments of their benefits. Nevertheless, the following section lays out how it could be done.

Benefits accruing from government expenditures on infrastructure and other public works—in logistics or other sectors—can be assessed in monetary terms just like other investments. Following Mackie et al. (2005), the term used for investments using public spending is "economic rate of return."[79] The economic rate of return encapsulates an investment's impact on economic welfare.[80] The economic rate of return (ERR) is closely related to the internal rate of return (IRR): Whereas the IRR refers to financial or economic flows, the ERR refers only to economic costs and benefits.[81] Both IRR and ERR show how fast benefits accrue from an investment, and can be used to compare investment alternatives.[82] Public expenditures should be carried out such that the ERR of the chosen investment is higher than the ERR of alternative uses of the funds.[83] IRR and ERR are related to the concept of Net Present Value, that is, the welfare gain over the entire life of an investment project: the IRR or ERR denotes the discount rate that renders the NPV of a given investment as zero.[84]

Two types of figures have to be determined to be able to calculate the economic rate of return of the measures proposed in the decision framework. The first one refers to the exact cost of each proposed measure. Costs can be one-time or occur in tranches over a period of time. The second one refers to the benefits of each proposed measure, expressed in monetary terms, including the time when they will accrue. Benefits in the future must be discounted, the rate of which needs to be determined

[79] Mackie et al. 2005, 1
[80] cf. Mackie et al. 2005, 1
[81] cf. Mackie et al. 2005, 1
[82] cf. Mackie et al. 2005, 1. The following definition of IRR by Mackie et al. 2005, 3 also applies to the ERR (the definition by Mackie et al. 2005 refers to transport projects): "IRR is the rate at which benefits are realized following an initial transport investment. It can be thought of as the constant compound rate of return which is equivalent to the actual – fluctuating – rate of return over the project lifetime."
[83] Herrera 2005, 1
[84] cf. Mackie et al. 2005, 2–3

ex ante. Benefits to be assessed include both monetary (e.g., higher customs revenue because of higher exports, or higher tax receipts from exporting companies and other firms benefitting from higher exports) as well as non-monetary (e.g., increased human capital if logistics courses are introduced, time savings from building roads, or environmental benefits of using more sustainable transport means).

Using these numbers, the economic rate of return of each proposed measure can be determined by calculating the present values of benefits and costs (assuming that costs occur at different points in time; if it is a one-time investment then the present value of costs equals the initial investment).[85] The formula for the IRR is:

$B_o - C_0 + \frac{B_1 - C_1}{(1+IRR)} + \frac{B_2 - C_2}{(1+IRR)^2} + \ldots + \frac{B_n - C_n}{(1+IRR)^n} = 0$, where B denotes benefits, C denotes costs and the subscripts (0, 1, 2, … n) denote the years, where n is the horizon (final) year.[86] The ERR can be calculated analogously to the IRR.

As a next step, a hurdle rate needs to be determined, that is, a value that the economic rate of return must meet or exceed so that the investment is deemed worthwhile. The hurdle rate is typically at least as high as the discount rate.[87] If the ERR exceeds the hurdle rate, an investment in the measure can preliminarily be regarded as beneficial. Given a total budget, one can determine the bundle of measures to be carried out by choosing the ones with the highest economic rate of return. However, for a full picture, the economic rates of return of investments in other public works competing with those regarding the logistics environment must be calculated so that policymakers can choose the one with the higher return rate.

Another challenge occurs when deciding to finance a bundle of measures related to the logistics environment, rather than other policy

[85] cf. Mackie et al. 2005, 3
[86] cf. Mackie et al. 2005, 2–3
[87] cf. Mackie et al. 2005, 5

areas, assuming that only some of the measures can be financed owing to budget limitations: Before deciding on a bundle of measures, one needs to study the interrelations between the chosen measures and assess whether the measures not to be financed are prerequisites for the benefits of the chosen measures to occur. This could happen, for example, if choosing to leave out training and education measures: Demand for exports might increase, but the labor force to handle the associated increase in demand for logistics services could be insufficiently trained, which could lead to sub-par logistics performance, a decline in customer satisfaction, and hence declining product demand, weakening the increase in exports. Once the interrelations between the chosen and omitted measures are determined, the final bundle of measures to be financed can be determined.

For the logistics interventions proposed in this dissertation, the approaches to quantifying public investments explained above could be used to appraise the measures suggested in level 6 of the application of the decision framework (see 5.4.6, 6.4.6, and 7.4.6,). The method lends itself to measures requiring upfront financial investments, such as the building of a road connecting a seaport with a logistics zone, but can equally be applied to measures consisting of policy reforms, in which no financial investment for a tangible asset is needed (e.g., removal of a truck scrappage subsidy scheme). Costs (e.g., building and material costs) and benefits (e.g., toll revenues or the budgetary or societal value of reductions in travel times) of each measure can be compared, and the economic rate of return calculated for each measure. The comparison with the hurdle rate enables a decision whether to carry out the measure.

2.2 Research design

2.2.1 Design of questionnaires and selection of interviewees

The country case studies for Vietnam, Morocco, and Kyrgyzstan are based on semi-structured interviews featuring open questions.[88] The goal was to obtain stakeholder-specific views (i.e., manufacturers vs. LSPs vs. public sector) of the strengths, weaknesses, and needs of the country's logistics environment, and to generate further content for the decision framework. The fluid structure of each interview allowed for flexibility regarding which topics to cover in detail, based on the interviewee's area of expertise. The approach to the semi-structured interviews is shown in Figure 2-3.

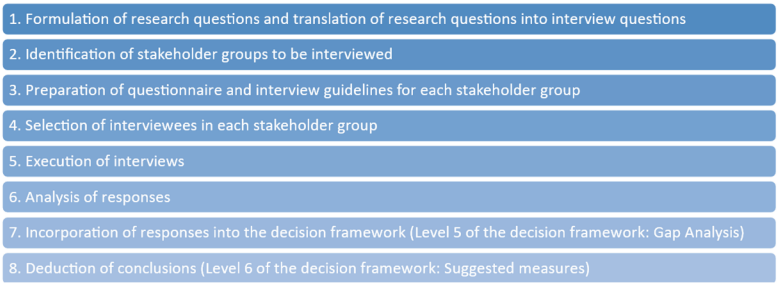

Figure 2-3: Methodological approach for the semi-structured interviews[89]

For step 1, the formulation of research questions, see section 1.4. For the identification of stakeholder groups (step 2), relevant stakeholders were defined as local and multinational LSPs, logistics experts from manufacturing companies, policymakers from public entities relevant to logistics (e.g., Ministry of Transport), and representatives from professional associations. Both the private and public sectors were represented for each country.

[88] For Vietnam, structured interviews were used in addition to semi-structured ones (section 2.1.5).
[89] Source: author

Regarding the preparation of questionnaires and interview guidelines (step 3), three questionnaires were designed for the following stakeholder groups to be interviewed for the three framework applications: (1) LSPs, (2) manufacturers and exporters, and (3) the public sector (government entities tasked with overseeing the logistics sector) and professional associations (see Appendix 10.2 for the questionnaires). Although the questions asked differed, all the questionnaires were designed to elicit information on the shortcomings in logistics encountered by various stakeholders in each country. A recurring question concerned reforms that should be carried out in the country to improve logistics. The environmental sustainability of logistics operations was another topic covered in the questionnaires. Guidelines on how to conduct the interviews are provided in section 4.3.4. A pre-test of the interview guidelines and the questions was omitted. Although this course of action carried the risks of neglecting relevant questions or including ambivalent ones, these were mitigated by including an open question at the end of the questionnaire requesting feedback from the interviewee.

To accomplish step 4, interviewees were selected to obtain a relevant sample of all stakeholders. For LSPs, both domestic and international logistics providers were interviewed (except for Morocco, where no LSP was available for an interview). For manufacturers and exporters, the selection focused on representatives from companies and/or professional organizations specializing in the respective product category (high-tech manufacturing for Vietnam, automotive products for Morocco, and perishable agricultural goods for Kyrgyzstan). Regarding the public sector, there were interviewees from government ministries and agencies tasked with transportation, trade, and/or logistics. Interviewees were selected in a non-probabilistic way because of the limited number of candidates. They were chosen based on their familiarity with the country under consideration and proficiency in the product category that was the focus of each case study. A list of stakeholders interviewed is provided in Appendix 10.2.

In step 5, the interviews, carried out by the author, were designed as semi-structured interviews. Three face-to-face and four phone interviews were conducted with Moroccan stakeholders in November and December 2015. The interviews were carried out either in French or in English (see Table 10-3). In April 2016, ten face-to-face interviews were carried out in Kyrgyzstan (in Bishkek and Osh, the two economic hubs of the country). The interviews were conducted either in Russian (with the help of a translator) or in English (see Table 10-4). Four phone interviews in English were carried out with Vietnamese stakeholders between February and July 2019 (see Table 10-1). To obtain views from more stakeholders in Vietnam, the largest and logistically most complex country studied in this dissertation, a round of structured interviews was carried out in addition to the semi-structured interviews. On behalf and under the guidance of the author, 15 interviews using closed questions designed by the author were, for language reasons, carried out by a Hanoi-based interviewer between December 2018 and August 2019 (see Table 10-2).[90] The Hanoi-based interviewer conducted the interviews in Vietnamese and provided an English translation of the responses. The author provided all questionnaires for the structured interviews and carried out the analysis of the interview responses alone.

The interviews in all three countries (both structured and semi-structured) were carried out in person or by phone, with durations averaging about 45 minutes; slightly longer for interviewees from the public sector and professional associations (about 50–75 minutes) and slightly shorter (about 30–40 minutes) for interviewees from the private sector. Challenges in setting up and conducting in-depth interviews in lower-income environments with a sufficient number of highly informed stakeholders were present throughout the research project. These included, but were not limited to, challenges regarding language and access. This problem was more pronounced in Vietnam and Kyrgyzstan than in

[90] The Hanoi-based interviewer was Trịnh Thị Thu Hương, Associate Professor at the Faculty of Economics and International Business at Foreign Trade University Hanoi, Vietnam.

Morocco. In Vietnam this challenge was addressed by involving a Hanoi-based interviewer who conducted some of the interviews in Vietnamese under the guidance of the author, as described above. In Kyrgyzstan the author carried out the interviews herself, with the help of a translator where necessary. Of the three case studies, the empirical base supplied by the interviews was narrowest in Kyrgyzstan, not because of the number of interviews, but because of several instances of incomplete or missing answers to the interview questions, which could not be replaced using follow-up questions. To mitigate this, the Kyrgyzstan case study—like the other two case studies—used secondary data on the logistics environment to conduct the gap analysis stage of the decision framework application (see 2.1.6).

Towards the end of the research project (between November 2019 and January 2020), a set of eleven structured interviews was carried out with Vietnamese stakeholders to validate the results; that is, to gauge whether the suggested measures derived through the decision framework could be expected to improve the logistics environment for high-tech exports in Vietnam. The interviews were designed as structured interviews with closed questions that could be carried out by both the author and the Hanoi-based interviewer. Three of the interviews were conducted by the author. For language reasons, eight additional interviews were conducted by a Hanoi-based interviewer, on behalf of and under the guidance of the author (see the entry on “Interviewer” in Table 10-5). The Hanoi-based interviewer conducted the validation interviews in Vietnamese and provided an English translation of the responses. The design of the questionnaire and analysis of the interview responses were carried out solely by the author. A list of validation interviews is provided in Table 10-5, including an indication of who carried out which interview.

To select the interviewees, the same guidelines regarding sampling were used for the case study interviews, as described earlier in this section. Several interviewees during the validation round in Vietnam were part of the group of experts previously interviewed for the case study. Addi-

tional ones were added on the basis of their expertise in logistics and high-tech manufacturing. Adding further interviewees also served to limit confirmation bias by including stakeholders whose input had not been used in formulating the suggested measures. Interviewees were asked for their feedback on the measures suggested to improve the logistics environment for high-tech manufacturing in Vietnam.

For both the initial and the validation interviews (and for both structured and semi-structured interviews), a possible bias exists in that interviewees with little free time may be underrepresented as they would not have agreed to an interview. This is likely a more acute problem for the stakeholder groups in the private sector (LSPs and producers/manufacturers) than for public sector interviewees and those from professional associations. This is also reflected in the fact that interviews with public sector representatives and those from professional associations were, on average, slightly longer than those with interviewees from the private sector. This possible bias was mitigated by seeking out a high number of private sector interviewees for the structured and the validation interviews.

2.2.2 Objectivity, reliability and validity of data collection

Objectivity of data collection refers to the independence of the results with respect to the person carrying out the study.[91] Objectivity was ensured by using a standard questionnaire for the semi-structured interviews, with some variation based on the country and the product category in focus (e.g., a focus on the availability of cold-chain infrastructure in Kyrgyzstan; but not in Morocco or Vietnam owing to the subject's irrelevance for the product categories selected). For the structured interviews with Vietnamese stakeholders, standard questionnaires with closed questions were used with each stakeholder group. The questions were the same as those for the semi-structured interviews (see Appendix 10.2), except that no follow-up questions were possible.

[91] Straube 2005, 13

The final results from applying the decision framework are partly dependent on the interviewees chosen for the case studies. Thus, if replicated by another researcher, they could differ. The results should, however, be comparable as answers among the interviewees (viewed separately for each country–framework application) were fairly uniform, with consistent recurring topics, and variation mostly occurred in terms of the functional categories (infrastructure, customs, etc.) that the interviewees' statements fell into. Thus, interviewees who were experts in logistics training mostly spoke about education and training issues, whereas interviews with road transport providers most often centered around infrastructure- and customs-related issues. A second reason why the proposed measures would likely by similar if conducted by another researcher is that the literature review used to gather possible measures to improve the logistics environment was designed to be as comprehensive as possible. The results of the framework applications first and foremost refer to the three countries studied (sections 8.1.3 for Vietnam, 8.1.4 for Morocco, and 8.1.5 for Kyrgyzstan), but a transfer of the main results to policymakers in other countries is attempted in section 8.1.6.

Reliability of data collection refers to the degree of precision to which an attribute is measured.[92] Although full reliability is difficult to attain using an interview-based approach, several approaches were implemented to pursue a high degree of reliability. First, the questions in the questionnaire were formulated in simple and clear terms to avoid confusion on the side of the interviewee, especially in light of the involvement of non-native speakers. Second, interviewees in each country were selected such that all main logistics stakeholder groups were represented.[93] Third, interviewees with high logistics knowledge of the country in question were sought out.

[92] Straube 2005, 13
[93] Exception: No LSPs were available for interviews in Morocco.

Validity of data collection is the extent to which the instrument used captures the intended subject.[94] Validity of data collection was pursued by using approaches that also relate to the reliability of data collection (i.e., simple and clear formulation of questions as well as a large number of interviewees) and by employing a semi-open approach to interviews, which enabled refining the questions. Details of the interview modes are included in Table 10-1, Table 10-2, Table 10-3, and Table 10-4.

[94] Straube 2005, 13

3 CONCEPTUAL BACKGROUND

3.1 Logistics as a pillar of international trade and development

A well-functioning logistics environment is key to a country's opportunities for trade, growth, and employment.[95] This is particularly relevant for developing countries: Poor trade logistics performance—measured as cost, time and complexity involved in import and export activities—precludes many developing countries from diversifying their economies and can thus depress trade, growth and employment.[96] A country's logistics performance is an important determinant of its productivity, its ability to participate in international trade and its attractiveness to outside investment.[97] Improved logistics increase market access and can hence increase trade.[98] Increasing logistics performance can foster trade, growth and competitiveness more than a tariff reduction, and is typically politically more feasible.[99]

Korinek and Sourdin (2011) examine the influence of trade logistics quality on the volume and value of international trade.[100] They show that trade logistics quality positively, significantly, and robustly impacts bilateral trade—and exports in particular. Improving logistics performance is particularly helpful for poorer countries: A low-income country can increase trade by at least 15 % if it increases its logistics performance to the average performance of a middle-income country.[101] However, increased trade does not translate into increased income for everyone. Negative impacts of more trade include unemployment of dislocated workers and fewer sales for domestic producers. Complementary

[95] A previous version of this chapter was used in an early publication of parts of the dissertation's results in Wiederer 2019.
[96] cf. Hausman et al. 2013, 236
[97] Hausman et al. 2013, 237
[98] Carruthers et al. 2004, 77
[99] Gonzalez et al. 2008, 8
[100] Korinek and Sourdin 2011, 13
[101] Qureshi 2011, 148

policies can mitigate, but not prevent, these effects.[102] The impact of logistics on development is an indirect one, with increased trade acting as an intermediary: high logistics performance facilitates trade. Trade liberalization, in turn, fosters productivity growth in firms;[103] productivity growth positively influences economic growth and technological upgrading;[104] and raising the ratio of trade to GDP by 1 % raises income per capita by between 0.5 and 2 %.[105]

Some countries enjoy less market access than others owing to their unfavorable geographic position. High logistics performance can make up for some of that distance and help countries gain access to otherwise unreachable markets. Investments in a country's logistics infrastructure and services can have a multiplier effect on the entire economy: Firms are able to access more markets, procure intermediate products more cheaply, and decrease production costs by reducing inventory.[106]

Competitiveness is elusive for countries with inefficient logistics environments because firms need to be able to quickly move goods across borders at low cost and with high reliability, and supply chains are only as strong as their weakest link.[107] Supply chain networks are put to test when firms spread out geographically.[108] Deficiencies in logistics infrastructure are key to companies refraining from extending their procurement networks to developing countries.[109] Thus, all links in a supply chain must be strengthened if a country wants to attract FDI and participate in international production networks or global value chains.

[102] Shepherd 2013, 16
[103] Pavcnik 2002, 271
[104] Shepherd 2013, 16
[105] Frankel and Romer 1999, 381
[106] Viswanadham 2015, 95
[107] Arvis et al. 2014, 9
[108] Straube and Pfohl 2008, 12
[109] Straube et al. 2011, 24

3.2 Measuring the effect of logistics performance on exports

The main transmission channel for logistics to influence economic performance, including exports, is via its effects on time, reliability, and cost. Time refers to lead time, that is, the time it takes for goods to arrive at the purchaser after the order has been placed.[110] Reliability refers to the level of certainty about when and how deliveries will occur.[111] Costs include direct costs, such as transporting goods, and indirect costs, such as for holding inventory while goods are in transit.[112]

Logistics affects the time it takes a product to reach its market, and time to market is related to trade in two ways.[113] (1) Based on time to market, a manufacturer decides whether to enter a certain market or not; and (2) time to market partly determines the volume of trade once a manufacturer has entered a certain market. For exports of manufactured goods, the probability of a country exporting to the U.S.A. decreases by 1.5 % for each day of additional shipping.[114] Viewed across all types of goods, the decrease in the probability of a country exporting to the U.S.A. is 1 %.[115] On average, an increase in inland transit time by one day reduces exports by 7 %.[116]

To assess which transport modes benefit most from logistics improvements, and regarding trade-level increases, Korinek and Sourdin (2011) differentiate between maritime and air transport and conclude that the effects of improvements in trade logistics are particularly strong for air

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110 Hausman et al. 2013, 241

111 Arvis et al. 2014, 2. Related definitions of reliability include the one by Hausman et al (2013, 241), where reliability refers to the degree of lead time uncertainty, and lead time refers to how long it takes for goods to arrive at the purchaser after the order has been placed, and the broader definition by Bundschuh et al. (2003, 2), where reliability refers to "the probability that a system or a component performs its specified function as intended within a given time horizon and environment".

112 Hausman et al. 2005, 3

113 Nordas et al. 2006, 7

114 Hummels 2001, 21. Manufactures exports refers to goods in SITC category 7 (machinery) and 8 (miscellaneous manufactures).

115 Hummels 2001, 21

116 Freund and Rocha 2010, 14

transport.[117] As it is high-value rather than low-value products that are shipped via air, this result has positive implications not just for a country's trade volume but also for its trade value. Air transport is gaining in importance in global value chains that increasingly rely on fast and just-in-time delivery, which is easier to attain with air transport than with other modes. Using the definition by Nordas et al. (2006), just-in-time "refers to a way of organising production where inbound as well as outbound inventories are kept to a bare minimum and inputs arrive at the factory at the point where they enter the production process."[118] Air cargo facilities are crucial for transporting high-value perishable agricultural goods such as specialty produce and flowers. Other transport modes, such as road, rail, or inland waterways, were not part of Korinek and Sourdin's (2011) research.

Durach and Wiengarten (2017) show that firms located in countries with low levels of infrastructure have fewer on-time deliveries (which is a component of high logistics performance) than those in countries with well-maintained infrastructure.[119] Supply chain failures, proxied by late deliveries, are more likely in countries with weak logistics-related infrastructure.[120] As for reliability as a transmission channel for logistics to influence economic performance, including exports, the reliability of a supply chain is a more important factor in determining transaction costs than the distance between trading partners.[121] Unpredictable delays and lack of reliability are even more detrimental to supply chains than high costs and long transport times.[122] When material and intermediate products arrive late because of unreliable supply chains, firms have to keep extra inventory, thus driving up the cost of production and keeping the funds from being used more productively.[123] For transporters and logis-

[117] Korinek and Sourdin 2011, 4
[118] Nordas et al. 2006, 8
[119] Durach and Wiengarten 2017, 167
[120] Durach and Wiengarten 2017, 167
[121] OECD 2015, 9
[122] Arvis et al. 2012, 22
[123] Subramanian et al. 2005, 6

tics service providers, a predictable delay is more manageable than an unpredictable situation in which the best outcome might be fast.[124] Delays harm economic performance in at least two ways: by reducing exports (by as much as 1 % per day of delay)[125] and by hampering export diversification.[126]

Studies showing that improvements in transport and logistics are linked to export performance can be traced back to the 1990s. Most of them have focused on infrastructure. They offer insights into the cost aspect of logistics and its impact on economic performance. Clark et al. (2004) found that, once countries have reduced their import tariffs, transport costs emerged as one of the main barriers to trade for many countries.[127] This holds for several Latin American countries.[128] Clark et al.'s (2004) focus is on maritime transport, whose cost is closely tied to port efficiency: Raising a port's efficiency from the 25th to the 75th percentile is linked to an increase in bilateral trade of about 25 % and a reduction in transport costs of around 10 to 12 %.[129] As port efficiency is partly influenced by the state of a country's infrastructure, investments in port infrastructure have the potential to increase port efficiency and bolster trade. Regulating market power in shipping and liberalizing port services, which in many countries are in the hands of state-owned operators, could help lower shipping costs by about 30 %.[130] A related result on the influence of transport costs on trade levels is that a 10-percentage-point increase in transport costs goes along with a 20-percentage-point reduction in trade volumes, with poor infrastructure accounting for 40 % of predicted transport costs.[131]

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124 Shepherd 2013, 12
125 Djankov et al. 2006, 16
126 Shepherd 2013, 11
127 Clark et al. 2004, 23. The average tariff rate in Asia decreased from 30 % in the early 1980s to 14 % at the end of the 1990s; and for Latin America average tariffs decreased from 31 % to 11 %. These numbers reflect simple averages of countries' unweighted tariffs; for weighted tariffs; the results would be even lower (Clark et al. 2004, 1)
128 Clark et al. 2004, 3
129 Clark et al. 2004, 7
130 Fink et al. 2002, 101
131 Limão and Venables 2001, 453

Using the example of Spanish firms, Albarran et al. (2013) explored the impact of investment in transport infrastructure on firms' export market participation. They found that transport infrastructure investments increase firms' probability of exporting.[132] This is because infrastructure investments lower domestic transport costs and hence reduce international trade costs, thus providing firms with a cost advantage in supplying goods to international markets.[133] By lowering road accessibility time to international markets by 30 minutes, export probability for firms with up to 200 employees increases by 0.5 % to 1.5 %.[134] This result has two implications for transport infrastructure investments in developing countries: First, these countries' economies are often dominated by small and medium-sized enterprises (SMEs), rather than by large multinational ones, so transport infrastructure investments predominantly favor the former. Second, developing countries are often far from international markets, which is exacerbated by poor transport infrastructure.

3.3 The role of logistics in facilitating a country's participation in global value chains

In many sectors, global value chains have gained in importance. The term "value chain" was first introduced by Porter (1985), who defined it as "a systematic way of examining all the activities a firm performs and how they interact."[135] Inbound and outbound logistics are two of the primary activities in a generic value chain, along with operations, marketing and sales, and services.[136] Porter (1985) introduces the term "value chain" to enable exploring the foundations of competitive advantage, with a focus on costs and sources of differentiation—both topics of interest to countries wishing to position themselves as manufacturing locations for internationally operating firms.[137]

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[132] Albarran et al. 2013, 889
[133] Albarran et al. 2013, 879; the authors control for firm heterogeneity.
[134] Albarran et al. 2013, 895
[135] Porter 1985, 33
[136] Porter 1985, 37
[137] Porter 1985, 33

In their definition of the value chain, Havenga et al. (2020) underline its connection to supply chains: "The value chain is defined as the linkage between multiple firms' supply chains, i.e. the set of distinct physical and technological value-adding activities performed by these economic actors in order to create the product or service required by the customer."[138] The importance of good logistics for competitive advantage is illustrated by the fact that savings in production costs are often outweighed by efficiency gains in logistics.[139] Countries can increase their competitive advantage vis-à-vis other countries by investing in infrastructure such that logistics costs are minimized and GDP maximized.[140] Whereas Havenga et al. (2020) focus on logistics infrastructure, this dissertation also discusses the services aspect of logistics to arrive at a full picture of a country's logistics environment.

The rise of global value chains goes hand in hand with the rising importance of logistics and transportation, as high logistics performance is a *sine qua non* for joining and strengthening participation in global value chains, which the World Bank (2020) defines thus:

> A global value chain (GVC) is the series of stages in the production of a product or service for sale to consumers. Each stage adds value, and at least two stages are in different countries.[141]

Logistics performance and GVC integration (on both the buyer and the seller sides) are positively correlated.[142] A smooth physical movement of goods along the value chain requires cost-effective logistics services, streamlined procedures for imports and exports, and good connectivity.[143] This is especially true in the automotive, high-tech, and agri-food sectors; each country involved in the chain needs to have a well-

[138] Havenga et al. 2020, 5
[139] Havenga et al. 2020, 5
[140] Havenga et al. 2020, 124
[141] World Bank 2020, 17
[142] Taglioni and Winkler 2016, 118
[143] Taglioni and Winkler 2016, 12

functioning transport and logistics sector.[144] Sound logistics benefits countries in two ways. First, well-functioning logistics unlocks higher degrees of specialization and sophistication for companies, thereby enabling them to move up in the value chain.[145] Second, modern logistics increases employment, as national and multinational companies require more and additional services, including specialized logistics services.[146]

Producing and exporting more sophisticated and diverse goods enables a country to grow. Until the mid-1980s, a country wanting to export first had to build a deep and wide industrial base.[147] Since the late 1990s countries can join an existing supply chain, becoming part of a global value chain (e.g., for cars) and move up the value chain to increase value added.[148] China, Vietnam, and Mexico are examples. The higher a country is in a value chain, the more important it becomes to move goods and services rapidly, cheaply, and reliably.[149] This is true for all countries, but especially for geographically remote ones such as landlocked countries and small island states.[150] Remote countries can partially compensate for their unfavorable geographic location by increasing logistics performance, for instance, by speeding up and increasing the reliability of transport times, as trade within international production networks heavily depends on logistics performance.[151]

Logistics' role in international trade becomes more pronounced as more countries shift production from products with comparatively lower logistics demands, such as traditional manufacturing, to engage in international vertical specialization.[152] Using the example of machinery, Saslavsky and Shepherd (2014) distinguish between trade in final goods and trade in parts and components when it comes to sensitivity to logis-

144 cf. Shepherd 2013, 11
145 Raballand et al. 2006, 1
146 World Bank and Ministère de l'Equipement et du Transport du Maroc 2006
147 Baldwin 2011, 29
148 Baldwin 2011, 5
149 Shepherd 2013, 18
150 Shepherd 2013, 18
151 cf. World Bank 2019, 37
152 Korinek and Sourdin 2011, 5

tics performance.[153] A country's score on the World Bank's Logistics Performance Index is used as a proxy for logistics performance.[154] Other variables whose influence is examined include GDP, the distance between two countries, exports from one country to another, sharing a common land border, and historical ties through colonialism.[155] They show that trade in parts and components is significantly more affected by improvements in logistics performance than is trade in final goods.[156] This result has implications for international production networks and global value chains as, when countries first join international production networks, they are likely to do so as parts and components suppliers, not as makers of final products. The difference in sensitivity to logistics performance implies that policymakers can support their countries' aspirations to join international production networks by improving logistics performance.

3.4 Logistics needs of internationally operating firms

As globalization continues, international firms shift operations to where they can be handled most efficiently. In most cases this entails a distribution of different functions across several countries at varying distances from the company's origin. As global sourcing spreads, emerging markets can benefit if they offer the right environment for at least a portion of a firm's supply chain.[157] Companies need high-quality logistics services to maintain manufacturing supply chains that span countries and continents. High-quality logistics involves short transit times, on-time deliveries, sustaining cold chains for products that need cooling, security from damage and theft, and certifications of product quality.[158] Memedovic et al. (2008) cite further demands that are made of today's supply chains: for example, the application of information technology in

[153] Saslavsky and Shepherd 2014, 989
[154] Saslavsky and Shepherd 2014, 983
[155] Saslavsky and Shepherd 2014, 983
[156] Saslavsky and Shepherd 2014, 983. The difference in the semi-elasticities of trade in final goods versus trade in parts and components is over 45 %.
[157] cf. Straube and Pfohl 2008, 94
[158] Carruthers et al. 2004, 77

physical distribution and materials management, intermodal transport, and innovations in containerization.[159]

Any country that strives for its firms to become part of a multinational's sourcing strategy must be mindful of the effects that its logistics environment has on the cost structure that local firms are facing. Logistics performance influences transaction costs and has a vital impact on the so-called total landed cost, which includes the costs of purchasing, freight, customs and duties, transactions, documentation, and inventory holding.[160] The latter includes cycle stock (dependent on shipment frequency), pipeline inventory (which depends on total lead time from source to destination), and safety stock (dependent on shipment frequency, average lead time, and variability in lead time: i.e., reliability).[161] Total landed cost determines companies' sourcing decisions—the producer with the lowest landed cost is typically chosen.

Straube et al. (2011) show that the main determinant for companies to decide where to source their products is regional proximity because of the large influence of geographical distance on lead times.[162] The second determinant of sourcing regions is based on product and material specialization, for instance, China sourcing raw materials from Brazil even though the two countries are geographically distant.[163] Firms usually use global sourcing for non-complex products first, and only later move on to global sourcing for modules and systems that are more complex, carry increased quality risk, exhibit less flexibility, and are typically lower value (between 25 and 40 % of procurement values).[164]

The automotive industry provides several examples of global sourcing: about half of the single parts and components used by German OEMs are sourced globally rather than locally (56 % for single parts and 49 %

[159] Memedovic et al. 2008, 355
[160] Hausman et al. 2013, 236
[161] Hausman et al. 2013, 236
[162] Straube et al. 2011, 18
[163] Straube et al. 2011, 18
[164] Straube et al. 2011, 16

for components in 2003).[165] Here, local sourcing here to sourcing in the country of production, i.e., a Hungarian Volkswagen (VW) plant that sources parts in Hungary would be considered to be sourcing locally. For the three big German automakers (VW, Mercedes, and BMW), the number of independent suppliers (i.e., those in which the OEMs did not have a financial stake) reached, on average, 441 in 2008.[166] For the same OEMs, the number of parts procured from suppliers in 2008 reached an average of 6,141, up from 5,041 in 1998.[167]

3.5 The importance of "soft" logistics infrastructure

"Hard" infrastructure, such as roads, railways, and ports, forms only one part of a country's trade logistics quality. The other side is the "soft" infrastructure comprising the processes and regulations associated with international trade, i.e., border administration, product standards, sanitary and phytosanitary (SPS) measures, labor conditions, environmental protection, education and training, and legal transparency. Differences in logistics performance can be explained in part by differences in the quality of the hard infrastructure, but, more frequently, they stem from differences in the soft infrastructure.

Weaknesses of the logistics system that often wreak even more havoc than poor infrastructure include policy and institutional constraints, such as overly bureaucratic processes, long clearance times at ports and border crossings, restrictive rules for cargo movement, or the lack of enforcement of rules of engagement.[168] Close to 100 % of imports into Sri Lanka and Nigeria, for instance, are subject to comprehensive inspection by customs authorities, whereas the figure for Germany is 2 % and for Canada 1 %.[169] High inspection rates slow goods movement and decrease supply chain reliability. Each additional day spent engaging with

[165] Göpfert and Grünert 2009, 148
[166] Göpfert and Grünert 2009, 140
[167] Göpfert and Grünert 2009, 141
[168] Hausman et al. 2013, 237
[169] Hausman et al. 2013, 237

trade procedures for preparing goods for export or import lowers trade by about 4 %.[170] The time spent on border procedures is more harmful than the same amount of time spent in sea transport. This reflects the detrimental effect of the uncertainty of durations. Trade logistics aspects such as customs procedures, logistics competence, and track-and-trace services impact on trade more than variables such as distance from markets and transport costs. The latter group of characteristics does not lend itself to policy intervention; the former one does.[171]

McKinnon et al. (2017) underline the importance of human resources (i.e., the right skills and competencies mix of the logistics workforce) for the logistical performance of businesses and countries. As Dadzie (1990) points out, the skills and competencies mix needed for logistics practitioners in less developed countries differs from the one relevant to more highly industrialized countries, as logistics managers in less developed countries face distinct challenges, for example, a frequent lack of alternate transport modes, recurrent delays in ports, the pronounced role of state-owned enterprises in transport and logistics, and comparatively high levels of buffer stock to guard against stockouts.[172] Although Dadzie's findings are from 1990, all the cited examples have emerged as logistics constraints in at least one country in the country gap analyses of the case studies presented in sections 5.4.5, 6.4.5, and 7.4.5. Materials and methods for teaching logistics in less developed countries should take into account these challenges.

3.6 Measuring logistics performance at the country level

There are several approaches to measure logistics performance at the country level. They can be divided into perception-based data and "hard" performance data. For perception-based data, one index is the Logistics Performance Index (LPI), published by the World Bank. The World Bank also publishes the Doing Business Indicators, the Trading Across

[170] Korinek and Sourdin 2011, 4
[171] Korinek and Sourdin 2011, 4
[172] Dadzie 1990, 10

Borders pillar of which covers aspects of logistics performance.[173] Up to 2016, the World Economic Forum published the Global Enabling Trade Report, which included the Enabling Trade Index.[174] DHL publishes the Global Connectedness Index.[175] Both the WEF and the DHL reports aggregate existing indices rather than creating new ones.

Surveys of logistics users such as exporters, importers, manufacturers, and traders offer another way to measure data on the performance of a logistics system.[176] These surveys incorporate key performance indicators related to cost, time, and reliability of the supply chain, e.g., warehousing costs, average order cycle time, the share of consignments delivered in full and on time, and damage rates.[177] Results are not available uniformly or for all countries and the surveys are costly and take time to carry out. Perception-based survey data can include measures of the quality of road, rail, port, and air transport infrastructure.[178]

"Hard" performance data include measures of lead time, clearance time, level of fees, and dwell time. Performance-based indicators for logistics infrastructure include road and railroad density and the availability of distribution infrastructure, e.g., logistics zones.[179] Port dwell time refers to the time that cargo (mostly containers) spends inside the port or its extension.[180] Nguyen et al. (2018) suggest a framework to evaluate logistics systems at the country level using performance-based indicators, and apply it to Cambodia.[181]

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[173] http://www.doingbusiness.org/en/data/exploretopics/trading-across-borders, accessed on March 23, 2019

[174] http://www3.weforum.org/docs/WEF_GETR_2016_report.pdf, accessed on May 17, 2020

[175] https://www.logistics.dhl/content/dam/dhl/global/core/documents/pdf/glo-core-gci-2018-full-study.pdf, accessed on March 23, 2019

[176] Nguyen et al. 2018, 93

[177] Nguyen et al. 2018, 109-110

[178] Nguyen et al. 2018, 101

[179] Road and railroad density is often only available as one number for the entire country. As industrial production tends to be clustered in certain areas of a country, sometimes around export processing zones or free trade zones, a density measure covering the entire country is less meaningful than the road density immediately surrounding those areas zones and their connection to the main export gateways (ports, airports, and land borders).

[180] Raballand et al. 2012, 1

[181] Nguyen et al. 2018, 101-102

There is no shortage of literature on measuring logistics service quality at the level of an individual company. Limbourg et al. (2016) provide an overview of the literature.[182] They distinguish between logistics service quality measured from the perspective of the logistics provider and from that of the customer; the latter is mostly based on surveys and interviews.[183] There is no such wealth of literature on measuring logistics service quality at the national rather than the company level. Yet several criteria used at the company level can be used as metrics for the quality of the freight transport system at the national level, which can be used as a proxy for logistics services, even though logistics services encompass more than freight transport.[184] They include average transit time, reliability, and the condition of goods on arrival.[185] Quantifying these variables is difficult owing to companies' confidentiality concerns and variations in speed and reliability by mode, carrier, route, consignment size, and goods type.[186] Moreover, for a high number of countries, most types of performance data are either unavailable in a uniformly measured way or not available as time series.

Excursion: The Logistics Performance Index (LPI)

The LPI is a qualitative benchmark of logistics performance at the country level. It has been published by the World Bank roughly every two years since 2007.[187] The LPI is based on a survey among about 1,000 international freight forwarders. The 2018 edition of the index, the latest available as of early 2021, includes 160 countries. Results from the 2018 aggregate LPI edition were used as a proxy for a country's logistics performance in the selection of the three case study countries (see 4.4.2 for details on country selection). The LPI ranking relies solely on assess-

[182] Limbourg et al. 2016, 125
[183] Limbourg et al. 2016, 125
[184] cf. McKinnon 2015a, 17-18
[185] McKinnon 2015a, 18
[186] McKinnon 2015a, 18
[187] Arvis et al. 2018, 1

ments by logistics professionals based outside the country in question, typically non-nationals of that country. The assessment is qualitative and perception based. The LPI's six dimensions are:[188]

1. Quality of trade and transport infrastructure;
2. Efficiency of customs and border management clearance;
3. Ease of arranging competitively priced shipments;
4. Quality of logistics services (e.g., trucking, forwarding, customs brokerage);
5. Ability to track and trace consignments;
6. Timeliness: Frequency with which shipments reach consignees within scheduled or expected delivery times.

The data collected are aggregated into a single indicator using Principal Component Analysis to enable cross-country comparisons. There are several caveats when interpreting LPI data. For example, assessments are perception-based; respondents in countries with a more highly developed logistics environment may have higher standards, which may be reflected in their assessments; and for landlocked and sealocked countries, a low LPI score can reflect access problems outside the country, e.g., in transit.[189] As with all survey-based instruments, sampling errors are possible. In some countries, it is not freight forwarders but other operators who handle most logistics operations, yet those are not captured by the survey. The LPI report includes confidence intervals for all scores to help determine whether a country's score change from one edition to another or the difference between two countries is statistically significant. For small countries or those with low survey-participation rates, confidence intervals are often large, reflecting more uncertainty over the "true" score.[190]

[188] https://lpi.worldbank.org/international, accessed on June 29, 2019
[189] Arvis et al. 2014, 14
[190] Arvis et al. 2018, 9

3.7 Logistics costs and their impact on international trade

3.7.1 Measuring logistics costs

The following section introduces methods of measuring logistics costs and serves as a basis for the discussion of transaction costs in chapter 4 and for the measures to lower logistics costs suggested in the decision framework. Trade transactions involve costs, and logistics costs are part of this. There is no set definition of logistics costs and no established method of measuring them, either at the level of the entire economy or at the level of individual firms. Straube and Pfohl (2008) note that the definition of logistics costs is standardized neither in research nor in practical applications at the firm level.[191] In some firms, not even logistics managers can give a full account of the components of logistics costs:[192] In a 2012 study carried out by Handfield et al. (2013), 14 % of participants (all of them supply chain executives) were unable to estimate their companies' logistics costs.[193]

Straube and Pfohl's (2008) definition of logistics costs at the firm (or micro) level involves six components: transport, packaging, warehousing, inventory carrying, value-added services, and administration.[194] At the level of the individual firm, logistics costs, according to Solakivi et al. (2015), are made up of the following categories: transportation, warehousing, inventory carrying, logistics administration, and other logistics costs.[195] Except for packaging and value-added services, this matches the definition by Straube and Pfohl (2008).[196] Cedillo-Campos (2015), in giving one of the shortest definitions, defines logistics costs as all "resources required for moving goods from an origin to a point of consumption."[197]

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[191] Straube and Pfohl 2008, 46
[192] Straube and Pfohl 2008, 48
[193] Handfield et al. 2013, 20
[194] Straube and Pfohl 2008, 49
[195] Solakivi et al. 2015, 12
[196] Straube and Pfohl 2008, 49
[197] Cedillo-Campos 2015, 10

Transport costs account for the bulk of logistics costs, but several other factors influence the cost level, for example, the public management of infrastructure and the institutional environment, as well as the ability of the private sector to innovate and adopt international best practices.[198] Figure 3-1 shows firm-level manufacturing and trading logistics costs as a share of net sales in Finland for the period 2011 to 2017.

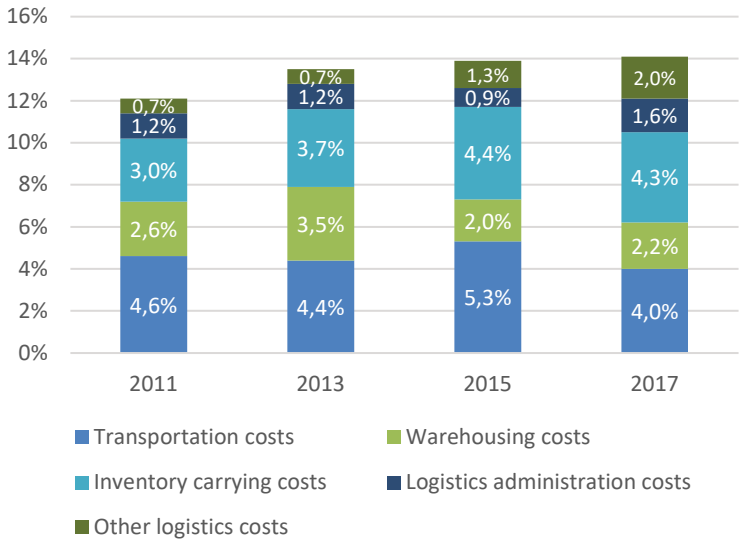

Figure 3-1: Logistics costs as percentage of net sales, Finland, 2011–2017[199]

Finland—a high-income country and hence not within the group of countries on which this dissertation focuses—was chosen for illustration as it provides one of the most detailed overviews of logistics costs over time. The surveys by Solakivi et al. (2015) and Solakivi et al. (2018), the methodology of which has remained constant over time, are among the

[198] Raballand et al. 2006, 2
[199] Adapted from Solakivi et al. 2018, 14

largest national self-reported surveys of logistics costs, both in absolute terms and when considered in relation to the country's size.

At the macroeconomic, or country, level, logistics costs can be measured according to three main concepts: first, their share of aggregated sales or turnover; second, their share of GDP; and third, as absolute costs.[200] Rantasila and Ojala (2012) name three methods by which these different logistics costs concepts can be measured:

1. Statistics-based studies, using statistical data, models and methods to determine logistics costs, e.g., national accounting figures.
2. Surveys, using questionnaires to collect data from respondents, such as logistics experts, at the company level. Examples include surveys among EU-based companies by Straube and Pfohl (2008) as well as the "Finland State of Logistics" surveys by Solakivi et al. (2015) and Solakivi et al. (2018).
3. Case studies and other studies: these tend to be used when neither statistics-based studies or surveys are available, e.g., owing to a lack of reliable data and interview subjects.[201]

Shepherd (2011) describes three ways of measuring logistics costs:

1. Logistics costs as a share of total firm costs. This approach is found, e.g., in Straube and Pfohl (2008). It captures logistics intensity: the higher the share of logistics costs in total costs, the more logistics-intensive the sector. This enables predicting the sectoral impacts of increases in logistics performance.
2. Logistics costs as a share of GDP, or another economic aggregate. This approach is used e.g., by Rodrigues et al. (2005). It allows measuring the size of the logistics sector, though not its performance. Another drawback of this method is that the final result can

[200] Rantasila and Ojala 2012, 9. Sales and turnover denote the same concept with the exception of how to treat the inclusion of value-added tax.
[201] Rantasila and Ojala 2012, 16

be inflated if intermediate inputs in the logistics sector are not removed from the calculation.

3. Using a performance variable as proxy. This approach does not produce a direct cost measure. Logistics costs must be calculated by converting the performance variable into a cost-like measure and using econometrics to isolate the share of logistics costs.[202]

One of the measuring methods described by Shepherd (2011), share of GDP, is equivalent to the methods described by Rantasila and Ojala (2012).[203] Another one is similar (share of total firm costs rather than share of aggregated sales), and a further one is different (absolute costs vs. proxying costs using a performance variable).

Gonzalez et al. (2008) provide a definition of logistics costs that focuses on international trade and differs slightly from the definitions above. It includes transaction costs related to transport and trade (e.g., processing of permits, customs, and standards), financial costs (e.g., inventory, storage, and security), and non-financial costs (e.g., insurance).[204] Another definition, based on the sequence of foreign-trade processes, is proposed by Pérez-Salas et al. (2014):

1. pre-shipment: packing, labeling, and cargo consolidation costs;
2. shipment to port of origin, i.e., land transport costs;
3. port/airport/border entry, i.e., cargo handling costs at terminal;
4. customs and control agencies, e.g., inspection, control, certification, and clearance procedure costs;
5. shipment to destination, e.g., freight shipment costs (road/air/sea);
6. inventory and finance, e.g., in-transit inventory costs or costs resulting from delays or lead-time variability.[205]

[202] Shepherd 2011, 5
[203] Shepherd 2011, 5; Rantasila and Ojala 2012, 9
[204] Gonzalez et al. 2008, 8
[205] Pérez-Salas et al. 2014, 6

The lack of a consistent logistics costs definition poses problems for cross-country comparisons. These are unreliable if measurements use heterogeneous methodologies, databases, and base years.[206] Moreover, there are no comprehensive cross-country comparisons of logistics costs and even the surveys covering only one or a few countries that previously existed have been discontinued. Examples include a survey covering logistics costs in Europe (carried out by A.T. Kearney for the European Logistics Association), the Davis Database surveys in the U.S.A., or the Touche Ross surveys in the United Kingdom. Consequently, much of the logistics costs data in this section are fairly old, with the exception of the data for Finland, and tracing longer-term trends in logistics costs has become difficult.[207]

3.7.2 International comparison of logistics costs

Logistics is a major part of global GDP. In 2002, logistics costs were estimated as making up 13.8 % of global output.[208] This number is similar to previous estimates that employed a comparable methodology: 13.7 % in 2000 and 13.4 % in 1997, each as a share of world GDP.[209] In their estimates, Rodrigues et al. (2005) point out that data gaps prevent an estimation of logistics costs in the Middle East and North Africa.[210] In industrialized countries, logistics typically makes up between 10 and 17 % of GDP.[211]

Straube and Pfohl (2008) surveyed 897 German-based and 155 other-EU-based companies and distinguished between logistics costs for retail and industry.[212] At 15.9 %, logistics costs in retail contributed a lower share of total costs than logistics costs in industry (7.0 %).[213] Figure 3-2

[206] Gonzalez et al. 2008, 8
[207] Data for Finland: Solakivi et al. 2018, 14
[208] Rodrigues et al. 2005, 10
[209] Rodrigues et al. 2005, 8
[210] Rodrigues et al. 2005, 2
[211] Memedovic et al. 2005, 358
[212] Straube and Pfohl 2008, 47
[213] Straube and Pfohl 2008, 47

shows logistics costs at country level (measured as a share of GDP) for several industrialized and emerging economies as of 2010.

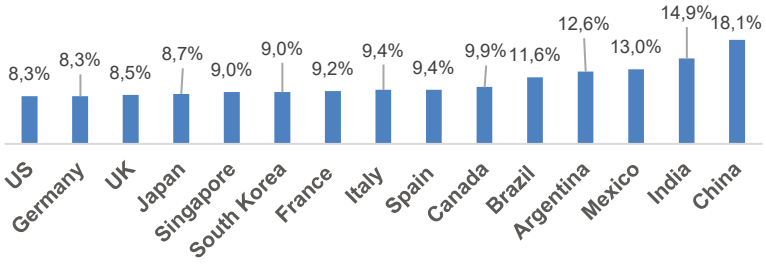

Figure 3-2: Logistics cost as a share of GDP, various countries, 2010[214]

Figure 3-3 shows that logistics costs represent a lower share of GDP in high-income countries than in low- and middle-income economies. At 17.9 % of GDP, the 2002 number for logistics costs is highest for lower-middle-income countries. A possible explanation for this is that the prevailing logistics environment in developing countries may have been ill-equipped to handle the increased economic activity stemming from higher growth rates in the 1990s.[215] Another possible explanation relates to the value and density of transported goods: density is affected by weight and volume, and transport vessels are usually constrained more by cubic capacity than by weight.[216] This favors low density, high-value products, which are more prevalent in the freight activity of industrialized countries.[217] For products with a low value density, such as foodstuffs, transport and logistics costs heavily influence the final product price, and that impact is proportionally higher than for products with higher value density.[218]

[214] Adapted from Morgan Stanley Research 2012, 6
[215] Rodrigues et al. 2005, 13
[216] Rodrigues et al. 2005, 13
[217] Rodrigues et al. 2005, 13
[218] Shepherd 2011, 17

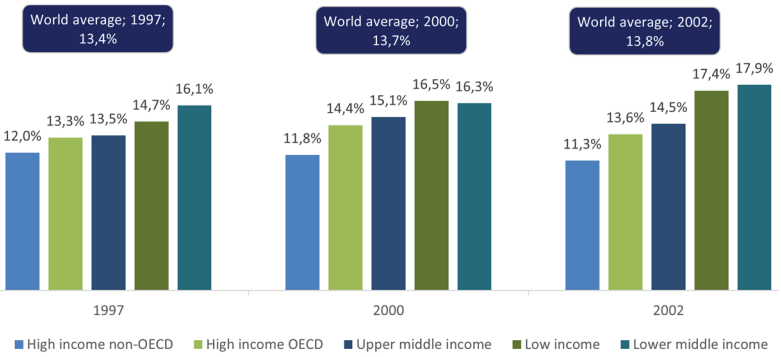

Figure 3-3: Logistics costs as a share of GDP by income group, 1997–2002[219]

Shepherd (2011) reasons that the figures cited by Rodrigues et al. (2005) may be inflated, as their method of measuring total logistics costs resembles gross production more than value added, which poses a problem when expressing those costs as a share of GDP, i.e., a value-added measure.[220] Shepherd (2011) includes an overview of logistics sector value added in several countries (see Table 3-1).[221] Part of the reason that Shepherd's (2011) results differ from the estimates by Rodrigues (2005) is that Shepherd measures the value added by the logistics sector relative to other sectors, rather than the total amount spent on logistics, including inventories.[222] This is especially important for low-income countries and those with low logistics performance, as their inventory costs tend to be high.[223] For Morocco (not included in Shepherd's overview), the share of logistics in value added has been estimated at 25 to 60 %.[224] The wide range illustrates the insecurity over how to measure logistics costs.

[219] Adapted from Rodrigues et al. 2005, 9
[220] Shepherd 2011, 5; Rodrigues et al. 2005, 9
[221] Shepherd 2011, 12
[222] Shepherd 2011, 12; Rodrigues 2005, 7-8
[223] Shepherd 2011, 9
[224] World Bank and Ministère de l'Equipement et du Transport du Maroc 2006, ii

Table 3-1: Logistics sector value added as a percentage of GDP, various years[225]

Country	Year	Narrow	Medium	Broad	Source
Vietnam	2000	2.21		12.93	Input-Output
USA	2007	2.95			National Accounts
Germany	2008	3.96	8.86	12.72	National Accounts
Indonesia	2005	4.18		15.72	Input-Output
Austria	2009	4.2	10.68	15.23	National Accounts
Thailand	2005	4.28		27.93	Input-Output
UK	2007	4.36	8.27	13.43	National Accounts
Japan	2006	4.39	13.22	17.47	National Accounts
France	2008	4.41	8.72	12.79	National Accounts
Poland	2007	4.79	11.85	18.82	National Accounts
Brazil	2005	4.96		18.74	Input-Output
S. Africa	2005	5.59		18.57	Input-Output
China	2005	5.68		12.5	Input-Output
Finland	2009	5.94	10.54	14.18	National Accounts
India	2003/2004	6.42		18.52	Input-Output
Mexico	2008	6.53	22.08	22.65	National Accounts
Greece	2008	6.72	16.34	22.88	National Accounts
Romania	2005	8.21		19.24	Input-Output
Russia	2000	8.96		39.51	Input-Output
Turkey	2002	12.26		26.15	Input-Output

[225] Adapted from Shepherd 2011, 12. The narrow definition of logistics here refers to transport and related activities; the medium one includes the narrow one plus wholesale trade; and the broad definition includes the medium one plus retail trade. The three definitions of logistics refer to which ISIC Rev.3 Sectors are included: sectors 60-62 (land, water, and air transport) and sector 63 (supporting and auxiliary transport services) for the narrow definition; sector 51 (wholesale trade) plus narrow definition for the medium one; and sector 52 (retail trade) plus medium definition for the broad one (Shepherd 2011, 10). For countries where national accounts data are available, Shepherd (2011, 11) is able to estimate all three versions because national accounts data are more disaggregated than input-output table data. For countries where only input-output data are available, only the narrow and broad definition can be distinguished.

3.7.3 Logistics costs' impact on international trade

Logistics costs are a major determinant of a country's competitiveness: Logistics is one of the main expenditures of manufacturing firms, therefore high logistics costs severely impact firm competitiveness.[226] A well-functioning logistics environment helps lower production costs. This works not just by lowering direct logistics costs, i.e., transport, storage, and administrative costs, but also indirectly by enabling companies to lower inventories at each production stage as the need for backup material and thus working capital decreases.[227] Adequate logistics infrastructure helps reduce the transaction costs of international trade, and this effect is more pronounced in less-developed countries where logistics costs typically make up a higher share of transaction costs than in more highly industrialized ones.[228]

High logistics costs are particularly detrimental to developing countries as the value of their export goods (per container) tends to be lower than those from more industrialized countries, rendering high logistics costs more punishing.[229] In most countries, trade costs are more affected by logistics costs than by tariffs.[230] For the majority of African countries, the impact of logistics costs (measured as the share of international transport costs in total trade value) is five times higher than the impact of tariffs, measured *ad valorem* to total trade value.[231]

The widespread adoption of containers for shipping goods since the 1960s has helped bring down logistics costs. Previously, goods had to be loaded onto ships individually (as so-called breakbulk), leading to ship loading times of up to two weeks and to high costs: transport costs for manufactured goods from the U.S.A. to Europe could reach 10 to 20 %

[226] Banomyong 2010, 394
[227] OECD 2015, 20
[228] OECD 2015, 2
[229] UNCTAD 2004, 2
[230] Gonzalez et al. 2008, 8
[231] OECD 2015, 19

of goods value.[232] The fixed costs of container shipping are higher than those of breakbulk shipping, mostly because of the need to build ports with container-handling capacities and because of the initial purchasing cost of the container itself, yet the average transportation costs are much lower for container shipping than for breakbulk.[233] The adoption of containerization benefited from network effects as containerized shipments—except for the U.S.A. and Australia with their large domestic trade and long distances between economic centers—were overwhelmingly used for international trade, and the more trading partners built container-handling facilities, the higher the incentives became for countries to adopt the new technology.[234] Containerized shipment, in part, enabled factories to spread to locations beyond the main ports, as manufacturing in the direct vicinity of a seaport became less important owing to the availability of containers.[235]

3.8 Research gaps

To evaluate and monitor logistics performance at a national level, it would be helpful to have objective (i.e., non-perception based) measures of a country's logistics performance available in a uniform format for a high number of countries, ideally with yearly updates to enable comparisons over time. These measures should include indicators such as clearance time, lead time, dwell time and the level of fees (e.g., port and road charges). Other indicators that would be useful refer to infrastructure quality (for ports, roads, airports, rail, warehousing facilities, and ICT) and service quality for maritime, road, air, rail, warehousing, and freight forwarding services, as well as customs and border management agencies.

[232] cf. Levinson 2020, 60
[233] Rua 2014, 9
[234] Rua 2014, 24
[235] cf. Levinson 2020, 60

Moreover, it would be desirable to have a standardized method of measuring logistics costs at the country level.[236] Such a method is currently unavailable; not even a unified definition of logistics costs exists. The ability to compare logistics performance and costs, including their main drivers, is indispensable for fact-based policymaking, most prominently for transport and logistics policy, but also in other sectors that use logistics as an input.

[236] Rantasila and Ojala 2012, 7

4 DERIVATION OF A DECISION FRAMEWORK

4.1 Overview of theories considered for guiding the analysis

The decision framework to be derived in this dissertation is designed to enable a country to attain a state of "adequate logistics" from the point of view of the public sector, as developed in section 1.3. As a theoretical foundation for the decision framework, behavioral economics, systems theory, and transaction cost economics were analyzed to gauge their potential for guiding the development of the decision framework. These three theories were chosen on the basis of their potential to help analyze a country's logistics environment. After an initial analysis, the theory options were narrowed from three to one. Behavioral economics and systems theory were not pursued as their potential explanatory contribution to the decision framework was judged to be too narrow. Instead, transaction cost economics was chosen for further analysis based on its suitability for explaining the role of institutions in shaping the logistics environment. The remainder of this section lays out the basic tenets of systems theory and behavioral economics and how they can be used in the context of logistics. The application of transaction cost economics to logistics is presented in the next section (4.2), and its contribution to the development of the decision framework is explained in section 4.3.2.

Systems theory was initially applied to the problem in this dissertation through using it to explain the structure of a country's logistics environment by viewing it as one system. "Logistics environment" could, here, be read as "logistics system." Systems theory can be traced back to the general system theory described by Ludwig von Bertalanffy in his 1968 work, "General System Theory—Foundations, Development, Applications."[237] Bertalanffy (1968) defines general system theory as "trying to derive, from a general definition of 'system' as a complex of in-

[237] Bertalanffy 1968. While Bertalanffy referred to the theory as "General system theory", most authors subsequently used "systems theory" in the plural, and this wording will be followed here.

teracting components, concepts characteristic of organized wholes such as interaction, sum, mechanization, centralization, competition, finality, etc., and to apply them to concrete phenomena."[238]

The theory's goal is to identify the purpose, conditions, dynamics, and constraints of a system. A country's logistics environment can be regarded as an open and dynamic system. Elements of a country's logistics environment are firms (e.g., LSPs as well as manufacturing and retail firms demanding logistics services) in addition to infrastructure operators and policymakers in transport, logistics, and trade. The logistics system is open in the sense that new elements (e.g., firms and operators) can enter the system, and exchange takes place with actors based outside the country. It is dynamic in the sense that its elements continually change: Not only do firms emerge and vanish, but other elements of the logistics system such as regulations and technologies constantly evolve. Inputs to a country's logistics environment include supply chain technologies, manpower, education and professional training, and a country's business climate. Several of these inputs constitute subsystems in their own right, for instance, the education system or the transport network. Ultimately, systems theory was not pursued further in this dissertation as its focus on the purpose, conditions, and interactions of a system was not central to deriving guidelines for the public sector's role in shaping a country's logistics environment.

After rejecting systems theory as a theoretical foundation for the decision framework, behavioral economics was explored. The main tenet of behavioral economics, which focuses on the behavior of individuals, is that economic actors do not always act fully rationally.[239] "Actors," for the purposes of this dissertation, could be firms and/or governments. Aharoni (2015) provides insights into the relevance of behavioral economics for prescribing policies.[240] This could be applied to logistics

[238] Bertalanffy 1968, 91
[239] cf. Aharoni 2015, 39
[240] cf. Aharoni 2015, 43

policymaking as covered by the decision framework. Aharoni (2015) recommends that "Policies should be tailored to influence actual, as opposed to an assumed, behavior."[241] Thus, recommendations included in the decision framework should take into account the actual logistical deficiencies that firms encounter when operating in a given country and should ensure that governments do not prescribe policies based on what they assume to be the bottlenecks. Although behavioral economics is helpful in explaining the behavior of economic actors, it is less useful for the decision framework in this dissertation, which focuses on identifying policy actions at the country level rather than at the level of individual economic actors.

While behavioral economics effectively captures the behavior of economic actors and while systems theory is helpful in explaining the interconnectedness of a country's logistics environment, they were not pursued as guiding theories for the decision framework as they offered too few reference points for how to structure the ideal set-up of a country's logistics environment and how to identify policy strategies for logistics. Instead, transaction cost economics was chosen for further analysis. The following sections will present the theory and how it may be used to analyze a country's logistics environment. Based on a review of transaction cost economics, the dissertation then derives a decision framework delineating how improvements in logistics can help a country expand its export opportunities.

4.2 Transaction cost economics

4.2.1 Transaction cost economics: Introduction

Transaction cost economics (TCE) emerged as one of the three main strings of New Institutional Economics, along with Principal Agent Theory and Property Rights Theory. TCE deals with the role of institutions in minimizing transaction costs, that is, the costs that are "incurred

[241] Aharoni 2015, 43

in operating an economic system" (North 1992, 6). North (1992) defines institutions as "formal rules, informal constraints (norms of behavior, conventions, and self-imposed codes of conduct), and the enforcement characteristics of both."[242] Enforcement can happen through self-imposed codes of conduct, retaliation, societal sanctions, or enforcement by the state.[243] This is where the role of national governments in improving the logistics environment comes into play: If political and economic institutions are in place that keep transaction costs low, efficient markets are made possible, which in turn underlie economic growth.[244]

TCE may help shape understanding for improving logistics at the country level as the theory analyzes the costs that accompany doing business in an economy. The logistics environment is one of several drivers of those costs. TCE focuses on individual transactions, whereas logistics is concerned with several transactions that are managed together, as chains.[245] Yet, given the importance of cost considerations in managing supply chains efficiently, TCE possesses explanatory value for this dissertation.

TCE makes two assumptions regarding the behavior of economic agents. The first assumption is bounded rationality, which posits that agents' behavior is rational, but only to a certain extent.[246] The second assumption is that economic agents are opportunistic, that is, they promote their self-interest.[247] Bremen et al. (2010) name risk neutrality as a third assumption.[248] The theory defines three key concepts that are key attributes of transactions. The first one is asset specificity. According to Williamson (1991), asset specificity of a transaction refers to "the degree to which an asset can be redeployed to alternative uses and by alternative users without sacrifice of productive value."[249] If asset speci-

[242] North 1992, 9
[243] North 1992, 9
[244] North 1992, 6
[245] Williamson 2008, 5
[246] Williamson 1996, 6
[247] Williamson 1996, 6
[248] Bremen et al. 2010, 21
[249] Williamson 1991, 282

ficity is present, the actors who carry out a transaction are dependent on each other.[250] TCE's second main concept is uncertainty, which Williamson (2008) defines as "the source of disturbances to which adaption is required."[251] In combination with bounded rationality, which TCE also assumes, uncertainty presents a problem, as the conditions surrounding a transaction are at least partly unknown.[252] Uncertainty could be offset by complete rationality, which could be used to include all contingencies in a contract.[253] However, in the absence of complete rationality, renegotiation costs will likely occur, for example, over the specifications and prices of a manufacturing process.[254] The higher the uncertainty, the higher the transaction costs will be.[255] TCE's third main concept is frequency.[256] This relates to the frequency of transactions and is relevant for the set-up costs of the transaction and for reputation: The higher the number of transactions, the more important is the perception of reputation between two contracting parties.[257]

Bremen et al. (2010) classify transaction costs into three categories: (1) information costs, (2) communication costs, and (3) coordination costs.[258] Hence, Bremen et al. (2010) do not explicitly include adjustment costs, that is, costs stemming from changes in, for instance, deadlines, quality, and quantity during a contract between a supplier and a producer. Unlike Bremen et al. (2010), Picot (1982) includes these costs in his classification of transaction costs:

1. initiation costs (or search costs), e.g., costs for searching for and obtaining information about potential transaction partners and their terms and conditions;

[250] Williamson 1991, 282
[251] Williamson 2008, 8
[252] Grover and Malhotra 2003, 459
[253] Grover and Malhotra 2003, 459
[254] Grover and Malhotra 2003, 459
[255] Grover and Malhotra 2003, 460
[256] Williamson 2008, 8
[257] cf. Williamson 2008, 8
[258] Bremen et al. 2010, 19

2. agreement costs, e.g., intensity and duration of negotiations, contract wording, and settlement;
3. control costs, e.g., the cost of ensuring that agreements on deadlines, quality, quantity, price, and confidentiality are honored;
4. adjustment costs, e.g., the cost of enforcing changes in deadlines, quality, quantity, and price due to a change in conditions during the agreement's lifespan.[259]

This dissertation adopts the 4-category classification of transaction costs by Picot (1982), rather than the one by Bremen et al. (2010), as Picot more explicitly captures adjustment costs, which is one of the main issues in maintaining logistics chains that rely on optimized time, cost, and reliability.[260] The transaction cost categories vary regarding level and frequency: In an economy distinguished by competition, initiation and agreement costs will be more dominant than control and adjustment costs.[261] The cost categories can be fixed or variable: initiation costs and agreement costs are variable if transaction partners vary, and fixed if transaction partners are permanent.[262]

4.2.2 Transaction cost economics: Application to logistics

As established in section 3.7, logistics costs at the firm level, following Straube and Pfohl (2008), consist of transport, packaging, warehousing, inventory carrying, value-added services, and administration.[263] In a transaction cost framework, these costs can be viewed as the costs associated with moving goods. Transaction costs influence how firms design their supply chains. The main mechanism is through the make-or-buy decision for a product, component, and service. Here, "make" refers to the in-house manufacturing of an intermediate product (or component or service, such as logistics services) and "buy" refers to purchasing the

[259] Bremen et al. 2010, 19; Picot 1982, 270
[260] Picot 1982, 270; Bremen et al. 2010, 19
[261] Picot 1982, 271
[262] Picot 1982, 271
[263] Straube and Pfohl 2008, 49

product, component, or service from an external supplier.[264] Following Williamson (2008), buying corresponds to an interfirm contract (denoted by Williamson as "market"), whereas making corresponds to an intrafirm contract (denoted as "hierarchy").[265] Williamson (2008) denotes long-term contracting between two firms as "hybrid," that is, an option situated between the two extremes of market and hierarchy.[266]

The two options, "make" or "buy", carry different sets of transaction costs; if these are low, the "buy" option typically prevails (i.e., intermediate products are purchased from suppliers in the market), whereas, if transaction costs are high, the "make" option usually prevails (i.e., intermediate products are made in-house by the firm itself).[267] Hybrid modes are between these two. The "buy" option can be characterized as outsourcing logistics services. Following Aertsen (1993), the economic advantages of outsourcing logistics services include economies of scale and scope, i.e., lower investments in distribution assets and lower operating costs.[268] Firms need to weigh these benefits against the economic disadvantages of outsourcing, namely, higher operating costs and switching costs (from carrying out logistics services themselves to outsourcing to an LSP and/or from one LSP to another).[269]

A second entry point for TCE in the logistics context is via the question of where to buy—locally or globally?[270] For firms operating internationally, transaction costs influence decisions about which countries to involve in their supply chains. Cost reduction is one of the main drivers of global sourcing.[271] Policymakers who aim to facilitate their countries' participation in global supply networks should strive to lower transac-

[264] cf. Williamson 2008, 8
[265] Williamson 2008, 8
[266] Williamson 2008, 8
[267] Grover and Malhotra 2003, 458
[268] Aertsen 1993, 25
[269] Aertsen 1993, 25
[270] Bremen et al. 2010, 19
[271] Other reasons include access to new sales markets, compliance with local content rules, and availability of manufacturing capacities and technical competencies (Bremen et al. 2010, 19)

tion costs in their countries, to the maximum extent possible for the public sector. Whereas parts and intermediate products can often be sourced easily from emerging markets, global sourcing of finished parts and modules is more difficult.[272] The complexity of sourcing more advanced parts lies in the requirements relating to supplier development, coaching of technical competencies, and knowledge transfer.[273] Another decision regarding both the make-or-buy question and that of where to source concerns the provision of services (in addition to products and components). Logistics services can be provided in-house or externally, and—if externalized—can be sourced locally or globally. Externalization of logistics services is only possible if a functioning market exists for such services in countries where firms set up production. Local as opposed to global sourcing of these services is only possible if competitive LSPs are present. Both of these offer entry points for governments trying to increase the competitiveness of their countries.

Ojala (1995) lays out the similarities of how costs are viewed in TCE and logistics.[274] Whereas TCE divides costs into production costs and negotiation costs (relating to, e.g., distribution, marketing, and uncertainty), logistics divides costs into direct costs (relating to freight and inventory handling) and indirect costs (relating to information management or the revenue effects of alternative logistics solutions).[275] The production costs of TCE thus find their equivalent in the direct logistics costs, and negotiation costs can be viewed as parallel to the indirect cost of logistics.[276] While Ojala (1995) uses the findings from TCE mainly for his application at the individual firm level, entry points for national governments wishing to improve the competitiveness of their countries' logistics environments exist for both the production, or direct, costs and the negotiation, or indirect, costs. Policymakers can contribute to lowering direct logistics costs through, for example, price setting for road tolls

[272] Bremen et al. 2010, 23
[273] Bremen et al. 2010, 23
[274] Ojala 1995, 37-39
[275] Ojala 1995, 38
[276] Ojala 1995, 39

and port fees, whereas indirect logistics costs can be influenced by increasing the reliability of logistics processes in the country through, for instance, timely customs and border clearance procedures; supporting a high level of logistics knowledge in the workforce through specialized education and training; or establishing large and reliable transport infrastructure networks.

Picot's (1982) four-tier classification of transaction costs can be used to identify costs related to international logistics, as presented in Table 4-1.

Table 4-1: Examples of transaction costs in international logistics[277]

Cost category	Examples related to international logistics
Initiation (search) costs	Costs for searching and obtaining information about potential foreign-based suppliers and their terms and conditions
Agreement costs	Costs of agreeing on a contract with a foreign supplier or a freight forwarder
Control costs	Costs of ensuring that logistics services are procured as agreed upon regarding time, cost, and reliability
Adjustment costs	Costs of enforcing changes in deadlines, quality, quantity and price with foreign suppliers due to changes in conditions

Asset specificity, as introduced in section 4.2.1 (as transferability of assets), can, in the context of logistics, refer to technical competencies that suppliers must obtain through training to produce an intermediate component.[278] It can also refer to requirements regarding the production schedule to accommodate downstream manufacturing processes or delivery dates of finalized products.[279] Another entry point for asset specificity in logistics is through specialized production equipment provided by the supplier: If a supplier invests in equipment that is valuable only to

[277] Source for the cost categories: Picot (1982, 270); for the examples: author
[278] Grover and Malhotra 2003, 459
[279] Bremen et al. 2010, 23

the procurement relationship with a certain buyer, he incurs the risk of losing that investment if the buyer ends the relationship or purchases less than agreed.[280] The higher the asset specificity, the higher the transaction costs will be.[281] Aertsen (1993) explores the significance of asset specificity on the degree of outsourcing of logistics services and suggests that firms will prefer own-account distribution over outsourcing logistics if asset specificity is high and coupled with difficulties in measuring the performance of LSPs.[282]

Other determinants of transaction costs in emerging countries are independent of the complexity of the product being sourced. Firms that spread their supply chains across emerging countries face the risk of uncertainty. Bremen et al. (2010) name four elements of uncertainty:

1. regulatory uncertainty: risk of changes in regulations affecting supply chains;
2. price changes, e.g., of labor or raw materials;
3. currency risks;
4. unpredictability of suppliers, e.g., last-minute cancellations.[283]

Entry points for national governments exist in the first three of these elements. Responsibility for regulation lies with the government (national, regional, or local level); price changes for labor or raw materials are, at least partly, affected by taxes and other duties levied by the state; and currency risks are influenced by monetary policy. Only the fourth element named by Bremen et al. (2010)—unpredictability of suppliers—is mainly in the hands of the private sector and thus beyond government control.[284]

Moving parts of their supply chain to foreign countries is especially challenging and costly for small and medium-size buyers located far

[280] Lambooy et al. 2001, 3
[281] Grover and Malhotra 2003, 460
[282] Aertsen 1993, 27
[283] Bremen et al. 2010, 23
[284] Bremen et al. 2010, 23

away from the sourcing market.[285] If local sourcing hubs exist, these costs can be lowered.[286] Although the distance between buyer and supplier is a crucial determinant of transaction costs, the reliability of a supply chain is more important in determining transaction costs than the distance between trading partners.[287] To conclude: the transaction costs of international trade can be mitigated by a well-functioning logistics environment.

4.3 Synthesis: A decision framework to enable countries to identify logistics measures that facilitate higher-value exports

4.3.1 Overview and purpose of the decision framework

The purpose of the decision framework is to enable policymakers to identify logistics interventions that improve the logistics environment for three product categories that lend themselves to higher-value exports: high-tech manufacturing, automotive, and higher-value perishable agricultural goods (see section 4.4.3 for details on the selection of product categories). It does so by defining what "adequate" logistics requires in each of these three product categories. By comparing the actual state of a country's logistics environment with these requirements, gaps in the current logistics environment can be identified. Based on the gap analysis, policy interventions are formulated that national governments can implement to improve the logistics environment for a certain product category. Such interventions could, for instance, take the form of infrastructure investments, regulatory reforms, subsidies, or education schemes. The framework provides guidance for these steps. The focus on government action implies that intra-company processes are mostly excluded.

The framework is intended to fill the need for a structured approach to identifying relevant measures to improve a country's logistics environ-

[285] Bremen et al. 2010, 23
[286] Bremen et al. 2010, 23
[287] OECD 2015, 9

ment in the form of a decision aid for policymakers. This is because national governments play a key role in shaping the logistics environment, e.g., by setting regulatory boundaries, providing infrastructure, managing borders, and providing a level playing field for all logistics actors. As for the type of the framework: It is a decision framework rather than a simple process model, as the different steps lead to a selection of measures that should be adopted to improve the logistics environment of a given country. To account for the complexity of decisions to be taken by logistics policymakers, the framework is not an automatic model that mechanically produces results upon feeding data into an algorithm, but rather an expert model, in the sense that a user needs some familiarity with logistics and with conducting semi-structured interviews. The framework is made available to the scientific community and to policymakers dealing with logistics internationally.

The framework was developed based on the guiding theory of transaction cost economics, a literature review, and elaborations by the author. It was applied to three countries and to three product categories in the form of three case studies. Based on these case studies, further content was generated for the final version of the decision framework and for the recommendations for policymakers. Owing to this additional content, the framework and its results are potentially relevant not only for the three countries covered in the case studies, but also for other—predominantly middle-income—countries: in section 8.1.6, the dissertation includes guidance on non-country-specific suggestions for logistics measures that can be taken by national governments to improve the logistics environment for each of the three product categories. An overview of how the findings from the case study applications are reflected in the decision framework is shown in Figure 8-1. The following sections in this chapter introduce the decision framework and explain how it is used. Later sections of the dissertation entail three applications of the framework to specific product categories: high-tech manufacturing in section 5.4, automotive in section 6.4, and perishable agricultural goods in section 7.4.

4.3.2 Contribution of transaction cost economics to the decision framework's development

Three fundamental concepts in logistics are time, cost, and reliability. Goods need to be shipped fast (or at least with a predictable timeline), at low cost, and reliably. The three concepts compete with each other, as improving one typically entails weakening another. Air freight provides an example of the trade-off between time and cost: Although it is usually the fastest transport mode, it is also the most expensive. These three concepts are reflected in the decision framework, which incorporates the notions of flexibility (as a proxy for time), cost, and reliability (section 4.3.3).

Any country that wants to be competitive will strive to lower the costs associated with doing business there, be it for local firms or for international companies seeking to establish themselves abroad. Transaction cost economics examines all three concepts named above: Cost is examined directly, and time and reliability can both be converted into cost equivalents, for example, by determining the costs of buffer stock to balance low supply reliability, of foregone production outputs due to low reliability, or of emergency deliveries to provide production inputs due to long transport times. The measures suggested by the decision framework are designed to lower the transaction costs of logistics in selected countries in selected product categories. Transaction cost economics looks at costs at the firm level, not at that of the country (i.e., the entire economy). The degree of its applicability to this dissertation, which focuses on logistics at the country level, is thus limited, but significant.

National governments can indirectly influence the levels of several types of transaction costs that firms operating in the country face, as well as the cost of providing the public elements of the logistics environment, such as infrastructure, regulations, customs, and public education. In addition to flexibility and reliability, cost efficiency is a crucial third feature of an adequate logistics environment and it is thus included in the target set-up

(the first level) of the decision framework. Measures to reduce logistics costs are included throughout the suggested measures section.

A caveat is necessary on viewing the reduction of logistics costs as a goal in itself: Owing to the paucity of data on logistics costs disaggregated by economic sector, the benchmarks on logistics costs in this dissertation refer to economy-wide logistics costs as a share of GDP rather than to the logistics costs of the product category in question. A desired reduction of economy-wide logistics costs can have unintended consequences in the event that a reduction is not achieved by increasing the efficiency of the logistics environment in a given sector, but by increasing the GDP share of sectors with inherently low logistics costs. Examples of the former would be increased efficiency through improved reliability and hence reduced need for buffer stock, or via a reduction of transaction costs because of an improved regulatory framework. An example of the latter would be increasing the GDP share of sectors that rely on virtual goods or on IT-based services rather than physical goods that need transporting and handling. Benchmarking logistics metrics, e.g., average transport cost per ton-km or inventory turnover ratios would be desirable, at least in addition to an exclusive focus on logistics costs. However, this was not pursued here owing to the lack of internationally comparable data on these metrics.

A question to be answered by the decision framework is how governments can influence the four transaction cost categories defined by Picot (1982): (1) initiation (search) costs, (2) agreement costs; (3) control costs; and (4) adjustment costs.[288] Initiation costs (category 1) can be kept low if all or most firms in an economy operate in the official sector, i.e., with proper registration and licensing, which eases the burden of researching, for example, possible LSPs. Business registries and wide coverage of high-speed internet can lower initiation costs further. The sections on “Organization of the logistics environment” and “Information and communications technology” in the decision framework

[288] Picot 1982, 270

cover this. The ease of transporting goods and services within a country also influences initiation costs and is covered in the section on "Trade- and transport-related infrastructure."

Picot's categories 2 (agreement costs) and 4 (adjustment costs) are positively affected by the rule of law. In a country where the rule of law prevails, firms can be reasonably certain that contracts are common and widespread (relevant for agreement costs) and enforceable (relevant for adjustment costs). The sections on "Regulatory environment" and "Customs practices" in the decision framework cover aspects of the rule of law. Cost category 3 (control costs) refers to the costs of ensuring that agreements on deadlines, quality, quantity, price, and confidentiality are honored. It is thus mostly in the hands of individual firms, with little role for the public sector. Nevertheless, the section "Business practices for high-quality logistics services" incorporates aspects of this, at least those for which a national government can provide incentives for private-sector practices.

Further entry points for the public sector to reduce transaction costs are tied to the level of skills and competencies of the workforce, which governments can shape through schools, universities, and vocational training. A highly trained workforce lowers the cost of adjusting to new business practices, business partners, production methods, and other processes that affect a logistics environment. The framework's section on "Education, skills, and professional training" covers this.

The logistics reforms suggested in the decision framework applications support the reduction of uncertainty of doing business in a country for a specific product category and can thus help lower the transaction costs involved, make logistics more efficient, and support trade in higher-value goods. As several proposed measures are general in nature, they will improve the logistics environment not only for one product category, but also for others, thus contributing to lowering transaction costs in logistics overall. Examples of these general measures include the facilitation of intermodal transport, a large road network in good condition (at

least between major production sites and export gateways), 24/7 opening hours of ports and airports, healthy competition in all transport modes, efficient warehousing, predictable border clearance procedures, and a high level of logistics knowledge at company level. Their prominent role in improving a country's logistics environment is illustrated by the fact that they appear in all three product categories covered in the framework applications (section 4.7).

4.3.3 Structure of the decision framework

The framework was designed as a decision aid for policymakers wishing to support an increase in the volume and sophistication of exports from their country in a given product category by improving the logistics environment that enables exports for the selected product category. It is built upon six levels which lead the user from a high-level overview of what "adequate logistics" looks like for a given product category to tangible measures that can improve the logistics environment in a chosen country. Figure 4-1 provides a schematic overview of the framework.

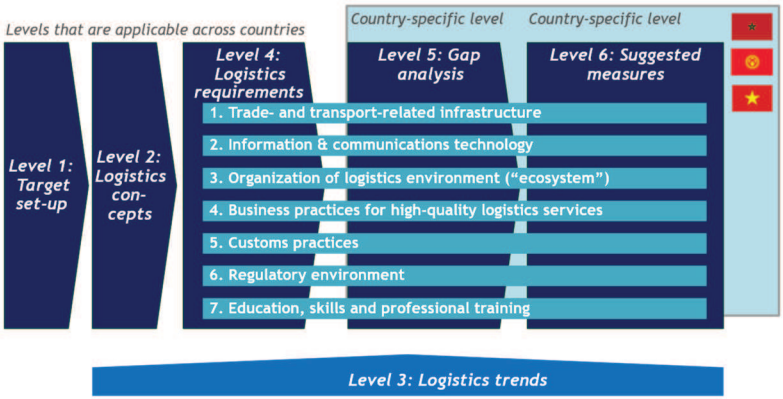

Figure 4-1: Overview of the decision framework[289]

[289] Source: author

The six levels, their logic, sequence, and interconnections, were created by the author as part of the development of the dissertation by working backwards from the goal of being able to formulate sound policy recommendations (level 6) based on theory, evidence, and good practices. Inputs for each level were partly taken from the literature, and partly supplied by the author. Together, these six levels capture the inputs and outputs that enable a user to move from an abstract, non-country-specific, ideal set-up of the logistics environment of a targeted product category to detailed country-specific logistics measures that are recommended to support an increase of exports in the chosen product category.

The framework has six levels:

1. target set-up
2. logistics concepts
3. logistics trends
4. logistics requirements
5. gap analysis
6. suggested measures

The following section includes a description and the rationale for each level. An overview is included in Appendix 10.1. The decision framework has been applied to three product categories: high-tech manufacturing, automotive (parts and components as well as finished automobiles), and perishable agricultural goods (sections 5.4, 6.4, and 7.4). In the following, the terms “a given product category” or “the product category in question” refer to these three product categories.

LEVEL 1: TARGET SET-UP

This level delineates the ideal state of a well-functioning logistics environment for a given product category. Its purpose is to provide a concise idea of what the logistics environment of a given product category should look like. This level, like levels 2 to 4, is product-category-specific, not country-specific. This was a design choice so that levels 1

to 4 can be applied across countries, with the need for only the last two levels, 5 and 6, to be tailored to the country, to allow for a widespread and easy application of the framework. It reflects the fact that the requirements of an adequate logistics environment for a given product category are not dependent on the country of production.

Level 1 is short and focuses on three key notions: flexibility, reliability, and cost. The level sketches how these notions apply to the product category in question. Flexibility here refers to the capability to change based on a set of defined contingency scenarios.[290] It covers the concepts of agility and adaptability. Reliability relates to the degree of uncertainty in the lead time, which refers to the time it takes for goods to arrive at the purchaser after the order has been placed.[291] Cost here refers to logistics costs (see section 3.7 for details on logistics costs, and section 4.3.2 for how transaction cost economics enters the framework).

When comparing the three framework applications, it becomes apparent that the respective target set-ups for the three product categories closely resemble each other. In each case, cost and time should be minimized, and reliability should be maximized. This is no coincidence: modern high-quality logistics for high-value-added products, such as those covered in the framework applications, necessitate the optimization of each of the three characteristics.[292] The three characteristics are partly in conflict with each other: an increase in one often comes at the expense of another. Delivery times, for instance, can be reduced, for example, by switching from maritime to air transport, but typically at great monetary expense. Reliability and flexibility, however, are not always at odds with each other: If reliability is high, the need for flexibility decreases. To illustrate: A certain production input might have a comparatively long lead time (e.g., three weeks). However, if LSPs, transport, customs, and

[290] cf. OECD 2013, 50
[291] cf. Hausman et al. 2013, 241
[292] For time and reliability, see e.g., Straube (ed.) 2019, 5; for cost and reliability, see e.g., Straube et al. 2011, 38; for time, cost, and reliability, see e.g., Straube (2004, 31), where "reliability" is not explicitly mentioned but referred to via "delivery quality' ("Lieferqualitäten")

other enabling conditions are working reliably, so that parts always arrive precisely two weeks after the item is ordered, this reduces the need for flexible solutions such as obtaining parts on short notice via air transport or using express carriers for the inland transport portion.

The specifics of each characteristic vary by product category: Reliability, for instance, means different things in the supply chain for perishable agricultural goods compared with the one for automotive goods. This is spelled out in each framework application. Such a close resemblance would likely also be the case for the target set-up of other product categories, which were not covered in the applications. In the applications of the framework to automotive, perishable agricultural, and high-tech goods, the data for this level originate in a review of the literature on ideal features of the logistics environment in each product category. For applications to other product categories, the same data source is recommended.

LEVEL 2: LOGISTICS CONCEPTS

This level links logistics concepts prevalent in the product category to the target set-up of the logistics environment. Examples of such concepts include make-to-order or just-in-time delivery, both used in the production of automobiles. The level's purpose is to provide a link between the key ingredients of the target set-up (level 1)—namely flexibility, reliability, and cost—and the logistics concepts that are employed by private manufacturers and producers in the product category. It lays the groundwork for level 4 (logistics requirements), which deals with the requirements that lend themselves to government intervention. Level 2 is product-category-specific, not country-specific. In the framework applications, data for this level originate in a review of the literature on logistics concepts and practices prevalent in the three product categories. For applications to other product categories, the same data source is recommended.

LEVEL 3: TRENDS

This level includes product-category-specific trends. Its purpose is to explore which trends with relevance to a particular product category

may impact logistics in the next decade, i.e., approximately until 2030. Examples include rising cost pressure as well as increased demand for transparency. Given the speed of technological change, the trends shaping logistics will likely change during the next five to ten years, with ramifications for logistics policymaking at the country level. It will be necessary to continually examine new trends concerning their applicability to the three product categories. This level is product-category-specific, not country-specific. As for trends that are not product-category-specific: Section 4.5.2 includes a brief discussion of the ramifications of the trend of environmental sustainability in logistics. Each of the three country-specific applications of the framework (sections 5.4, 6.4, and 7.4) includes suggested measures to enhance environmental sustainability in logistics for that product category. In the three framework applications, data for this level originate in a review of the literature on trends in logistics for the three product categories. For applications to other product categories, the same data source is recommended. Figure 4-1 depicts the trends level as a cross-cutting level with ramifications for several parts of the model (logistics concepts, requirements, gap analysis, and Measures). In the three country-specific applications (sections 6.4, 7.4, and 5.4) the trends level is inserted as level 3, between logistics concepts and logistics requirements.

LEVEL 4: LOGISTICS REQUIREMENTS

The purpose of this level is to lay out the logistics requirements of a given product category that national governments can influence, either alone or in cooperation with the private sector. All requirements listed here respond to the need of the logistics environment to be flexible and reliable while keeping costs low. This level is the first one that is divided into seven functional categories: (1) trade- and transport-related infrastructure, (2) information and communications technology, (3) organization of the logistics environment (ecosystem), (4) business practices for high-quality logistics service, (5) customs practices, (6) regulatory environment, and (7) education, skills, and professional training (see

Table 4-2). These seven functional categories reappear in the subsequent two levels, i.e., the gap analysis and measures. The functional levels were developed as a way to categorize the product-category-specific logistics requirements that surfaced in the literature review. They are a partly inspired by a mapping of policy areas for trade facilitation by the World Bank (2010), though with limited overlap.[293] Although different categorizations would have been possible, this one was chosen as it enables mapping policy areas to government entities at the country level.

Table 4-2: The seven functional categories used in the decision framework[294]

No.	Short name	Long name
1	Infrastructure	Transport- and trade-related infrastructure
2	ICT	Information & communications technology
3	Ecosystem	Organization of the logistics environment[295]
4	Business practices	Business practices for high-quality logistics services
5	Customs	Customs practices
6	Regulatory env.	Regulatory environment
7	Training	Education, skills, and professional training

[293] cf. World Bank 2010, 43–45. The policy areas in World Bank (2010, 43–45) are the following: (1) tools and institutions to measure and assess logistics performance, (2) institutions and regulations, (3) regulation of transport and logistics services, (4) quality, reliability of logistics services, (5) business practices, (6) customs modernization, (7) related procedures, (8) trade facilitation initiatives, (9) transit regime, (10) air and sea connectivity and liberalization of services, (11) public infrastructure. Of these eleven areas, four inspired part of the functional categories in the decision framework: regulation of transport and logistics services (in the framework: regulatory environment); business practices (business practices for high-quality logistics services); customs modernization (customs practices); public infrastructure (transport- and trade-related infrastructure). The author added the three functional categories of ICT, organization of the logistics environment ("ecosystem"), and education, skills, and professional training.

[294] Source: author

[295] "Environment" here refers to the business environment rather than the physical or natural environment.

Requirements are grouped by two of the target set-up characteristics (flexibility and reliability). Requirements related to costs (the third target set-up characteristic) are included in two ways: (1) explicitly (as an entry in the "Ecosystem" functional category), and (2) implicitly, via entries in all seven functional categories that cover how policymakers can contribute to lowering logistics costs by improving the reliability and flexibility of the logistics environment (see section 4.3.2 for details). This level is product-category-specific but not country-specific, as the main requirements for the logistics environment per product category do not change from country to country. It can thus be used by policymakers and users of the decision framework in any country wishing to improve the logistics environment in the given product category. The level includes the rationale for each requirement, so that policymakers can trace the link between logistics requirements, proposed logistics measures, and the goal of enabling higher-value exports. It contributes to the framework's usefulness by serving as the basis for level 5 ("gap analysis"), in the sense that in level 5 the logistics environment of a chosen country will be measured in terms of whether the logistics requirements defined in level 4 are met.

In the framework applications, data for this level originate predominantly in a review of the literature on the requirements of logistics in the three product categories. To a lesser extent, data for this level originate in suggestions by the author and interviews carried out with stakeholders from Morocco (in 2015), Kyrgyzstan (in 2016), and Vietnam (in 2019/2020): Some of the requirements are derived from answers that interviewees discussing the three product categories mentioned as crucial to their company's or members' success. These inputs were checked against requirements cited in the literature on each product category's logistics features to decide whether they merited inclusion in the list of requirements (which transcends the single-country focus). If a match with the literature occurred, these requirements were included. For applications to other product categories, the same procedure is recommended.

LEVEL 5: GAP ANALYSIS

This is the first country-specific level. As with all others, it is product-category-specific. For each pair of product category and country selected (e.g., the pairing of high-tech manufacturing and Vietnam), this level includes an analysis of gaps prevalent in the country relevant to fulfilling the logistics requirements of the chosen product category. The purpose of this section is to pinpoint shortcomings in logistics performance in a given product category in a certain country, which serves as the basis for the suggestions of country-specific logistics measures in level 6.

The guideposts for the gap analysis are the logistics requirements from level 4 which, in a perfect logistics environment, would all be met. Gaps are grouped by functional category. All entries refer to gaps that can at least partially be addressed by government action, with the exemption that entries under "business practices" include those with limited scope for government action as they refer to intra-company processes. Yet the gaps identified are those for which governments can exert at least partial influence, for example, through taxes, regulation, or subsidies.

Level 5 contributes to the framework's usefulness by providing country-specific evidence of logistics deficiencies in a given product category on the basis of which the suggested measures in the level 6 (logistics measures) are designed. Unlike levels 1 through 4, which are not country-specific and have already been completed for three product categories, the gap analysis and the measures section have to be completed separately for each country.

In the three applications of the framework, data for this level originate in the following sources: (1) interviews carried out with stakeholders from Morocco, Kyrgyzstan, and Vietnam; (2) official country statistics (e.g., statistical yearbooks); and (3) public databases and reports. A corresponding procedure is recommended for applications to other product categories and countries, with interviews being carried out in the country in question. There is a caveat for data on this level: In the country applications of the framework (sections 5.4, 6.4, and 7.4), some of the data

originate in interviews with different stakeholder groups (LSPs, producers/manufacturers of the product category in question, policymakers dealing with logistics, and industry associations, all based in or familiar with the country in question). Answers across the stakeholder groups might thus be heterogeneous, reflecting different perceptions and priorities.

LEVEL 6: SUGGESTED MEASURES

The purpose of this last stage of the decision framework is to formulate policy measures that national governments can take to improve their countries' logistics environments to foster the volume of exports of a given product category that lend itself to higher-value international trade. This level is the second country-specific level. As with all others, it is product-category-specific. Measures were formulated by analyzing the gaps identified in level 5 and selecting those that a national government (rather than the private sector) would be best placed to address. This meant excluding measures that rely purely on inter-company organization and including some measures for other product categories that have the characteristics of a public good, that is, non-excludability and non-rivalry: An example is improving border procedures. For some of the measures, the government will need to secure the collaboration of the private sector. The suggested measures are grouped by functional category.

This level adds to the framework's usefulness by using inputs from all previous levels to come up with evidence-based policy recommendations for improving a country's logistics environment. It was developed by taking the desired outcome of the decision framework (i.e., to formulate sound and actionable policy recommendations) and going backwards through the steps necessary to reach this, all the way down to formulating the target set-up of a well-functioning logistics environment for a given product category.

Unlike levels 1 through 4, which are not country-specific and have already been completed for the three product categories, the measures section (and the gap analysis) have to be completed separately for each country. In the three applications of the framework, the measures listed

address the gaps identified in the preceding level and respond to the need of the logistics environment to be flexible and reliable while keeping costs low. Measures related to costs (the third target set-up characteristic) are included in two ways: (1) explicitly, as entries in the Ecosystem functional category; and (2) implicitly, through suggestions in the seven functional categories for how policymakers can contribute to lowering logistics costs through policy measures that improve the reliability and flexibility of the logistics environment (section 4.3.2). Reliability and flexibility are two components of each product category's target set-up that can be converted into cost equivalents.

In the framework applications, data for this level originate in two sources: (1) a literature review of best practices in logistics in each of the three product categories and (2) suggestions by the author based on the preceding product-category-specific analysis of logistics requirements and country-specific gaps, in some instances taking into account suggestions by interview partners. The framework could be expanded to cover further product categories that lend themselves to higher-value exports. When applied in any combination of country and product category other than those included in this dissertation, data for this level will come from:

- a literature review of best practices in logistics in the product category studied;
- suggestions by the person carrying out the assessment, based on the preceding product-category-specific analysis of logistics requirements and country-specific gaps;[296]
- if the product category chosen is one of the three already explored in the three framework applications in this dissertation, the measures from that application can serve as an inspiration for measures for other countries, provided there is overlap in the gap analysis.

[296] The person carrying out the application of the decision framework is advised to have knowledge of logistics at the country level, country-specific knowledge, and knowledge of the logistics requirements of the product category studied.

4.3.4 Guide to the decision framework

This section describes the steps necessary to apply the decision framework. The assumptions are threefold. First, policymakers in a certain country intend to improve the logistics environment for a given product category with the aim of increasing exports of that product category. Second, the product category was chosen based on (1) stated goals in the country's National Development Plan or similar strategy document, (2) suitability of the product category for higher-value exports (i.e., demand in world markets and higher earnings potential for products in the product category than for other goods currently exported by the country, if any), and (3) feasibility of increasing or setting up production/manufacturing of products from the chosen product category in the country, for example, in terms of geographical features, access to trade lanes, availability of workforce, and land reserves. The third assumption is that at least one expert with expertise in logistics and conducting semi-structured interviews is available to support the application of the framework. The rest of this section assumes that the product category chosen is one of the three for which the decision framework was developed in this dissertation. For other product categories, an application of the decision framework is possible but would first necessitate the development of all levels (rather than just 5 and 6) by a logistics expert in the chosen product category. The framework is applied as below.

Step 1: The user familiarizes him/herself with the entries under level 1 (target set-up), level 2 (logistics concepts), level 3 (trends), and level 4 (logistics requirements). These can be used without adaptation, or, if major technological developments have occurred in the sector since the framework was developed, can be used after an update. Level 5 (gap analysis) and level 6 (logistics measures) are country-specific and must be carried out anew for each country. Entries under levels 5 and 6 for the existing applications (high-tech manufacturing for Vietnam, automotive products for Morocco, and perishable agricultural goods for Kyrgyzstan) and the guidelines from section 8.1.6 may be used as inspiration, yet for

a robust set of country-specific recommendations, the gap analysis and formulation of measures must be carried out in full.

Step 2: Review statistical information on the logistics environment of the country, as relevant to the chosen product category. For this, the user needs to review statistical yearbooks, publications by providers of logistics infrastructure and services, and reports by reputable organizations on aspects of the country's logistics environment. The goal is to find as much information as possible relevant to gauging whether the logistics environment in the country meets the requirements of the chosen product category as laid out in level 4 (logistics requirements). The user then compares this information with the logistics requirements to come up with a first draft of the gap analysis. The review of statistical information will likely leave several fields in the gap analysis empty. The user should strive to fill them during the interview stage by choosing interview partners knowledgeable in the logistics of the chosen product category.

Step 3: Conduct semi-structured interviews. The user sets up a series of semi-structured interviews to complete the gap analysis level (see Appendix 10.2 for a guide to the semi-structured interviews). Exact country-specific gaps in the logistics environment are vital for the formulation of targeted measures. These are usually not covered by public databases and will have to be ascertained during the interview stage, especially as they relate to bottlenecks that exporters experience. During the interviews, information on deficiencies in hard infrastructure is usually the category easiest to come by. Categories other than trade- and transport-related infrastructure (e.g., availability of skilled labor force, regulatory gaps) should be covered as well, possibly by using prompts and follow-up questions. The number of interviewees should be sufficient to represent the main stakeholder groups of logistics in the chosen product category, and interviews should be conducted with representatives of:

- the public sector (policymakers responsible for transport and logistics);
- industry associations (covering logistics and the chosen product category);
- the private sector: domestic and international LSPs as well as producers in the chosen product category, possibly represented by professional associations;
- education institutions, i.e., providers of vocational training, higher education, and training for established professionals.

If the country is polycentric, interviews should be conducted in the main industrial centers. The format of semi-structured interviews enables the user to draw out the main information needed for completing the gap analysis while allowing for modifications based on the expertise and available time of the interviewee. As for the questions to be asked, the questionnaire should at least include questions on shortcomings in logistics that the interviewee is aware of in the country that have ramifications for the chosen product category, and the top 3 logistics reforms the interviewee would like to see happening in the country to improve logistics, with application to the chosen product category.

Step 4: Identify gaps (level 5): The results of the interviews are used to determine whether the logistics requirements defined in level 4 are met for the country and product category in question, and to highlight any gaps.

Step 5: Formulate suggested measures (level 6): Based on the gap analysis, formulate policy recommendations for logistics measures to optimize the logistics environment for the chosen product category. Good practice for ascertaining the usefulness of the suggested measures is to share them with the stakeholders from the interview round and ask for their feedback on whether the suggested measures would relieve the shortcomings mentioned by them, and whether the measures could be expected to increase exports of the product category in question.

4.4 Representativeness and choice of countries and product categories in the framework applications

4.4.1 Representativeness and limits of the decision framework

The overall structure of the framework (i.e., the formulation of target set-up, logistics concepts, trends, logistics requirements, gap analysis, and suggested measures) can be applied to various product categories and countries. This dissertation includes applications of the decision framework to three product categories and to three countries: Section 5.4 covers high-tech products, with application to Vietnam; section 6.4 covers automotive products, with application to Morocco; and section 7.4 covers perishable agricultural products, with application to Kyrgyzstan.

Levels 1 to 4 of the framework (target set-up, logistics concepts, trends, and logistics requirements) are product-category-, not country-specific, and are applicable across countries. In the three framework applications, these levels have been completed for the three product categories named above. Levels 5 and 6 (gap analysis and suggested measures) are product-category- and country-specific and must be completed for each country. In the three framework applications, levels 5 and 6 have been completed for Vietnam, Morocco, and Kyrgyzstan, for one of the product categories each.

The results from levels 5 and 6 of the framework applications may serve as a starting point for policymakers in other countries trying to identify needed reforms, but for a full and targeted set of measures a country-specific gap analysis is needed first. As an illustration, a country wishing to improve its logistics performance to facilitate exports in the high-tech sector could use levels 1 to 4 of the framework application for high-tech manufacturing. Levels 5 and 6 would have to be carried out separately, as the current application focuses on Vietnam. As additional guidance to policymakers in countries other than the ones explored in the case studies, section 8.1.6 includes three sets of measures and meta-measures that national governments can take to improve the logistics environment for high-tech manufacturing, automotive, and perishable agricultural goods.

Due to its focus on exports, the framework emphasizes the logistics performance of gateways (e.g., ports, airports, and land border crossings). It is thus not well-suited to supply chains that take place entirely within a country.

There are two caveats for the decision framework. First, although designed to capture all major aspects of the logistics environment of the three product categories that governments can influence, the framework does not include all conceivable measures that a government can take to foster logistics and will benefit from periodic updates as logistics and production technologies evolve. A decision framework in an area as dynamic as logistics cannot be 100 % comprehensive. One way to remedy this is to continually screen new technologies and trends in the logistics sector for applicability to the three product categories, and design new measures accordingly. This task could be fulfilled by national logistics observatories, that is, public entities whose responsibilities include collecting logistics-related data at the national scale, gathering examples of good practices from other countries, and assembling inventories of potential policy instruments. Artificial Intelligence (AI), for instance, will likely impact logistics operations, and its potential is reflected in a few of the suggested measures. The same screening process should be adopted for production and other innovations in each product category.

Second, owing to the complexity of policymaking for logistics at the country level, with several actors and policy areas involved, the decision framework is not an automatic model; that is, it does not mechanically produce results upon data insertion. It is a guided model, meaning that some expert knowledge of logistics is needed to carry out the gap analysis in each country. For the three selected product categories, the first four levels of the decision framework, that is, target set-up, logistics concepts, trends, and logistics requirements, are automated. The gap analysis (level 5) is not automated, but rather carried out using semi-structured interviews with logistics stakeholders as well as statistical information and public reports on the country's logistics environment

(section 4.3.4). Similarly, level 6 (suggested measures) of the framework is not automated as the recommendations rely on the outcome of level 5. To obtain the most relevant country- and product-category-specific results, a user should be familiar with logistics and with conducting semi-structured interviews. For users without this knowledge, for example, policymakers with broad portfolios and little expert knowledge, the section on general measures by product category (section 8.1.6) provides an overview of the areas that should be considered when trying to improve the logistics environment for a particular product category.

4.4.2 Reasoning for choice of countries in the framework applications

The main entities of investigation in this dissertation are countries rather than individual firms, geographic regions, or other units. The framework is designed to be applied in middle-income countries but could be applied in any country, regardless of income level, as the requirements of a specific logistics environment do not depend on the income level of the country in which they are based. Nevertheless, for low-income countries, the logistics requirements laid out in the framework will likely be too high, and for high-income countries they might be too low. High-income countries have usually surpassed the development stage of middle-income countries, which tends to be mirrored in their logistics performance and in their level of industrial diversification. Conversely, the logistics environments of low-income countries often warrant more basic interventions than those in middle-income economies. Middle-income countries were chosen as a focus for this dissertation based on a combination of potential and need: they tend to have the (albeit limited) financial potential to carry out reforms of their logistics environments and, at the same time, tend to have a need to improve their logistics performance to realize higher exports.

The categorization of countries into three groups (high-, middle-, and low-income) by national income is coarse-grained, yet there is some evidence in the trade- and logistics-related literature that focusing on

logistics in middle-income countries is worthwhile to foster exports originating in those countries. First, there is evidence that improvements in transport and logistics infrastructure in middle-income countries are linked to export performance. Improvements in transport infrastructure enhance trade, and this effect is more pronounced for middle-income than for high- or low-income countries.[297] High-income countries may already have carried out the improvements with the highest benefits; in low-income countries, gains from improvements in transport infrastructure may be impeded by problems that are more trade-inhibiting than poor infrastructure, e.g., lack of security, political stability, or legal certainty.[298] Second, adequate logistics partly determines the costs of sourcing from and supplying to global markets: inland transport to the export gateway is one of the largest constraints for exports of firms in middle-income countries, with higher obstacles to smaller and younger firms.[299]

Middle-income countries are not a homogenous group. With 107 countries classified as middle-income by the World Bank as of 2020, a selection of countries was necessary so that the application of the decision framework could be illustrated in an actual country.[300] Vietnam, Morocco, and Kyrgyzstan were chosen to be representative in as many ways as possible of the following variables: world region, geography (coastal vs. landlocked), population size, and economic size (see Table 4-3). Moreover, logistics must have featured at least somewhat prominently in national policymaking for the period 2010–2020.

[297] Korinek and Sourdin 2011, 18
[298] Korinek and Sourdin 2011, 18
[299] Taglioni and Winkler 2016, 12
[300] See Appendix 10.1 for a list of middle-income countries. Source: https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups, accessed on May 21, 2020

Table 4-3: Geographic and economic characteristics of countries selected for the decision framework application[301]

	Country		
Dimension	**Morocco**	**Kyrgyzstan**	**Vietnam**
World region	Middle East and North Africa	Europe and Central Asia	East Asia-Pacific
Geography	Coastal	Landlocked	Coastal
Population size (2020)	37.0 million	6.6 million	97.1 million
Size of the economy in 2018 (GDP, PPP, constant 2017 international $)[302]	272.2 billion	21.1 billion	589.7 billion
Logistics performance (2018 LPI score: maximum 5)[303]	2.54	2.55	3.27

Middle-income countries similar to Morocco regarding geography (in terms of coastal or landlocked position, not regarding world region), population size, economic size, and logistics performance include the Dominican Republic, Ecuador, and Sri Lanka.[304] Middle-income countries similar to Kyrgyzstan regarding geography, population size, economic size, and logistics performance include Armenia, Kosovo, Moldova, and North Macedonia.[305] Middle-income countries similar to Vietnam in terms of geography, population size, economic size, and logistics performance include Colombia and South Africa.[306] Morocco, Kyrgyzstan,

[301] Source: author, except where noted
[302] World Bank 2020
[303] https://lpi.worldbank.org/international/global (accessed on June 14, 2020)
[304] Selection criteria: Geography = coastal; population between 10 million and 40 million; LPI 2018 score between 2.19 and 2.89 (= +/-0.35 of Morocco's score); GDP (PPP, constant 2017 international $) between 136 billion and 407 billion (= +/-50 % of Morocco's 2018 GDP)
[305] Selection criteria: Geography = landlocked; population below 10 million; LPI 2018 score between 2.20 and 2.90 (= +/-0.35 of Kyrgyzstan's score (no 2018 LPI score available for Kosovo); GDP (PPP, constant 2011 international $) between 10.5 billion and 31.6 billion (= +/-50 % of Kyrgyzstan's 2018 GDP)
[306] Selection criteria: Geography = coastal; population above 40 million; LPI 2018 score between 2.92 and 3.62 (= +/-0.35 of Vietnam's score; GDP (PPP, constant 2011 international $) between 294.8 billion and 884.5 billion (= +/-50 % of Vietnam's 2018 GDP)

and Vietnam were chosen based on the prominence of logistics in national policymaking between 2010 and 2020 (see section 4.4.3 for details).

4.4.3 Reasoning for choice of product categories in the framework applications

4.4.3.1 Overview

To illustrate how the framework can be used at the product-category level, the framework is applied to a different product category for each country: high-tech manufacturing for Vietnam; automotive products for Morocco, that is, parts and components as well as finished automobiles; and perishable agricultural goods for Kyrgyzstan. The product categories were selected based on two characteristics:

1. stated goals in the selected countries' National Development Plans and/or National Logistics Strategy regarding which product categories to foster;
2. potential of the product category to support higher-value exports (in the sense of higher-value added exports rather than merely a higher export volume).

The following sections explain the selection of product categories in more detail.

4.4.3.2 High-tech manufacturing (Vietnam)

High-tech manufacturing was chosen as the product category on which to focus for Vietnam based on its suitability for higher-value exports and the government's focus on it. In Vietnam's "Strategy on exports and imports for 2011–2020, with visions to 2030," the Government of Vietnam names high-tech products along with building materials, petrochemicals, and rubber as products whose export should be promoted to support economic restructuring.[307] High-tech products are defined as technical products, the manufacturing of which involves a high intensity of research

[307] National Assembly of Vietnam 2011 [unpaginated], Section 5, Implementing the Strategy

and development.[308] Examples include electronics and other products, such as semiconductor devices, airplanes, and scientific instruments.[309] In this dissertation, "high-tech products" refers to certain Standard International Trade Classification (SITC) division subgroups from nine SITC divisions: aerospace; computers and office machines; electronics and communication; pharmaceuticals; scientific instruments; electrical machinery; chemicals; non-electrical machinery; and armaments.[310]

The export value of high-tech products in Vietnam in 2018 was US$82.6 billion, up from US$3 billion in 2008.[311] Total exports of goods and services in 2018 were US$259.5 billion.[312] As part of the Government of Vietnam's strategy, the share of high-tech exports in total exports will rise to 62.9 % in 2020.[313] In 2018, Vietnam reached a free trade agreement with the EU. With high-tech exports such as electronic products and telephone sets already among the main exports of Vietnam to the EU, high-tech exports are expected to rise even further under the trade liberalization scheme, as will those of footwear, textiles and apparel, coffee, rice, seafood and furniture.[314]

In their logistics needs, high-tech products are representative of other goods with a comparatively high value-to-volume ratio, ample competition (especially in East Asia, e.g., South Korea and China), and the need for multimodal facilities, especially to facilitate road-to-maritime and road-to-air transport. Although high-tech manufacturing can be a difficult sector to enter for middle-income countries looking for higher-value exports, a country like Vietnam, which has enjoyed high levels of gar-

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308 https://www.oecd.org/sti/ind/48350231.pdf, accessed on July 1, 2019.

309 A full list of product categories included under high-tech manufacturing in the SITC (Rev. 4) classification can be found here: https://ec.europa.eu/eurostat/cache/metadata/Annexes/htec_esms_an5.pdf (accessed on Nov. 14, 2018)

310 The full list of SITC codes (with full names of division subgroups) can be found here: https://unstats.un.org/unsd/publication/SeriesM/SeriesM_34rev4E.pdf (accessed on March 16, 2020)

311 World Bank 2020; values are reported in current US$

312 World Bank 2020; values are reported in current US$

313 National Assembly of Vietnam 2011 [unpaginated], Section 3, Export orientations

314 http://ec.europa.eu/trade/policy/countries-and-regions/countries/vietnam/, accessed on Nov. 16, 2018

ments exports for several decades, can use this experience and skills base to its advantage and focus on higher-quality materials to increase export value.

4.4.3.3 Automotive products (Morocco)

As laid out in its "National strategy for the development of logistics competitiveness," the government of Morocco wants to enhance the competitiveness of the automotive industry.[315] In this dissertation, "automotive products" refers to all products covered under SITC Division 78 (Rev. 4), i.e., finished road motor vehicles, but also parts and accessories of motor vehicles.[316] For this wider definition of automotive products, the export value in 2018 for Morocco was US$6.62 billion.[317] Automotive products thus made up 20.8 % of Moroccan exports of goods and services in 2018.[318]

In their logistics needs, automotive products are representative of manufactured items that rely on just-in-time or just-in-sequence production, with comparatively high complexity, a make-to-order philosophy (rather than make-to-stock), and transmission of responsibility for quality assurance shifted from manufacturer to supplier or to 3PLs. Other product categories with these features include metalworking and machinery.

4.4.3.4 Perishable agricultural goods (Kyrgyzstan)

Large-scale industrial production or manufacturing are not feasible in landlocked Kyrgyzstan owing to a shortage of accessible production locations and an inadequate workforce size. Agriculture is the sector that holds the highest potential for higher-value exports for the country.[319]

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315 Ministerère de l'Equipement et du Transport du Maroc 2010, 28

316 https://unstats.un.org/unsd/publication/SeriesM/SeriesM_34rev4E.pdf, pp. 147-149 (accessed on May 23, 2020)

317 UN Comtrade database, retrieved via wits.worldbank.org on May 23, 2020. Numbers refer to mirror data, i.e., imports reported by the rest of the world rather than exports reported by Morocco.

318 UN Comtrade data, retrieved via www.wits.worldbank.org on May 24, 2020. Export value in 2018 was US$31.8 billion. Exports refer to goods and services.

319 Asian Development Bank 2014b, xii

Kyrgyzstan's National Development Plan cites the agri-industrial sector as the first of three strategic industries to be fostered.[320] For this dissertation, perishable agricultural goods, in particular fruit and vegetables, were chosen to represent the agri-industrial sector based on their suitability for cultivation in several Kyrgyz regions, for example, the Ferghana Valley, Chuy province, and around lake Issyk-Kul. In this dissertation, "fruit and vegetables" refers to all products covered under SITC Division 05 (Rev. 4).[321] In 2018, Kyrgyzstan exported fruit and vegetables with a value of US$83.5 million, accounting for 3.6 % of the country's exports.[322] In their logistics needs, fruit and vegetables are representative of other perishable export goods that rely on a continuous cold chain, on the full traceability of inputs and final products, and on elaborate quality assurance mechanisms such as testing facilities. Other product categories with these features include meat and meat preparations, dairy products and birds' eggs, and fish and crustaceans.

4.4.4 Comparison of logistics characteristics of the three selected product categories

The three product categories selected differ in their logistics characteristics. Table 4-4, Table 4-5, and Table 4-6 compare the product categories regarding the physical, organizational, and informational set-up of their logistics environments. Several observations can be made to sum up these characteristics. The automotive supply chain is an example of a customer-specific supply chain with a high level of product variation.[323] Automotive products are almost always produced based on a specific order (pull-oriented production), rather than make-to-stock.[324] Automotive companies

[320] National Council for Sustainable Development of Kyrgyzstan 2018, 5. The other sectors mentioned as strategic are light industry and tourism.

[321] https://unstats.un.org/unsd/publication/SeriesM/SeriesM_34rev4E.pdf, 10-14 (accessed on May 23, 2020)

[322] UN Comtrade database, retrieved via wits.worldbank.org on May 23, 2020. Numbers refer to mirror data, i.e., imports reported by the rest of the world rather than exports reported by Kyrgyzstan. Total Kyrgyz exports of goods and services as reported by the rest of the world were US$2.33 billion in 2018.

[323] cf. Merschmann and Thonemann 2011, 45 for product variation

[324] cf. Ivanov et al. 2019, 153

(original equipment manufacturers) must contend with demand variations, limited flexibility in production and logistics, and with production processes that are often globally dispersed.[325] The industry is under high pressure to develop and incorporate new technologies, for instance, to achieve lower vehicle emissions, thus necessitating frequent changes to the production process and hence to the selection of parts and components.[326] Original equipment manufacturers can simplify production-related logistics processes by standardizing production processes and limiting the number of product variations.[327]

Table 4-4: Logistics characteristics of the product categories selected for the decision framework applications: Physical level[328]

	Automotive products	Perishable agricultural products	High-tech products
Degree of product variation[329]	High	Low	Medium
Specificity to customer	High	Very low	Medium
Product cycle length	Long	Short	Medium
Volume-to-weight ratio[330]	High	Medium	Medium
Value-to-weight ratio[331]	Medium	Low	High
Substitutability of product[332]	Medium	High	Medium
Product vulnerability[333]	Low	High	Low

[325] cf. Ivanov et al. 2019, 112
[326] cf. Ivanov et al. 2019, 112
[327] Ivanov et al. 2019, 112
[328] Sources for logistics characteristics as cited in the left-most column; categorization of data for the three product categories into ordinal scale by the author
[329] cf. Merschmann and Thonemann 2011, 45. Applications to the product categories by the author.
[330] cf. Rushton et al. 2017, 109-110. Applications to the product categories by the author.
[331] cf. Rushton et al. 2017, 110. Applications to the product categories by the author.
[332] cf. Rushton et al. 2017, 111. Applications to the product categories by the author.
[333] Assuming proper packaging

Unlike automotive products, agricultural products tend to be produced in anticipation of, rather than in reaction to, customer orders (push-oriented production).[334] Seasonality is pronounced, and suppliers are mostly local or regional. The number of intermediaries is low compared with other product categories, as is the degree of product variation, with some variation occurring regarding quality and type of crop cultivation (e.g., organic vs. non-organic). For agricultural supply chains (unlike for automotive and high-tech manufacturing), it is rare, at least in less developed countries, to have in place mechanisms beyond basic tracking that notify all systems that will be affected by a delay so that production schedules can be modified or alternative sources sought.[335]

Table 4-5: Logistics characteristics of the product categories selected for the decision framework applications: Organizational level[336]

	Automotive products	Perishable agricultural products	High-tech products
Push- or pull-type of supply chain[337]	Pull	Push	Pull
Responsiveness	High	Low	High
Seasonality	Low	High	Medium (except for holiday peaks)
Number of suppliers	High	Medium	Medium
Geographical distribution of suppliers	International	Majority local or regional	International
Length of distribution channel (no. of intermediaries)[338]	Medium	Low	High
Risk of counterfeiting	Medium	Low	High

[334] cf. Ivanov et al. 2019, 153
[335] cf. Simchi-Levi et al. 2000, 224
[336] Sources for logistics characteristics as cited in the left-most column; categorization of data for the three product categories into ordinal scale by the author
[337] Refers to whether production takes place in anticipation of or in reaction to customer orders, cf. Ivanov et al. 2019, 153. Applications to the product categories by the author.
[338] cf. Rushton et al. 2017, 64. Applications to the product categories by the author.

The supply chain for high-tech goods is mostly a pull-type.[339] The degree of product variation and customer specificity is lower than for automotive products but higher than for agricultural products. The high-tech manufacturing supply chain is responsive to changes in demand. Suppliers are located internationally and the degree of supply chain visibility is high, as is the incidence of electronic data interchange (EDI) between supply chain partners, so that changes in one partner's schedule can quickly be relayed to other partners.

Table 4-6: Logistics characteristics of the product categories selected for the decision framework applications: Informational level[340]

	Automotive products	Perishable agricultural products	High-tech products
Degree of supply chain visibility (type of tracking available)	Real-time	Typically not real-time	Close to real-time
Incidence of EDI between supply chain participants[341]	Very high	Low	High

National governments and private companies fulfill different roles in ensuring that the logistics environment functions well. As a rule of thumb, private sector actors are responsible for intra-company processes, whereas national governments provide the basic necessities and regulations that companies need to function. These government-provided goods, services, and rules (e.g., public infrastructure) often take the form of public goods. Table 4-7, Table 4-8, and Table 4-9 give an overview of the roles that policymakers and private sector actors adopt in each of the three selected product categories. Table entries are sorted into the

[339] Tseng et al. 2013, 91

[340] Sources for logistics characteristics as cited in the left-most column; categorization of data for the three product categories into ordinal scale by the author

[341] cf. Rushton et al. 2017, 108. Applications to the product categories by the author.

seven functional categories that the decision framework entails (infrastructure, ICT, customs, etc.). Entries are illustrative rather than exhaustive. Some entries overlap among the product categories.

Table 4-7: Comparison of the roles of national governments and private sector in automotive logistics (illustrative examples, non-exhaustive)[342]

	National governments	Private sector
Trade- and transport-related infrastructure	• Construction of public transport infrastructure (roads, rail, seaports, inland waterways, airports) • Provision of intermodal transport links, especially those serving the automotive supply chain	• Construction of privately owned logistics zones and warehousing • Purchase or lease of transport equipment (trucks etc.)
Information and communications technology	• Public infrastructure to enable ICT, e.g., high-speed internet • Availability of digital government services	• Introduction of specialized user software, e.g., SAP HANA (database management system) • Enabling of tracking & tracing • Set up of digital collaboration tools between all supply chain partners
Organization of the logistics environment ("ecosystem")	• Enabling of round table discussions involving all logistics stakeholders, including establishment of national logistics councils • Long and reliable opening hours of trade-enabling services, e.g., ports and airports	• Decision where to produce • Selection of suppliers and organization of supplier network • Organization of suppliers into those responsible for material, parts, components and modules

[342] Source: author, except where noted

	National governments	Private sector
Business practices for high-quality logistics services	• Enabling/fostering of desirable business practices via incentives, subsidies and regulations • Set conditions to keep logistics costs as low as possible	• Constant development and innovation in materials • Application of efficiency-enhancing production and logistics practices, e.g., just-in-time and lean production • Mitigation of supply chain volatility • Adoption of quality management systems
Customs practices	• Streamlined and predictable border clearance procedures • Adoption of risk management procedures and availability of EDI for customs[343]	• Compliance with customs regulations • Adapting to technical standards for EDI of national customs authorities
Regulatory environment	• Setting of regulatory standards (labor, environment, social) • Minimization of market distortions	• Design of supply chain practices according to regulatory standards (labor, environment, social)
Education, skills, and professional training	• Provision of structured training at the vocational and tertiary level • Certification of logistics skills and competencies	• Provision of structured training at the company level (on-the-job training) • Provision of internships • Dissemination of automotive-specific logistics knowledge

When considering automotive products, several main differences between the roles of national governments and the private sector become apparent (Table 4-7). The main tasks of the public sector lie in the capi-

[343] Risk management as used in the World Trade Organization's (2014, 8) Agreement on Trade Facilitation refers to concentrating "customs control and, to the extent possible other relevant border controls, on high-risk consignments and expedite the release of such low-risk consignments."

tal-intensive provision of trade- and transport-related infrastructure (e.g., ports and airports), in customs and border control, as well as in setting the regulatory environment for traders and logistics actors. In contrast, the main tasks of the private sector consist of shaping business practices such as innovation management, quality management, and dealing with supply chain volatility. In terms of customs and regulations, their main task is confined to complying with rules set by the government. Another difference between the public and private sectors lies in ICT: Whereas the government is responsible for basic infrastructure, all company-internal ICT processes are the responsibility of private firms, e.g., the introduction of specialized software.

Table 4-8: Comparison of the roles of national governments and private sector in logistics for perishable agricultural goods (illustrative examples, non-exhaustive)[344]

	National governments	Private sector
Trade- and transport-related infrastructure	• Construction of transport infrastructure (roads, rail, seaports, inland waterways, airports) • Provision of intermodal transport links, especially those serving the agricultural supply chain • Provision of clearance facilities close to regional production hubs to minimize spoilage	• Construction of privately owned logistics zones and warehousing, including temperature-controlled establishments • Purchase or lease of transport equipment (trucks etc.), including transport equipment to maintain cold chain

[344] Source: author

	National governments	Private sector
Information and communications technology	• Public infrastructure to enable ICT, e.g., high-speed internet • Availability of digital government services	• Introduction of specialized user software, e.g., SAP HANA (database management system) • Enabling of tracking and tracing • Use of technology to support an uninterrupted cold chain
Organization of the logistics environment ("ecosystem")	• Enabling of round-table discussions involving all logistics stakeholders, including establishment of national logistics councils • Long and reliable opening hours of trade-enabling services, e.g., ports and airports	• Decisions on where to produce • Organization of collaboration of supply chain partners, e.g., for sharing of distribution infrastructure and vehicles • Waste management
Business practices for high-quality logistics services	• Enabling/fostering of desirable business practices via incentives, subsidies, and regulations • Set conditions to keep logistics costs as low as possible	• Selection of suppliers and organization of supplier network • Mitigation of supply chain volatility • Adoption of quality management systems
Customs practices	• Streamlined and predictable border clearance procedures • Adoption of risk-management procedures and availability of EDI for customs	• Compliance with customs, SPS measures and food safety regulations • Adapting to technical standards for EDI of national customs authorities
Regulatory environment	• Setting of regulatory standards (labor, environment, social, food safety, animal health) • Minimization of market distortions	• Design of logistics practices according to regulatory standards (labor, environment, social) • Adherence to quality standards for freshness and pesticides

	National governments	Private sector
Education, skills, and professional training	• Provision of structured training at the vocational and tertiary levels • Certification of logistics skills and competencies	• Provision of structured training at the company level (on-the-job training) • Provision of internships • Dissemination of food logistics knowledge

In the perishable agricultural goods category, the role of government is less pronounced than that of the private sector in ensuring the chief objective of logistics: avoiding loss of product quality by maintaining the cold chain from source to shelf. Firms involved in the supply chain have to provide temperature-controlled vehicles and storage, whereas the role of government is confined to providing transport links and possibly offering clearance facilities close to major production centers to avoid long intra-country transport. The role of government is more prominent in education and skills building (the provision and certification of skills), in regulation (e.g., by setting food safety standards), and in offering streamlined customs procedures.

Table 4-9: Comparison of the roles of national governments and the private sector in logistics for high-tech manufacturing (illustrative examples, non-exhaustive)[345]

	National governments	Private sector
Trade- and transport-related infrastructure	• Construction of transport infrastructure (roads, rail, seaports, inland waterways, airports) • Provision of intermodal transport links, especially those serving the high-tech manufacturing supply chain, i.e., connection from road to air transport	• Construction of privately owned logistics zones and warehousing, including those directly serving export markets • Purchase or lease of transport equipment (trucks etc.)

[345] Source: author

	National governments	Private sector
Information and communications technology	• Public infrastructure to enable ICT, e.g., high-speed internet • Availability of digital government services	• Introduction of specialized user software, e.g., SAP HANA (database management system) • Enabling of tracking and tracing • Set-up of digital collaboration tools between all supply chain partners
Organization of the logistics environment ("ecosystem")	• Enabling of round table discussions involving all logistics stakeholders, including establishment of national logistics councils • Long and reliable opening hours of trade-enabling services, e.g., ports and airports	• Decision on where to produce • Research and development into new production and logistics technologies
Business practices for high-quality logistics services	• Enabling/fostering of desirable business practices via incentives, subsidies and regulations • Set conditions to keep logistics costs as low as possible	• Selection of suppliers and organization of supplier network • Application of efficiency-enhancing production and logistics practice, e.g., just-in-time and lean production • Mitigation of supply chain volatility • Adoption of quality management systems
Customs practices	• Streamlined and predictable border clearance procedures • Adoption of risk management procedures and availability of EDI for customs	• Compliance with customs regulations • Adapting to technical standards for EDI of national customs authorities

	National governments	Private sector
Regulatory environment	• Setting of regulatory standards (labor, environment, social) • Minimization of market distortions	• Design of supply chain practices according to regulatory standards (labor, environment, social)
Education, skills, and professional training	• Provision of structured training at the vocational and tertiary levels • Certification of logistics skills and competencies	• Provision of structured training at the company level (on-the-job training) • Provision of internships • Dissemination of logistics knowledge adapted to high-tech manufacturing logistics

For logistics for high-tech manufacturing, the division of roles between the public and private sectors is similar to that for automotive goods. Private firms provide the majority of the effort for maintaining a flexible, reliable, and cost-effective supply chain via business practices such as a careful organization of their supplier networks and quality management. In contrast, one of the main tasks of the public sector in this product category is to ensure swift customs clearance processes and the availability of sufficient trade-related infrastructure at all export gateways so that time-sensitive high-tech products can be exported and production inputs received without delay.

For a well-functioning logistics chain in any product category, it is imperative that both the public and private sectors fulfill their roles and that they work hand in hand. The decision framework presented in this dissertation, while focusing on the role of government, takes into account the role of the private sector in that the logistics requirements in level 4 were formulated partly using the input of private sector actors in the respective sector, and partly based on a literature review of logistics requirements in each product category.

4.5 Trends with potential implications for logistics in middle-income countries

4.5.1 Overview of trends

Product-category-specific trends are included in the decision framework application for each product category. This section covers non-product-category-specific trends with potential effects on logistics in middle-income countries. These include:

- **Cost pressure:** Logistics costs are an integral part of companies' costs. Increasing pressure to decrease logistics costs may drive more companies to source a growing share of their parts in emerging economies, many of which are middle-income countries, e.g., Brazil, China, India, Indonesia, Morocco, South Africa, and Vietnam.[346] National governments can play a role in lowering logistics costs, e.g., by increasing the reliability of logistics infrastructure and services.

- **Advanced process automation, information, and virtualization:** This entails increased use of technologies for automating logistics processes using machine learning,[347] increased use of robotics, widespread adoption of mobile internet applications via smartphones (portable devices),[348] increased use of big data analysis tools to increase planning and control outcomes,[349] and adoption of blockchain and cloud-based platforms to increase supply chain visibility.[350]

- **Networked economy:** Rather than acting as independent market players or only interfacing with direct suppliers and customers, companies must collaborate with numerous vertical and horizontal part-

[346] Handfield et al. 2013, 14
[347] Straube (Ed.) 2019, 38
[348] Vorst and Snels 2014, 4
[349] Handfield et al. 2013, 9
[350] cf. Lehmacher 2017, 24

ners in their supply chain.[351] This is facilitated by improved data exchange between logistics partners.[352] The shift towards a networked structure with close ties among all supply chain actors has so far been less pronounced in middle-income countries than in high-income ones, and there is a need to catch up.

- **Skills shortage:** A talent shortfall affects firms in developed economies with shrinking working-age populations, but shortfalls are also seen in low- and middle-income countries, especially at the higher levels of the logistics workforce, e.g., supply main managers and logistics supervisors.[353]

Reform measures to cope with these trends are included in the framework applications.

4.5.2 Environmental sustainability in logistics

The decision framework includes suggested measures for one trend only, namely environmental sustainability, as this lends itself to government action (see 5.4.6, 6.4.6, and 7.4.6). This does not hold for the product-category-specific trends named in sections 5.4.3, 6.4.3, and 7.4.3, for example, rising share of global sourcing; these refer to business practices and are thus either not, or only indirectly, tied to government action.

Environmental sustainability, that is, preserving the environment for future generations, is a megatrend affecting all industrial activity including logistics. Seuring and Müller (2009) define sustainable supply chain management as the "management of material, information and capital flows as well as cooperation among companies along the supply chain while taking goals from all three dimensions of sustainable develop-

[351] Handfield et al. 2013, 14. According to Kern and Wolff (2019, 4), big data analytics refers to "datasets characterized by large volume, velocity, variety and veracity as well as data analytics (also known as business intelligence)".
[352] cf. Straube (Ed.) 2019, 40
[353] McKinnon et al. 2017, 16

ment, i.e., economic, environmental and social, into account which are derived from customer and stakeholder requirements."[354] Logistics-related activities that affect the environment include greenhouse gas emissions from vehicles and business processes in the supply chain, fuel consumption, vehicle noise, waste, storage of intermediate and final products, and production technologies that may be less environmentally friendly.[355]

Both the demand and the requirements for environmental sustainability of logistics operations can be expected to rise in the future. It is especially important when viewing the logistics environment at a national scale, as governments—more so than individual companies—consider non-economic trade-offs such as environmental costs.[356] Sustainability is also a rising concern for private companies sourcing their parts and components globally, both through internal motivation and peer pressure from stakeholders and customers. According to Straube et al. (2011), there are four reasons for this: (1) to make more efficient use of resources, i.e., energy and materials; (2) to support enhanced cooperation with suppliers in emerging markets; (3) to reduce costs; and (4) to avoid loss of reputation and competitiveness.[357]

Vulnerable ecosystems are subject to pressures such as pollution, erosion, and depletion of natural resources that will influence the areas considered suitable for industrial and food production and force some economic actors, including logistics providers, to shift their operations geographically.[358] Climate change may also increase the price volatility of raw materials.[359] Reducing the environmental impact of logistics operations has ramifications for greenhouse gas emissions, energy use, water

[354] Seuring and Müller 2009, 1700. "Sustainability" typically covers the three areas environmental, economic and social sustainability (Seuring and Müller 2009, 1700). This work will focus on environmental sustainability.
[355] Tsolakis et al. 2015, 12
[356] Banomyong et al. 2015, 24
[357] Straube et al. 2011, 26
[358] cf. Vorst and Snels 2014, 4
[359] Vorst and Snels 2014, 5

use, air pollution, and deforestation. To combat climate change, some governments may choose to adopt more stringent environmental requirements. This will impact on logistics operators. McKinnon (2015b) provides a categorization of policy instruments that governments may use to increase the environmental sustainability of logistics:

1. taxation, e.g., of fuel;
2. financial incentives, e.g., to use more sustainable freight modes;
3. regulation, e.g., of vehicle design or rates charged by LSPs;
4. liberalization of freight markets to increase environmental sustainability, e.g., to promote rail freight;
5. management of nationalized companies;
6. infrastructure and land-use planning;
7. advice and exhortation, e.g., to promote environmental practices in companies.[360]

The measures suggested in the decision framework applications include applications of several of the categories proposed by McKinnon (2015b).[361]

Rather than addressing environmental sustainability at each step of a supply chain, Mintcheva (2005) underlines that a holistic approach is needed to address environmental sustainability in logistics.[362] Her study focuses on the food supply chain and uses the integrated product policy (IPP) approach, which tries to reduce the environmental impact of products and services over their life cycles.[363] The IPP framework includes five classes of policy instruments: information, voluntarism, self-regulation, economic instruments, and command and control.[364] Three of those (economic instruments, command and control, and information) can be used for government interventions to make logistics more envi-

[360] McKinnon 2015b, 378
[361] McKinnon 2915b, 378
[362] Mintcheva 2005, 718
[363] Mintcheva 2005, 721
[364] Mintcheva 2005, 722

ronmentally sustainable, including in product categories other than food. Economic instruments include taxes and charges, subsidies, tradable permits, funds and soft loans, as well as research and development, whereas command and control includes bans, phase-outs, standards, and mandatory take-backs.[365] Government interventions related to information could include public databases on companies' environmental features (e.g., pollution levels) that can guide firms and consumers in their selection of suppliers. Economic instruments and command-and-control measures to address sustainability in logistics operations are included throughout the categories of measures in the framework applications.

4.6 Technologies with potential implications for logistics in middle-income countries

4.6.1 Overview

Where relevant, the logistics requirements and measures suggested by the decision framework incorporate novel digital SCM techniques that can enhance the efficiency of logistics operations, e.g., 3D printing or predictive analytics. These techniques are part of the process termed Industry 4.0. Although there is no set definition for Industry 4.0, the characterization by Ivanov et al. (2019) is helpful:

> The main idea is that in the future companies will intensively utilize and connect machines, materials, tools, warehouses, transportation technology etc. in an intelligent way. […] Materials, machines or devices can exchange information mutually, set priorities, trigger action and help to schedule and sequence the work in process.[366]

Digitalization and greater use of IT and information management may play an important role in developing sound logistics systems especially in poorer countries, as these technologies potentially enable countries to "leapfrog," i.e., skip stages of technological development that other countries had to go through sequentially. Examples of this include the

[365] Mintcheva 2005, 722
[366] Ivanov et al. 2019, 488

introduction of smartphones and tablets to bypass landline phone infrastructure, desktop PCs and laptops, or providing internet access without the need for cable infrastructure through providing wireless internet access via, for example, balloons. Figure 4-2 includes technologies with potential applications in logistics.

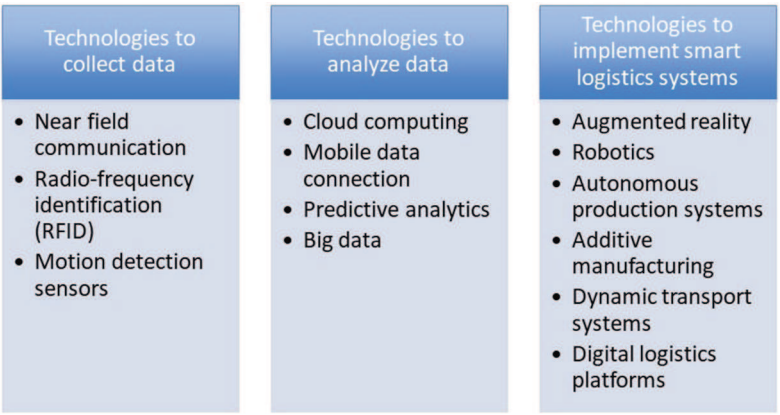

Figure 4-2: Technologies with potential implications for logistics[367]

All of these technologies enable firms to collect and analyze data for better decision making. They permit longer and more complex supply chains as goods and information flows are increasingly decoupled.[368]

Picking technologies and supporting their adaption by the business community is not a core task of governments. Despite their relevance to logistics, this dissertation will thus not explore the technologies and technology-enabled business models identified above. However, one technology-enabled business model that is relevant for the framework applications in chapters 5, 6, and 7 and, potentially, for other middle-

[367] Based on unpublished material on technologies supporting smart logistics systems by the Chair of Logistics at TU Berlin, Prof. Dr. Frank Straube, Dr. Stefan Doch, Dr. Daniel Roy (2015)
[368] Vorst and Snels 2014, 5

income countries concerns digital logistics platforms, which will be explored in the next section. Such platforms can prove especially useful in countries with limited cooperation of logistics partners, a shortage of specialized equipment due to low volumes and lack of access to credit, or an underdeveloped tracking and tracing system—all of which apply to the case study countries.

4.6.2 Digital logistics platforms

Digital platforms link people, data, objects, services and processes into an intelligent ecosystem.[369] There are three types of digital platforms. Transaction platforms merge supply and demand by offering information and search functions; data-centric or innovation platforms offer data analysis and certification of components; and integrated platforms combine characteristics of transaction and data-centric platforms.[370] With few exceptions, platforms for logistics fall into the transaction platform category. A typical transaction platform would be a freight exchange (freight platform), which denotes an online or application-supported system where companies can offer or search for excess freight space. Freight platforms can also include other matching services (e.g., for warehousing space) and offer value added services, for example, payment services, credibility checks, insurance, and tracking.[371] They allow companies to bundle shipments and avoid empty trips.[372] Freight exchanges enable LSPs to find return cargos and shippers at the best price and with the most efficient allocation for the LSPs' transport needs. One of their advantages from the viewpoint of the demand side of freight services is their potential to heighten price transparency between providers and thus potentially lower costs.[373]

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[369] Based on unpublished material by ITCL GmbH - International Transfer Center for Logistics (2018)
[370] Based on unpublished material by ITCL GmbH - International Transfer Center for Logistics (2018)
[371] World Bank Group et al. 2018, 18
[372] Arnold et al. 2008, 594
[373] cf. Straube (Ed.) 2019, 37

Logistics platforms in which public sector intervention is warranted include two types. First, freight exchanges.[374] The second type refers to port operations platforms, also called port community systems, for instance, PortNet in Morocco. These types of platforms are characterized by a comparatively asset-heavy structure, with large infrastructure owned by the public sector. Asset-light applications typically do not lend themselves to platforms operated by governments. A further application of digital logistics platforms includes information sharing.[375] For agricultural logistics, platforms can be used to reduce wastage by offering real-time tracking technology whereby producers, carriers, warehouse operators and retail managers can check the location of shipments.[376]

Benefits of setting up logistics platforms include:

- transparency of prices and service offerings for both the demand and supply side, e.g., via freight exchange platforms;[377]
- higher capacity utilization for private infrastructure (e.g., trucks) and thus more efficient logistics processes at the firm level;
- information exchange about market demand (e.g., on platforms) with other parties involved in the logistics environment, which can decrease the "bullwhip effect" (excessive inventory buildup and stockouts due to small variations in demand) caused by inadequate coordination among supply chains actors;[378]
- increased pace of order processing;[379]

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374 World Bank Group et al. 2018, 18

375 Cedillo-Campos and Cedillo-Campos 2018, 3

376 Vorst and Snels (2014, 8) note: "It is estimated that in developed markets about 40 % of food is wasted, predominantly at the consumer end in the supply chain. […] Low-income countries show relatively large food losses in the early stages of the chain, with decreasing wastage levels in consecutive stages. […] handling and storage after harvest show the biggest food losses. As a result, improving the food supply chain in developing countries /LIC [low-income countries (author)] has to focus on improvement of farm practices and post-harvest logistics."

377 World Bank Group et al. 2018, 11

378 Vorst et al. 2007, 11

379 cf. Straube (Ed.) 2019, 37

- lower environmental burden through the reduction of empty runs;[380]
- potentially higher market participation of SMEs as freight sharing enables higher capacity utilization and removes the need to purchase equipment, thus removing barriers to entry.[381]

Logistics platforms sponsored by governments include the following additional benefits:

- higher capacity utilization for public infrastructure through better usage coordination;
- lower transaction costs for use of public infrastructure and services via one-stop shops for all fees;
- transparency on rules and regulations, e.g., customs procedures;
- reduced opportunities and motivation for informal payments.

Freight platforms could enhance the efficiency of logistics services in all three countries examined in the applications of the decision framework, as could port operations platforms for the coastal countries Vietnam and Morocco. In Morocco, the PortNet platform has been instituted but could be extended regarding service offerings. No digital logistics platform was identified in Kyrgyzstan. In Vietnam, a platform called LOGIVAN was founded in 2017 that offers automatic matching of shippers and providers of road transport via trucks.[382] As of 2019, there was an online freight exchange in Vietnam called VTRUCK, which focuses mostly on logistics activities in Vietnam rather than international logistics, and is not yet operating profitably.[383] Suggestions for applications of digital logistics platforms are included throughout the framework applications, particularly in the business practices, regulatory environment, and organization of the logistics environment categories.

[380] Arnold et al. 2008, 594
[381] Arnold et al. 2008, 594
[382] Interview with Vietnamese logistics expert, Feb. 2019
[383] Interview with Vietnamese LSP, Hanoi (2), July 2019

4.7 Logistics requirements applicable to all three product categories examined

The next three chapters include case studies in which the decision framework is applied. The case studies deal with three product categories: high-tech manufacturing, automotive, and perishable agricultural goods. Level 4 of the decision framework (sections 5.4.4, 6.4.4, and 7.4.4) contains the requirements that the logistics environment of a country needs to fulfill so that exports in a given product category can be supported. Some requirements identified during the literature review and the interview phase of the case studies were identical across all product categories.[384] These cross-cutting requirements are described below.

Healthy competition should prevail on all transport modes and in logistics services, including competitive freight handling, trucking, shipping and warehousing services.[385] This contributes to lower prices and higher reliability than under imperfect competition. To avoid collusive behavior, there should be no restrictions to entry and no obligatory association membership for logistics professionals. Digital government services for import and export ensure swift trading processes.

Electronic data interchange for customs helps to eliminate the need for duplicate data entry, increase transaction speed, and reduce cost and error rates.[386] Streamlined and predictable border clearance procedures serve the same goals. The adoption of risk-management procedures enables customs authorities to concentrate control efforts on high-risk shipments.[387] Risk management, as used in the World Trade Organization's (2014) "Agreement on Trade Facilitation," refers to concentrating "customs control and, to the extent possible other relevant border con-

[384] The cross-cutting requirements applicable to all product categories are included in appendices 10.5.4, 10.6.4, and 10.7.4, so that these appendices include a full list of requirements, both cross-cutting and product category-specific.
[385] cf. World Bank 2012, 14
[386] cf. Rushton et al. 2017, 751. EDI is defined by Rushton et al. (2017, 750) as "computer-to-computer exchange of structured data for automatic processing"
[387] cf. World Trade Organization 2014, 8

trols, on high-risk consignments and expedite the release of such low-risk consignments."[388]

Tracking and tracing should be available to support supply chain visibility, ideally incorporating modern supply chain visibility applications based on AI or machine learning.[389] Tracking and tracing is provided by the private sector, so the role of the public sector is limited, but it should not be impeded by the government by law or because of insufficient ICT infrastructure. Supply chain metrics and performance measurements should be used to continually improve processes. Distribution and consolidation centers (logistics zones) that can directly serve export markets should be available. As for education and logistics skills development, structured training (e.g., vocational training) should be combined with on-the-job training.

Lastly, there should be coping strategies in place to deal with supply chain disruptions. Stecke and Kumar (2009) classify supply chain disruptions into four categories: natural (e.g., pandemics, earthquakes, or blizzards), accidental (e.g., airplane crashes or train derailments), terrorist (e.g., bombings or gas attacks), and non-terrorist disruptions (e.g., strikes or economic downturns).[390] With an increasing focus on supply chain efficiency, greater supply chain vulnerability in the face of such disruptions has been an unintended consequence, for example, because outsourcing to remote suppliers increases the time needed to reach core markets and renders a supply chain more vulnerable to transportation mishaps.[391] Fulfilling these cross-cutting requirements could also improve the logistics environment for other product categories, though this was not investigated as only three product categories were explored in depth.

[388] World Trade Organization 2014, 8
[389] cf. Poschmann et al. 2019, 162
[390] Stecke and Kumar 2009, 206
[391] cf. Stecke and Kumar 2009, 195 and 204

5 CASE STUDY 1: VIETNAM

5.1 Rationale for selecting Vietnam as a case study

As a large, populous, and growing country, Vietnam is an example of a nation whose importance in international trade is growing. With merchandise trade making up 196 % of the country's GDP in 2018, Vietnam is an extremely open country when it comes to trade, surpassed only by Singapore (215.2 %) and Hong Kong Special Administrative Region (329.5 %), both of them city states.[392] At the same time, Vietnam's GDP per capita, US$2,360, means the country is classified as a lower-middle-income country, with large catch-up potential for development, trade, and logistics.[393] A further reason for choosing Vietnam for a case study is that logistics has featured prominently in policymaking over the past decade, with a National Logistics Action Plan adopted in 2016.[394] The decision framework application in this case study focuses on high-tech manufacturing, a sector that has seen rising importance as the country tries to move up in global value chains from less sophisticated industries such as garments.

5.2 Country profile

Vietnam is a comparatively large country in Southeast Asia, with a long coastline of 3,200 km and access to the South China Sea and the Indian and Pacific oceans. As of 2020, Vietnam had a population of 97.1 million. The largest city is Ho Chi Minh City; others with a population of more than 1 million include Hanoi (the capital), Hai Phong, Can Tho, and Da Nang. In 2018, GNI in Vietnam was US$225.9 billion.[395] This gives a per capita GNI of US$2,360.[396] Overall annual GNI growth

[392] World Bank 2020
[393] World Bank 2020, GNI per capita, Atlas method, measured in current US$
[394] Ministry of Industry and Trade of the Socialist Republic of Vietnam and World Bank 2016
[395] World Bank 2020; calculated using Atlas method (current US$)
[396] World Bank 2020; Atlas method, current US$

between 2014 and 2018 averaged 5.9 % per year.[397] The annual growth rate of value-added services (including logistics services) was 6.8 % between 2014 and 2018.[398]

Vietnam's economic structure is polycentric with an emphasis on the southern region around Ho Chi Minh City and another center in the north around Hanoi. The country benefits from low labor costs and from international manufacturers looking for production opportunities in Southeast Asia outside of China. Among the companies that have contributed to Vietnam's export boom in the past years are Foxconn, Samsung, and General Electric. Vietnam is a net exporter, though with an almost even balance between exports and imports. In 2018, the country exported goods valued at US$24.37 trillion.[399] Its imports of goods amounted to US$22.71 trillion.[400] As of 2018, telephones were Vietnam's main export product, followed by electronic integrated circuits (see Figure 5-1).

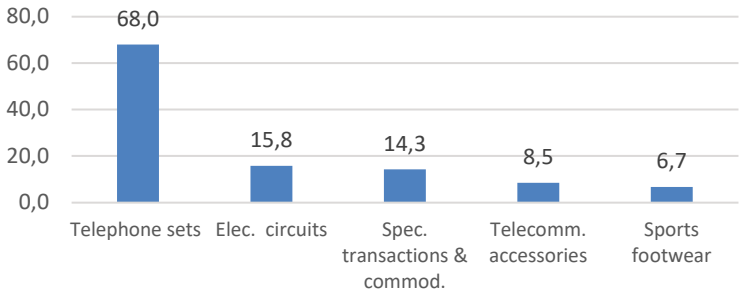

Figure 5-1: Vietnam's Top 5 Export Products (in US$billion), 2018[401]

[397] World Bank 2020
[398] World Bank 2020
[399] World Bank 2020; Measured in current US$ from Balance of Payments. Excludes services exports.
[400] World Bank 2020; Measured in current US$ from Balance of Payments. Excludes services imports.
[401] Products classified at 4-digit SITC (Rev. 4) code. Source: UN Comtrade data, retrieved via www.wits.worldbank.org on May 24, 2020. The products refer to SITC codes 7641, 7764, 9310, 7649, and 8512 (in descending order).

The majority of intra-country transport (77 % based on ton-km) in Vietnam happens by road.[402] In contrast, most (at least 90 %) import–export trade happens by sea, with only 10 % of goods transported by road to neighboring countries such as China, Cambodia, and Laos.[403] Vietnam has 44 seaports with a capacity of 500 million tons per year.[404] The freight volume (throughput) handled in Vietnamese seaports in 2016 was 495.8 million tons, an increase of 8 % over 2015.[405] In addition to the deepwater ports of Da Nang, Cai Mep, and Cai Lan, Vietnam has several non-deepwater ports, including Hai Phong (close to Hanoi), Vung Ang (in mid-Vietnam), and Cat Lai. These ports are serviced by feeder vessels through container transloading in Singapore or Hong Kong. The port of Cat Lai serves the manufacturing area around Ho Chi Minh City and handles container traffic that is then transloaded, mostly in Singapore or Hong Kong. A new deepwater port, Hai Phong International Gateway Port, has been in operation since 2018.[406] This port is the first to offer direct maritime connections to North America, with two sailings per week to Long Beach (USA) and Canada.[407]

Little freight is transported on Vietnam's railways: in 2018, the share of rail was about 1 % of all freight.[408] As for air freight, four of the 21 airports have separate cargo terminals.[409] The two airports that handle most of the country's air cargo are Noi Bai in Hanoi and Tan Son Nhat in Ho Chi Minh City.[410] In 2017, the volume of air freight stood at 1.13 million

402 World Bank Group et al. 2018, 1
403 Pham et al. 2013a, 41
404 Ministry of Industry and Trade of the Socialist Republic of Vietnam 2017, 45
405 Ministry of Industry and Trade of the Socialist Republic of Vietnam 2017, 46
406 Interview with Hanoi (Vietnam) branch of multinational LSP, Nov. 28, 2019
407 Interview with Hanoi (Vietnam) branch of multinational LSP, Nov. 28, 2019. The information on the frequency of direct connections between Vietnam and North America is from before the COVID-19 pandemic.
408 Interview with Hanoi (Vietnam) branch of multinational LSP, March 2019
409 Vietnam Logistics Business Association 2018, 154
410 Banomyong et al. 2015, 40

tons.[411] The main goods transported by air in and out of Vietnam are electronic components, garments, agricultural products, and seafood.[412]

The Vietnamese road transport industry is fragmented; 50 % of trucks are estimated to be owner-operated, i.e., run by companies with only one truck.[413] There are less than ten large trucking companies and about 100 SMEs, which usually have fewer than ten trucks.[414] The number of LSPs in Vietnam was estimated at 30,000 in 2018 by the Vietnam Logistics Business Association; of these, 4,000 had international operations.[415] Although possibly contributing to greater competition and lower freight rates, this situation will likely increase transaction costs for high-tech manufacturers and their suppliers, as fragmentation of LSPs hampers contracting out and coordinating of logistics services. About 25 multinational logistics companies operate in Vietnam, which account for 70–80 % of the market for logistics services.[416] There are several government-owned logistics firms: Vinalines, Viconship, Vietrans, and Vinafreight.[417] There are also several joint-stock companies, which are partly government-owned.[418] Only the largest LSPs offer a wide array of logistics services consisting of clearing, forwarding, consolidation, distribution, warehousing, trucking, tracking and tracing.[419] About 15 to 20 % of companies outsource their logistics operations to 3PLs.[420]

In 2016, logistics costs in Vietnam were estimated at 20.8 % of GDP.[421] This is higher than international best practice and higher than logistically high-performing countries in the region, namely China (17.8 %) and

411 Vietnam Logistics Business Association 2018, 154
412 Vietnam Logistics Business Association 2018, 155
413 Clean Air Asia 2017, 3
414 World Bank Group et al. 2018, 14
415 Vietnam Logistics Business Association 2018, 121
416 Clean Air Asia 2017, 40
417 Pham et al. 2013a, 53
418 Pham et al. 2013a, 53
419 Pham et al. 2013a, 53
420 World Bank Group et al. 2018, 15
421 https://english.vietnamnet.vn/fms/business/192227/vietnam-s-logistics-costs-make-up-20-8--of-gdp.html, accessed on Nov. 15, 2018

Singapore (9 %).[422] It is also higher than in ASEAN peer countries Thailand (15 %) and the Philippines (13 %).[423] The main reasons for high logistics costs in Vietnam are inadequate transport and logistics infrastructure; for example, low-quality warehousing and old trucks.[424] Owing to low data availability, it is impossible to distinguish logistics cost in Vietnam by economy-wide and firm-level costs (manufacturing and retail vs. third-party logistics providers).

In section 5.4, the decision framework developed in chapter 4 will be applied to Vietnam. The product category chosen for the application is high-tech manufacturing. High-tech manufacturing involves importing parts and manufacturing intermediate or final products that are exported for further processing or to their final destination.[425] Among the high-tech products exported from Vietnam are mobile phones, telephone parts, personal computers, semi-conductors, and electronics.[426] Exports of high-tech goods have risen in Vietnam in the past decade both in absolute terms and as a share of manufactured exports: from 8.8 % of manufactured exports (value of US$3.01 billion) in 2008 to 40.2 % of manufactured exports in 2018 (value of US$82.6 billion).[427] Vietnamese electronics exports rose faster than global electronics exports, albeit from a low base.[428]

International companies that have moved some of their high-tech manufacturing to Vietnam include Samsung, GE, Schneider, Fujitsu, HP, LG, Sony, Toshiba, Canon, Intel, Foxconn, and Nokia. At least as of 2013, these companies manage their own supply chains in Vietnam, both inbound and outbound.[429] Most electronics parts and products manufacturing takes place in the country's north (92 %), and 98 % of this produc-

422 Clean Air Asia 2017, 40
423 Vietnam Logistics Business Association 2018, 167
424 Clean Air Asia 2017, 41
425 Pham et al. 2013a, 52
426 Ministry of Industry and Trade of the Socialist Republic of Vietnam 2017, 13
427 World Bank 2020; export values are measured in current US$
428 Pham et al. 2013b, 29
429 Pham et al. 2013b, 32

tion is shipped through the port of Hai Phong.[430] In addition, 2 % of production leaves the country via air transport through Noi Bai airport.[431] An estimated 90–95 % of inputs for Vietnam's electronics exports are imported, mainly from China, Japan, and Korea.[432]

5.3 Government plans for upgrading the logistics environment

Logistics as a policy issue has received increased attention from Vietnamese policymakers in recent years, as evidenced by the "Action Plan for Enhancement of Competitiveness and Development of Vietnam's Logistics Services by 2025," which was developed by the Ministry of Industry and Trade in 2016.[433] Upgrading the logistics environment is needed to keep pace with Vietnam's strong export growth (14.3 % in 2018 and 16.7 % in 2017), and the associated rise in freight flows.[434] The plan aims to increase the share of outsourced logistics services to 50–60 % and to have Vietnam place among the top 50 countries in the LPI.[435] Another goal of the Action Plan is to reduce logistics costs to 16–20 % of GDP by 2025.[436] The last goal seems the least ambitious, given that logistics costs in Vietnam in 2016 stood at 20.8 % in 2016.[437] The Action Plan sets out further goals, namely attracting investment in logistics infrastructure, supporting the development of high-performing LSPs, applying new logistics technologies, improving skills development, and developing legislation pertaining to the logistics industry.[438]

A shortcoming of the plan for upgrading the logistics environment in Vietnam is the confusion around logistics-related authorities and national

[430] Pham et al. 2013a, 53
[431] Pham et al. 2013a, 53
[432] Pham et al. 2013b, 30
[433] Socialist Republic of Vietnam 2017, 1. In the following, the document is referred to as the "Action Plan".
[434] World Bank 2020; growth rate refers to exports of goods and services
[435] Socialist Republic of Vietnam 2017, 2
[436] Socialist Republic of Vietnam 2017, 2
[437] Limbourg et al. 2016, 124
[438] Socialist Republic of Vietnam 2017, 2

logistics development strategies, with overlap between several government agencies in terms of jurisdiction for logistics, exacerbated by a lack of coordination among institutions.[439] Although the Ministry of Industry and Trade is the presiding agency for the Action Plan, the multitude of line ministries involved complicates implementation (e.g., Ministry of Transport; Ministry of Justice; Ministry of Finance; Ministry of Labor, Invalids, and Social Affairs; Ministry of Education and Training; and Ministry of Planning and Investment). In addition to national ministries, regional and local authorities will be involved in carrying out the Action Plan, for example, the People's Committees of Provinces and Cities.[440]

5.4 Application of decision framework to high-tech manufacturing and Vietnam

5.4.1 Level 1: Target set-up of logistics environment

The target set-up is the first stage of the decision framework (section 4.3.3). It describes the ideal state of a well-functioning logistics environment. For high-tech goods, it is characterized by a high degree of flexibility in the logistics environment, with tight order cycles and short delivery times of a few weeks or days. Flexibility here refers to the capability to change based on a set of contingency scenarios.[441] The ideal logistics environment for high-tech manufacturing is also characterized by a high degree of reliability: the logistics environment is resilient in the face of disruptions such as port shutdowns and road congestion. Reliability here relates to the degree of uncertainty in the lead time, which refers to the time it takes for goods to arrive at the purchaser after the order has been placed.[442] Lastly, the target set-up is characterized by a low level of logistics costs, on par with international standards (ca. 10–17 % of GDP, viewed across all economic sectors) or, ideally, lower.[443]

[439] cf. Banomyong et al. 2015, 25–26
[440] Socialist Republic of Vietnam 2017, 3
[441] cf. OECD 2013, 50
[442] cf. Hausman et al. 2013, 241
[443] cf. Memedovic et al. 2005, 358

5.4.2 Level 2: Logistics concepts

This section links logistics concepts prevalent in the high-tech product category to the target set-up of the logistics environment. The logistics concepts listed here are business practices (i.e., they come into play at the intra-company level), but they need an enabling environment made up of components from all seven functional categories:

- Trade-off between responsiveness and efficiency of the logistics environment:[444] Responsiveness must be high to keep up with pace of technology industry, though cost pressure mandates cost efficiency of the logistics environment. This links to the target set-up components reliability, flexibility, and cost.
- Storage buffer capacity restricted to a few weeks due to high cost of inventory. This links to flexibility.
- Collaboration of logistics partners: sharing of distribution networks, infrastructure, and vehicles. This links to flexibility and cost.
- Adoption of just-in-time production and total quality management.[445] This links to reliability and flexibility.
- Ability to handle high volumes of imported inputs, most of them by sea.[446] This links to reliability and flexibility.
- Ability to handle high volumes of exported finalized products by air and sea.[447] This links to reliability and flexibility.
- Fragility of product requiring high-quality packaging. This links to reliability.

5.4.3 Level 3: Trends

As the framework aims to guide future investment decisions by governments, it is critical to not only look at the current state of logistics but to anticipate future trends. After reviewing the literature on trends in the

[444] cf. Ivanov et al. 2019
[445] cf. Wu and Weng 2010, 392
[446] cf. Pham et al. 2013a, 42
[447] cf. Pham et al. 2013a, 42

high-tech sector, the following trends were identified that may impact logistics for high-tech manufacturing in the next decade, i.e., until approximately 2030:

1. **Increasing speed of technology cycles**, thus increasing demands on logistics providers for reliability and speed in getting products to market. This will partly be facilitated by increased inter-organizational data exchange.[448]
2. **Fluctuating consumer demand**: need for flexible supply chains that can adapt to rising and falling demand, as consumer demand is closely linked to economic up- and downturns.[449]
3. **Changing geographic makeup of key markets**: stronger growth in emerging markets in East and Southeast Asia coupled with slower growth in established markets, with implications for product flows and transport needs.[450]

Another trend impacting the logistics environment for high-tech manufacturing, but not specific to that product category, is environmental sustainability. Both the demand and requirements for environmental sustainability in logistics will rise.[451] Measures to address sustainability in logistics operations are included in level 6.

5.4.4 Level 4: Logistics requirements—Answer to research sub-question 1 with application to high-tech manufacturing

This section lays out the requirements of the logistics environment for the high-tech product category, without a focus on a particular country. It forms the answer to research sub-question 1, with an application to high-tech manufacturing:

What are the logistics requirements of high-tech goods?

[448] cf. Straube (Ed.) 2019, 40
[449] cf. Bargenda and Jandhyala 2011, unpaginated
[450] cf. Bargenda and Jandhyala 2011, unpaginated
[451] cf. Göpfert et al. 2017, 12

The full list of requirements is included in Appendix 10.5.4 and shows the requirements grouped by functional category and target set-up characteristic. Requirements applicable to all three product categories examined are included in section 4.7.

TRANSPORT- AND TRADE-RELATED INFRASTRUCTURE

Infrastructure is a crucial ingredient in providing the flexibility and reliability of a supply chain with sophisticated just-in-time and just-in-sequence production such as the high-tech manufacturing supply chain demands. One of the main requirements is the facilitation of intermodal transport, so that production inputs and finished outputs can be transported to and from the place of production using the most efficient combination of transport modes. The availability of alternative transport modes if the mode of choice is unavailable enables a trade-off between responsiveness (flexibility) and cost of the supply chain, for example, by allowing swiftly bringing in production inputs with high value density by air or express road transport to avoid production stoppages. Moreover, the availability of reliable air transport is important to ensure flexibility at different levels: first, to ensure the regular flow of production components; second, to enable fast emergency deliveries of components that could otherwise entirely stop a production run; and third, so that products with high value density, such as smartphones and laptop computers, can be quickly exported from the country.

INFORMATION AND COMMUNICATIONS TECHNOLOGY

High-tech manufacturing puts comparatively high demands on the ICT structure as a high number of domestic and international supply chain partners need to exchange real-time information about potential order shortages and bottlenecks. A digital supply chain—involving Internet of Things (IoT) devices, cloud computing, big data analytics, mobile technologies, and blockchain—is necessary to help companies to reduce material lead times, improve inventory planning, and ensure supply

chain visibility.[452] Counterfeiting and tampering with high-tech products must be prevented.

ORGANIZATION OF THE LOGISTICS ENVIRONMENT ("ECO-SYSTEM")

Trade-enabling services such as ports and airports should be open 24/7 or nearly so, such that time-sensitive high-tech exports can quickly be processed. Reliable management of ports, airports, and rail transport helps keep these services cost-effective and dependable.[453] Efficient warehousing options should be available, with logistics providers offering the following functions: "receiving, sort and direct put-away, directed put-away, wave management, merge and pack-out, manifest documents, label or bar code printing, kitting, and pick/pack activities" (Vaidyanathan 2005, 91). Beyond warehousing, high-tech manufacturers need access to advanced logistics services. All parts of the logistics environment should be responsive to demand surges, for example, around major holidays, when high-tech products tend to see higher sales figures. To increase the competitiveness of a country as a production location for high-tech goods, logistics costs should be on par with international standards (ca. 10–17 % of GDP) or lower.[454]

BUSINESS PRACTICES FOR HIGH-QUALITY LOGISTICS SERVICES

Business practices refers to intra-company processes, hence the role of government here is limited to regulations and incentives. Information flow to and collaboration among all logistics partners should be encouraged, i.e., to suppliers, manufacturers, and LSPs.[455] This is particularly important for the complex high-tech supply chain, in which manufactured devices often incorporate hundreds of parts. The high number of parts and components means that efficient inventory management be-

[452] Kern and Wolff 2020, 4–5
[453] cf. World Bank 2010, 45
[454] For the numbers on logistics costs: cf. Memedovic et al. 2005, 358
[455] cf. Lee 2004, 4

comes even more important. Temperature-sensitive packaging prevents damage of goods in transit.

CUSTOMS PRACTICES

Customs personnel should have high technical skills.[456] In case there are multiple border protection agencies, efficient inter-agency coordination is crucial for high-tech products to be swiftly processed for export. Similar to the need for ports and airports to open 24/7, customs services and border posts should have long and reliable opening hours to minimize time lost in the cross-border transport chain, as high-tech goods with a short life span could otherwise face increased rates of obsolescence.

REGULATORY ENVIRONMENT

Within national governments, responsibility for logistics is often spread across different ministries (typically Transport, Trade and/or Industry) so that legislative authority is scattered across entities. Legislation covering all aspects of logistics helps provide a dependable legal framework for logistics actors in high-tech manufacturing and thus improves the business environment. Enforcement of legislation is necessary to keep transaction costs low. For the same reason, trade laws and regulations should be easily accessible, and guidelines should be consistent.

EDUCATION, SKILLS, AND PROFESSIONAL TRAINING

Despite recent technological advances in logistics operations, logistics remains a labor-intensive business. An adequate supply of trained logistics specialists is thus crucial to meet the needs of the high-tech manufacturing logistics environment. Staff should possess both general logistics knowledge as well as specialized knowledge of the high-tech supply chain, including a focus on security and careful handling of products with high value density.

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[456] cf. World Bank 2012, 36

5.4.5 Level 5: Gap analysis—Answer to research sub-question 2 with application to high-tech manufacturing and Vietnam

The gap analysis as the fifth stage of the decision framework is product-category- and country-specific: It juxtaposes the logistics requirements from section 5.4.4 with the current state of the logistics environment for high-tech goods in Vietnam and identifies which logistics constraints are prevalent in the country for high-tech manufacturing. This section forms the answer to research sub-question 2, with application to Vietnam and high-tech manufacturing:

Which country-specific constraints are prevalent in Vietnam in the logistics environment for high-tech goods?

The full gap analysis for Vietnam is included in Appendix 10.5.5. Data for this level originate in the following sources: (1) interviews carried out with Vietnamese stakeholders (see Appendix 10.3 for a list of interviews), (2) official country statistics, and (3) public databases and reports.

TRANSPORT- AND TRADE-RELATED INFRASTRUCTURE

Intermodal transport in Vietnam is hampered by missing links between transport modes, particularly in terms of links between ports with air and rail transport.[457] This holds for all ports in Vietnam. Seaports also lack road connections to facilities in the hinterland.[458] There is low connectivity between logistics nodes, and there are few multimodal linkages.[459] Inland waterways suffer from low draft at several inland ports.[460] Inland container depots (ICDs) in the north are only accessible by road, not by other transport modes.[461]

[457] Interview with Vietnamese LSP, July 2019
[458] Interview with Vietnamese logistics expert, April 2019
[459] Victoria University Melbourne 2014, 12; lack of multimodal linkages corroborated by interview with M1 Viettel, Vietnamese manufacturer of communications and electronic devices, August 2019
[460] Interview with Vietnamese logistics expert, Hanoi, August 2019
[461] Vietnam Logistics Business Association 2018, 151

Port capacity to handle high container volumes is insufficient, especially for a sector as reliant on just-in-time production as the high-tech one: delays are frequent.[462] There are several ports with a draft of only 9–10 m, thus limiting the size of incoming ships.[463] The cost of accessing the new deepwater port at Cai Mep is high: Cai Mep is less attractive to shippers than Cat Lai (the port closer to Ho Chi Minh City) as costs to clear in Cai Mep are higher than in Cat Lai and transport from Cai Mep to an inland factory is more expensive than from Cat Lai to an inland factory because of the longer distance.[464] Port development in previous years was not synchronized: the focus was almost exclusively on berth length rather than seaport connections.[465]

Although air transport works fairly well in the country, storage capacity at airports is limited. Storage areas are small, modern air cargo technologies are not applied, and paperwork is cumbersome.[466] No risk management is applied, thus 100 % of air freight needs to be scanned at the airport. Moreover, the scanner at Hanoi airport is small and pallets frequently do not fit and have to be unpacked for physical checks.[467] Air cargo agents and LSPs are not allowed to offer storage and warehousing within the airport as warehousing is controlled by airport operators.[468] Storage prices are set by the government.[469]

There is a lack of logistics zones in strategic positions (close to ports, airports, national highways, and production centers) with warehouse and support services for import and export companies and LSPs.[470] Logistics zones are also lacking along major highways and ports.[471] The cities and

[462] Interview with Vietnamese LSP, Ho Chi Minh City, Dec. 2018; corroborated by interview with Vietnamese logistics expert, Hanoi (2), August 2019
[463] Interview with Vietnamese logistics expert, Feb. 2019
[464] Interview with Vietnamese LSP, July 2019
[465] Interview with Vietnamese logistics expert, Hanoi (2), August 2019
[466] Interview with Vietnamese LSP, Hanoi, Jan. 2019
[467] Interview with Hanoi (Vietnam) branch of multinational LSP, March 2019
[468] Interview with Hanoi (Vietnam) branch of multinational LSP, March 2019
[469] Interview with Hanoi (Vietnam) branch of multinational LSP, March 2019
[470] Interview with Vietnamese logistics expert, Hanoi (2), August 2019
[471] Interview with Vietnamese logistics expert, Hanoi, Dec. 2018

regions with the largest deficits of logistics zones are Ho Chi Minh City, Hanoi, Nha Trang, Lam Dong, and the Mekong Delta.[472] The locations of ports and of logistics and industrial zones are not well aligned; road links are vulnerable to traffic jams owing to a lack of alternative ways for trucks to enter and exit ports.[473]

INFORMATION AND COMMUNICATIONS TECHNOLOGY

The use of ICT by logistics providers is limited, hampering cross-company information exchange between suppliers and customers.[474] The level of ICT-enabled innovation is low.[475] The e-airway bill has, so far, not been introduced nationwide.[476] Most domestic IT systems are under-developed and unable to connect to external IT systems while guaranteeing the required security level, thus preventing data tools being available to support an uninterrupted supply chain.[477] Tracking and tracing is not widespread.[478]

ORGANIZATION OF THE LOGISTICS ENVIRONMENT ("ECO-SYSTEM")

Most ports in Vietnam are operated by state-owned enterprises: An example is Saigon Newport Corporation, which runs the port of Ho Chi Minh City.[479] These enterprises are often vertically integrated and can prevent a level playing field if coupled with market power in the upstream segment, e.g., port operations, or the downstream segment of transport services.[480] Saigon Newport Corporation, for instance, offers port operations, handling, and container transshipment and accounts for

[472] Blancas et al. 2014, 49
[473] Interview with Vietnamese LSP, July 2019
[474] Ministry of Industry and Trade of the Socialist Republic of Vietnam and World Bank 2016, 19
[475] Limbourg et al. 2016, 129
[476] Ministry of Industry and Trade of the Socialist Republic of Vietnam 2017, 58
[477] Ministry of Industry and Trade of the Socialist Republic of Vietnam 2017, 57
[478] Banomyong et al. 2015, 45
[479] World Bank Group et al. 2018, 14
[480] cf. World Bank Group et al. 2018, 21

more than half of Vietnam's container market.[481] Another state-owned enterprise is Vinalines, the national shipping company, which controls about 25 % of Vietnam's shipping fleet and offers warehousing, runs several ICDs, and operates 15 seaports, accounting for 30 % of the total length of Vietnam's piers.[482] Its subsidiary Vinastarlines operates over 100 trucks and offers freight forwarding.[483] This entails the risks of lack of competitive neutrality and abuse of power to exclude competing downstream cargo holders.[484]

Cooperation among logistics actors is not seamless. In several ports (e.g., in Hai Phong), different port terminals are run by different providers, including different customs offices, with little integration between them, thus making it difficult for LSPs to move cargo between terminals owing to the complicated customs procedures involved.[485] Most LSPs are SMEs, with low capital, little experience, and few management skills.[486] Moreover, logistics costs in Vietnam in 2016 were 20.8 % of GDP and thus not on par with international standards (ca. 10–17 % of GDP) or, ideally, lower.[487] In many cases, transportation costs account for 40–50 % of production costs.[488]

BUSINESS PRACTICES FOR HIGH-QUALITY LOGISTICS SERVICES

The logistics services business is fragmented. Most Vietnamese LSPs are SMEs, often inexperienced and lacking professionalism, providing only basic services and competing mainly on price rather than quality. Development of transport services for high-tech goods has not been fast

481 World Bank Group et al. 2018, 12
482 World Bank Group et al. 2018, 23
483 World Bank Group et al. 2018, 23
484 World Bank Group et al. 2018, 53
485 Interview with Hanoi (Vietnam) branch of multinational LSP, March 2019
486 Interview with M1 Viettel, Vietnamese manufacturer of communications and electronic devices, August 2019
487 https://english.vietnamnet.vn/fms/business/192227/vietnam-s-logistics-costs-make-up-20-8--of-gdp.html, accessed on Sep. 15, 2019. For the numbers on international logistics costs: cf. Memedovic et al. 2005, 358
488 Interview with Vietnamese LSP, Hanoi, July 2019

enough in view of the rising importance of e-commerce in the high-tech manufacturing sector.[489] The majority of Vietnamese LSPs are small-scale providers with an average capitalization of US$18,750 to US$31,250.[490] The degree of professionalism of LSPs is low, for example, with limited knowledge of customs regulations.[491] Local logistics providers have inadequate technical know-how.[492]

There are too few companies providing auxiliary services for high-tech companies.[493] Many logistics companies do not have a comprehensive service offering and instead only offer customs clearance and simple shipment orders.[494] Despite rising demand for value-added logistics services, most are carried out in-house, as outsourcing is uncommon.[495] If logistics is outsourced, it is mostly for basic services: In 2013, 70 % of the 130 logistics companies in Da Nang provided only 1PL and 2PL services.[496]

CUSTOMS PRACTICES

Customs formalities at the border are cumbersome, despite recent improvements in border procedures. This is due to missing coordination between Vietnam and neighboring countries and persistent reliance on paper-based processes.[497] While the customs clearance process has been improved in recent years, customs declarations still cannot be done 100 % electronically. Several stages have to be completed manually, e.g., submitting the yearly settlement report of export compa-

489 Interview with Vietnamese logistics expert, Hanoi (2), August 2019
490 Interview with Vietnamese logistics expert, Hanoi, Dec. 2018
491 Interview with Vietnamese branch of an international high-tech manufacturer, Hanoi, May 2019
492 Banomyong et al. 2015, 52
493 Interview with Vietnamese logistics expert, Hanoi (2), August 2019
494 Pham et al. 2013a, 53
495 Limbourg et al. 2016, 125
496 Limbourg et al. 2016, 125
497 Interview with Vietnamese logistics expert, April 2019; information on delays/time spent with customs formalities corroborated by interview with Hanel Joint Stock Company (state-owned Vietnamese electronics and IT company), January 2019, by interview with Azoom Vietnam Co, Ltd., June 2019, by interview with Vietnamese LSP, Ho Chi Minh City, July 2019, and by interview with Vietnamese LSP, Hanoi, July 2019

nies.[498] Customs and border management agency processes are only partially automated and paper-based declarations presented in person are still often required.[499] Acceptance of digital signatures for administrative procedures is currently only available for goods entering and exiting through marine terminals.[500]

In Vietnam, 51.7 % of LSPs cite complex document procedures as one of the main impediments to doing business in the country.[501] Overlapping customs procedures are also a problem;[502] rules for completing certificates of origin are unclear;[503] and lack of agreement between customs staff and importing/exporting companies on which HS codes to use leads to hold-ups in clearance.[504] Waiting times at customs are long, not only owing to lengthy procedures but also because of the need for supporting documents from several other government agencies.[505] The incidence of informal payments at customs clearance is high.[506]

As for risk management, the adoption of the Authorized Economic Operator system is not comprehensive.[507] Customs bonds are lacking, and ex-

[498] Interview with Vietnamese LSP, Hanoi, Jan. 2019. Note: Following Circular No. 39, customs clearance via the "yellow channel" can be done using electronic signatures, i.e., no hard copies anymore (source: Interview with Vietnamese branch of an international manufacturer of electrical equipment, July 2019)

[499] Ministry of Industry and Trade of the Socialist Republic of Vietnam and World Bank 2016, 15

[500] Ministry of Industry and Trade of the Socialist Republic of Vietnam 2017, 22

[501] Vietnam Logistics Business Association 2018, 182

[502] Interview with Vietnamese logistics expert, Hanoi, August 2019

[503] Interview with Hanoi (Vietnam) branch of multinational LSP, Nov. 28, 2019

[504] Interview with Executive Board Member of the Vietnam Electronics Industries Association, Dec. 2019. "HS code" refers to the Harmonized Commodity Description and Coding System, an international standardized system for commodity classification, used, e.g., in customs.

[505] Interview with Vietnamese LSP, Ho Chi Minh City, Dec. 2018

[506] Pham et al. 2013a, 70; corroborated by interview with Vietnamese logistics expert, Feb. 2019, and by Blancas et al. 2014, 104

[507] Interview with Hanoi (Vietnam) branch of multinational LSP, Nov. 28, 2019; corroborated by interview with Executive Board Member of the Vietnam Electronics Industries Association, Dec. 2019. "Authorized Economic Operators" refer to operators who meet specific criteria, including high prior levels of compliance with customs regulations and financial solvency, who can benefit from additional measures facilitating imports, exports, and transit formalities, e.g., low documentary requirements, fast release times, and deferred payments of duties (World Trade Organization 2014, 9). The WTO uses the term "Economic Operator" rather than "Authorized Economic Operator".

cept for a pilot program with FDI companies (e.g., Inditex) there are no customs bonds, which could lower clearance times and reduce the cost of customs inspection.[508] Policies and inspections for import and export goods are governed by 350 legal documents from the Vietnam Customs Department; these include 39 regulations; 77 Government Decrees and Decisions/Directives by the Prime Minister; and 240 Circulars/Decisions of Ministries.[509] These lead to difficulties for traders in clearing imports and exports.[510] The skills levels of some government officials dealing with cargo movements are low.[511]

REGULATORY ENVIRONMENT

Several gaps in the regulatory environment exist: There is no legislation governing multimodal transport.[512] Legislation governing dry ports and logistics zones is also nonexistent.[513] The same goes for legislation governing export and import processes for the high-tech industry, including for customs procedures.[514] Moreover, there is a lack of insurance products for LSPs: There is liability insurance for international freight, but for inland road transport there are no limits to liability for LSPs. If the shipper does not have insurance, LSPs are liable and smaller companies can be bankrupted by a single shipment gone awry. This also presents an obstacle to the widespread adoption of digital logistics platforms in the country, because it is unclear who is liable if cargo is damaged while being transported on another firm's truck.[515] Moreover, the lack of insurance services impairs logistics for high-tech manufacturing.[516]

[508] Interview with Vietnamese LSP, July 2019
[509] Interview with Vietnamese logistics professional, Nov. 2019
[510] Interview with Vietnamese logistics professional, Nov. 2019
[511] Interview with Vietnamese logistics expert, Hanoi, Dec. 2018; corroborated by Blancas et al. 2014, 82
[512] Pham et al. 2013a, 132
[513] Victoria University Melbourne 2014, 23
[514] Interview with Vietnamese logistics expert, Feb. 2019
[515] Interview with Vietnamese LSP, July 2019
[516] Interview with Vietnamese logistics expert from the public sector, July 2019

Trade- and logistics-related regulations are difficult to understand for economic actors: numerous regulations overlap among state agencies.[517] For several imported goods, the cost of fulfilling legal requirements is higher than the value of the goods.[518] International trade regulations relating to commodity classification, commodity valuation, product inspection, and licensing and certification of certain products are ambiguous, difficult to understand, and not transparent.[519]

Restrictions to entry to the logistics sector are present. Price reference guides are in place for trucking services for public procurement contracts, with prices set for each province, type of road, distance, and material, potentially facilitating collusive agreements.[520] Foreign capital for road transportation services is limited to 49 %; if companies with more than 49 % foreign capital want to use their own fleet (i.e., obtain a trucking license), they have to apply for a special permit.[521]

EDUCATION, SKILLS, AND PROFESSIONAL TRAINING

Structured training and education in logistics are lacking.[522] Consequently, there is an overall shortage of qualified logistics staff.[523] There is a lack of professional logistics staff, specifically in high-tech companies.[524] Moreover, there is an overall dearth of logistics staff, especially those who can handle business relations with international customers—a

[517] Interview with Vietnamese LSP, Hanoi, Jan. 2019; corroborated by interview with Vietnamese LSP, Hanoi (2), July 2019
[518] Interview with Vietnamese LSP, Hanoi, Jan. 2019
[519] Blancas et al. 2014, 82
[520] World Bank Group et al. 2018, xi
[521] World Bank Group et al. 2018, 31
[522] Limbourg et al. 2016, 125; corroborated by interview with Hanel Joint Stock Company (state-owned Vietnamese electronics and IT company), Hanoi, January 2019
[523] Interview with Vietnamese logistics expert, Hanoi, Dec. 2018; corroborated by interview with Vietnamese LSP, July 2019, and by interview with Vietnamese logistics expert, Hanoi (2), August 2019
[524] Interview with Vietnamese logistics expert, Hanoi, August 2019

task currently often carried out by foreign staff.[525] The skill level of workers in cargo-handling facilities and logistics zones is low.[526]

Current training schemes lack competency standards,[527] and 60.5 % of Vietnamese LSPs report gaps in human resources as one of the main difficulties encountered in doing business in the country.[528] Combining all levels and competencies, an estimated 200,000 logistics professionals will be needed in Vietnam by 2030.[529] It is unclear how the current education and training system will be able to qualify such a high number of candidates. Staffing of road transport is also inadequate owing to a shortage of skilled truck drivers;[530] moreover, enforcement of standards for truck driver licensing and training is insufficient.[531]

IMPLICATIONS OF GAP ANALYSIS RESULTS FOR VIETNAM

The gap analysis pinpoints problems in Vietnam's logistics environment pertaining to the logistics requirements for high-tech manufacturing, in particular concerning flexibility, reliability, and cost efficiency. One of the main shortcomings negatively affecting flexibility and reliability is the dearth of qualified logistics staff, especially in a sector as international and time-driven as the high-tech one. Other obstacles to maximizing flexibility and reliability include the underuse of tracking and tracing technology and the inability of most domestic IT systems to connect to external ones, thus preventing efficient collaboration with supply chain partners.

A low number of LSPs coupled with a low degree of professionalism of LSPs, in particular regarding export procedures, further constrains flexi-

525 Interview with Vietnamese LSP, Hanoi (2), July 2019
526 Blancas et al. 2014, 49
527 Ministry of Industry and Trade of the Socialist Republic of Vietnam 2017, 111
528 Vietnam Logistics Business Association 2018, 182
529 Ministry of Industry and Trade of the Socialist Republic of Vietnam and World Bank 2016, 6
530 Ministry of Industry and Trade of the Socialist Republic of Vietnam and World Bank 2016, 6
531 Blancas et al. 2014, 84

bility and reliability. The fragmentation of the logistics services sector and the lack of companies providing auxiliary services for high-tech companies raises transaction costs for manufacturers and their suppliers by making it difficult to contract and coordinate logistics services. Partly for reasons of unsolved liability for damaged cargo, digital logistics platforms have not yet been widely adopted in Vietnam, meaning that exporters and LSPs miss out on the flexibility and cost reduction potential that such platforms offer.

Weak competition caused by restrictions to entry for road transport services and high market shares of state-owned companies in, for example, port operations and transport services potentially raise the cost of logistics for high-tech manufacturing. The same goes for the high incidence of informal payments at customs clearance coupled with complex document procedures and the high number (350) of legal documents from Vietnam Customs that exporters and importers have to review. Hold-ups in customs clearance as well as complex and overlapping customs procedures counteract cost efficiency in logistics. Administrative costs are elevated for the air transport-reliant high-tech sector as digital signatures for administrative procedures are only offered for maritime cargo and the introduction of the e-airway bill has, so far, been limited. The following section suggests logistics measures to close the gaps identified in section 5.4.5.

5.4.6 Level 6: Logistics measures—Answer to main research question with application to high-tech manufacturing and Vietnam

This is the sixth and final stage of the decision framework. Based on the preceding gap analysis, the following measures are suggested for Vietnam to meet the logistics requirements of high-tech goods and to foster exports in that product category. This section forms the answer to the main research question, with application to high-tech goods and Vietnam:

Which country-specific logistics measures should the government of Vietnam take to foster high-tech exports?

The full list of suggested measures is included in Appendix 10.5.6.

TRANSPORT- AND TRADE-RELATED INFRASTRUCTURE

***Focal area**: Availability of reliable air transport to ensure that goods with value density can be swiftly brought in (to avoid production stoppages) and products with high value density can be quickly exported out of the country*

Cargo terminals at Noi Bai airport (Hanoi) and Than Son Nhat airport (Ho Chi Minh City) could be upgraded to better accommodate air freight, for instance, by introducing pallet scanners at Noi Bai to avoid the need to unpack pallets for physical checks.[532] To ease congestion at Than Son Nhat airport and to serve air cargo needs from Ho Chi Minh City and the southern Vietnamese region, it would be beneficial to finalize construction of Long Thanh International Airport.[533]

Logistics infrastructure for high-tech production units could be planned with air transport in mind. For instance, the connections on the Hanoi-Thai Nguyen highway from Noi Bai airport to the Samsung production areas in Bac Ninh and Thai Nguyen provinces are convenient, thus making Noi Bai the focal point for import and export goods with the largest throughput value nationwide.[534] Once Long Thanh airport is open, transport infrastructure and land use around it could be developed such that high-tech production units find similarly favorable conditions.[535]

Logistics zones catering to air transport needs (including advanced sorting and loading/unloading facilities) could be constructed around the

[532] For accommodation of air freight: cf. Banomyong et al. 2008, 366; for introduction of pallet scanners: interview with Hanoi (Vietnam) branch of multinational LSP, March 2019

[533] Victoria University Melbourne 2014, 15

[534] Interview with Vietnamese logistics expert from the public sector, July 2019

[535] Interview with Vietnamese logistics expert from the public sector, July 2019

airports of Noi Bai, Tan Son Nhat, and Da Nang, facilitating easier access with less congestion for LSPs.[536] The monopoly on airport storage for airport operators could be removed by allowing cargo agents and third party providers (e.g., LSPs) to offer storage and warehousing in the airport (pending security scans). It would be worthwhile to review the role of the Ministry of Transport in price setting for airport storage.

The current 100 % level of scanned cargo could be lowered if risk management was applied in customs clearance for air freight.[537] To ease the establishment of air freight hubs in the country, it might be sensible to negotiate freight traffic rights independently from passenger traffic rights in bilateral air services agreements.[538] Separate clauses in air-services agreements could be considered to provide for all-cargo air services.[539]

***Focal area**: Facilitation of intermodal transport and availability of a large road and rail network so that production inputs and finished outputs can be transported to and from the place of production using the most efficient combination of transport modes*

To enable ports to handle higher container volumes, third and fourth berths could be added at Hai Phong International Gateway Port.[540] The ports of Cai Mep, Da Nang, and Hai Phong could be enabled to handle higher container volume by improving handling efficiency through widespread availability of full-truck scanners, automated gate entry, and modern ICT systems.[541] The port hinterland could be enabled to support port expansion by enhancing transport infrastructure, including increas-

[536] cf. Vietnam Logistics Business Association 2018, 132; corroborated by interview with Vietnamese logistics professional, Nov. 1, 2019
[537] Cargo destined for the US and (from 2021 on) to Hong Kong needs to be scanned at 100 % following US and Hong Kong legislation
[538] cf. Bowen and Leinbach 2006, 156
[539] Interview with Vietnamese logistics professional, Nov. 2019
[540] Interview with Hanoi (Vietnam) branch of multinational LSP, Nov. 28, 2019
[541] Banomyong et al. 2015, 34; need for upgrading cargo handling equipment corroborated by interview with Vietnamese logistics expert, Hanoi (2), August 2019

ing the capacity of the main corridors leading to and from the port and easing access to industrial and logistics centers.[542]

Feeder roads could be constructed or upgraded between Cai Mep and NH51, the main highway connecting the port with Ho Chi Minh City. Road infrastructure could incorporate congestion fees to ease road congestion, especially around seaports, with the priority port road links being Hai Phong port to Hanoi to Lao Cai province (400 km); Cai Mep port to Ho Chi Minh City (100 km); and Da Nang port to Quang Ngai province (170 km).[543] To increase Cai Mep port's utilization rate, introduce a system of container depots around its terminals to entice more ocean shipping companies to add the port to their rotations.[544] Also, in light of the data collected during the interviews with Vietnamese stakeholders, access to Cat Lai port by road could be improved.[545] A further way to increase intra-country road transport intensity would be to shift more cargo to inland waterways. Handling facilities at river ports could be upgraded to increase the freight volume moved on rivers, in particular in the Mekong delta.[546] The waterway from Cai Mep to Cat Lai port could be widened and deepened so that vessels do not get stuck and block other ships.[547]

To better serve high-tech export markets, it would be beneficial to set up privately owned logistics zones, particularly at Cai Mep and Hai Phong ports.[548] These zones would ideally incorporate centralized warehouses and support services for LSPs as well as import and export companies. A further suggested location for such a zone would be in the Song Than area in the country's south.[549]

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542 cf. Acciaro and McKinnon 2013, 12
543 Victoria University Melbourne 2014, 15
544 Interview with Vietnamese logistics expert, Hanoi, Dec. 2018
545 Interview with Vietnamese LSP, July 2019
546 Interview with Vietnamese logistics expert, April 5, 2019
547 Interview with Vietnamese logistics professional, Nov. 1, 2019
548 Interview with Vietnamese logistics expert, Dec. 2018
549 Interview with Vietnamese LSP, July 2019

INFORMATION AND COMMUNICATIONS TECHNOLOGY

Focal area: *Integration of IT tools between suppliers and customers to enable and automate cross-company information exchange*

Increased collaboration of supply chain partners could be enabled via digital logistics platforms by strengthening the broadband internet infrastructure necessary for online coordination. To enable and automate cross-company information exchange, the development of cloud-based IT applications could be incentivized to facilitate low-cost and secure access to ICT systems for LSPs.[550] The introduction of predictions of estimated time of arrival for the entire transport chain could be supported by using AI and machine learning tools that take into account infrastructure, resources, order characteristics, and weather.[551]

Supporting the development and introduction of IoT devices can help to prevent attempts at counterfeiting high-tech products. A database on logistics and freight transport at the national or provincial level could be built.[552] New technologies for tracking and security could be permitted and promoted.[553] These measures all represent ways for governments to help increase supply chain visibility, which is required so that companies can adequately react to problems in the supply chain.[554]

Introducing a digital supply chain that includes the above features is the responsibility of the individual firms in a high-tech supply chain, however, governments can contribute via standardization and data security so that firms are comfortable with adopting new technologies without having to fear theft of intellectual property. Standardization (e.g., for data formats) can be supported by funding standardization bodies or by

[550] Ministry of Industry and Trade of the Socialist Republic of Vietnam and World Bank 2016, 19
[551] cf. Poschmann et al. 2019, 162
[552] Interview with Vietnamese logistics expert, Hanoi, Dec. 2018
[553] cf. World Bank 2010, 43
[554] See World Economic Forum 2020, 16 for a discussion of the role of supply chain visibility in manufacturing, especially in light of the COVID-19 crisis.

developing data conversion tools.[555] Data security can be bolstered by governments through publishing recommendations on data security or adopting laws combating cybercrime.[556]

ORGANIZATION OF THE LOGISTICS ENVIRONMENT ("ECO-SYSTEM")

***Focal area**: Provision of flexible, cost-effective, and reliable trade-enabling services*

24/7 opening of ports and airports would be useful. If border traffic does not warrant such long hours, opening times should at least be reliable and match the private sector's needs, including weekend opening times if production and exporting schedules require this. Where not introduced already, commercial management could be introduced into seaport, airport, and potentially rail operations.[557] Private sector participation to build and maintain public infrastructure could be raised.[558]

***Focal area**: Provision of incentives and regulations for efficient warehousing*

Zoning laws could be set up such that warehouses and distribution centers are easily accessible from manufacturing hubs and ports. The set-up of better warehousing, including with high-tech functions, could be incentivized.[559] The implementation of warehouse management systems could be subsidized to allow for just-in-time and just-in-sequence delivery via, for example, automatic transmission of predicted truck arrival times, automatic selection and preparation of docking slots, and automatic assignment of storage space.[560] For high-tech manufacturers it

555 cf. Kern and Wolff 2019, 5
556 cf. Kern and Wolff 2019, 5
557 cf. World Bank 2010, 45
558 cf. World Bank 2010, 45
559 Interview with Vietnamese logistics expert, April 2019
560 cf. Barreto et al. 2017, 1249

would be advantageous for bonded trucking to have access to offsite airport storage to ease congestion in onsite airport storage; that is, the option to transport goods to an authorized warehouse outside the port of entry without customs release, as is already available to the two Samsung production sites in Bac Ninh and Thai Nguyen provinces.[561]

***Focal area**: Establishment of a level playing field for all logistics actors and tight coordination of logistics-related government entities to ensure low prices and high reliability*

It would help to create a level playing field if state-owned enterprises in transport and logistics did not enjoy advantages vis-à-vis private operators. To ensure healthy competition, relevant legislation could be overhauled such that it covers all transport modes. The capabilities of government employees whose work impacts logistics performance could also be upgraded.[562]

The national management information system could be enhanced by connecting information between logistics-related agencies such as the ministries of Industry and Trade, Transport, and Finance to minimize competing administrative procedures and reduce waiting times at international gateways and border posts.[563] A national logistics council uniting all logistics stakeholders, possibly chaired by the Ministry of Industry and Trade, could be set up to ensure a feedback mechanism between private and public actors in logistics.

***Focal area:** Reduction of logistics costs to international best practice*

Logistics costs could be brought down from their 2016 level of 20.8 % of GDP to levels more closely aligned with international best practice

[561] Interview with Hanoi (Vietnam) branch of multinational LSP, Nov. 28, 2019; need for offsite airport storage corroborated by interview with Vietnamese logistics expert from the Ministry of Industry and Trade, Dec. 2019
[562] Victoria University Melbourne 2014, 12
[563] Interview with Vietnamese logistics expert, Hanoi (2), August 2019

(ca. 10–17 % of GDP).[564] This could be achieved by fostering competition in all transport modes; lowering transaction costs for transit (customs and handling charges and time needed for documentary compliance); and increasing reliability and predictability in the logistics environment.

BUSINESS PRACTICES FOR HIGH-QUALITY LOGISTICS SERVICES

Focal area: *Support for efficient intra-company processes*

The technical know-how of local LSPs could be increased; for example, on how to manage inventory. Standard performance contracts could be initiated for transport and logistics services to support the adoption of international standards by logistics operators.[565] Incentives may be warranted for the implementation of transport management systems (using, e.g., GPS systems) to consolidate shipments, control freight costs, and integrate with technologies such as warehouse management systems by monitoring freight movements and vehicles.[566]

To mitigate supply chain volatility, incentives could be created for supply chain partners to share stock levels to increase forecasting accuracy.[567] The use of additive manufacturing could be encouraged to produce spare parts to reduce lead times and cost of safety inventory.[568] Supply chain data and logistics statistics could be collected and compared against key performance indicators.[569] Incentives for efficient re-

[564] https://english.vietnamnet.vn/fms/business/192227/vietnam-s-logistics-costs-make-up-20-8--of-gdp.html, accessed on Nov. 15, 2018. For the numbers on international logistics costs: cf. Memedovic et al. 2005, 358

[565] cf. World Bank 2010, 43; corroborated by interview with Nguyen Thi Minh Phuong, Operational Purchasing Manager, ABB Vietnam, Nov. 2019

[566] cf. Barreto et al. 2017, 1249

[567] cf. Nitsche 2018, 19. Supply chain volatility is defined by Nitsche and Durach (2018, 868) as "unplanned variation in upstream and downstream material flows resulting in a mismatch of supply and demand at the focal firm".

[568] cf. Liu et al. 2014, 1169

[569] Victoria University Melbourne 2014, 13, corroborated by interview with Vietnamese logistics expert, April 2019

verse logistics could be provided so that unneeded but intact high-tech products can be reused.

CUSTOMS PRACTICES

***Focal area**: Introduction of efficient and predictable border management procedures to enable fast export processes without undue cost burdens*

The pilot application for automated customs management and monitoring for air cargo from Noi Bai airport could be extended to all airports. The use of customs bonds could be expanded to all exporting companies to reduce clearance times and lower the cost of customs inspections. A licensing system for customs brokers could be introduced. Customs coordination with neighboring countries might be improved, for instance, by setting up joint border posts at the Vietnam–China border to avoid duplicate controls.[570] Border control entities should be open 24/7. If such long opening hours are not warranted, they should at least be reliable, in line with the hours of other trade-enabling services (e.g., ports and airports), and match the private sector's needs, including weekend opening times if exporting schedules require this. The technical skills of customs staff could be raised.[571]

The Authorized Economic Operator program could be applied more widely so that inspection rates can be minimized.[572] At the border, single-stop inspection could be adopted with risk-based management.[573] The documents governing inspections for import and export goods by the Vietnam Customs Department could be streamlined and their number reduced. The procedure to obtain certificates of origin (enabling

[570] Interview with Hanoi (Vietnam) branch of multinational LSP, Nov. 28, 2019

[571] Interview with M1 Viettel, Vietnamese manufacturer of communications and electronic devices, August 2019

[572] cf. World Bank 2010, 44; corroborated by interview with Hanoi (Vietnam) branch of multinational LSP, Nov. 28, 2019, and by interview with Executive Board Member of the Vietnam Electronics Industries Association, Dec. 2019

[573] Pham et al. 2013a, 132

traceability of product inputs) could be simplified, and the rules for completion clarified.[574]

Focal area: *Offering modern electronic customs technology to reduce cost and increase speed for exporters*

World Customs Organization standards for classification, filing practices, and electronic data exchange could be introduced.[575] E-customs, that is, using electronic instead of paper-based procedures, could be offered in all Vietnamese provinces, thereby eliminating the opportunity for informal payments.[576] Technical support could be provided to users encountering technical issues using the customs platform. As a long-term measure, blockchain technology could be introduced for archiving customs documents to prevent unauthorized modifications, expedite the flow of information, and improve confidence in customs documentation.[577]

REGULATORY ENVIRONMENT

Focal area*: Adaptation of regulatory environment to logistics and minimization of market distortions*

It would be beneficial to pass legislation on investment and operations in dry ports and logistics zones.[578] Filling gaps in legislation related to export and import processes for the high-tech industry would also be a positive step. Regulatory gaps in liability and insurance law could be filled to increase the attractiveness of digital logistics platforms.[579] A reform of the legal framework for technology application in logistics

[574] Interview with Hanoi (Vietnam) branch of multinational LSP, Nov. 28, 2019
[575] cf. Blancas et al. 2014, 123
[576] For suggestion of e-customs: Interview with Vietnamese logistics expert, Feb. 2019; corroborated by interview with Hanoi (Vietnam) branch of multinational LSP, Nov. 28, 2019
[577] cf. Ivanov et al. 2019, 500. Blockchain is defined by Kern and Wolff (2019, 4) as "an open, distributed ledger that can record transactions between two parties efficiently and in a verifiable and permanent manner".
[578] cf. Victoria University Melbourne 2014, 23
[579] Interview with Vietnamese LSP, July 2019

activities could be carried out, covering, for example, blockchain and transport modes for urban traffic.[580]

Price reference guides would ideally be phased out, and the foreign capital limit for road transportation services increased and eventually eliminated.[581] The requirement for truck drivers to be Vietnamese citizens could be removed. Rules and regulations related to international trade included in the Vietnam Trade Information Portal should be reviewed to ensure consistency and avoid duplication. In response to information gathered during the interviews with Vietnamese stakeholders, it would be good to remove overlapping responsibilities among state agencies and to improve cooperation and coordination among them.[582] Cooperation with other governments could be improved, for instance, by harmonizing rules for issuing certificates of origin.[583]

EDUCATION, SKILLS, AND PROFESSIONAL TRAINING

Focal area: *Ensuring adequate supply of trained logistics specialists with knowledge of high-tech manufacturing logistics*

Logistics courses, including logistics majors, could be introduced at universities and course content focused on the requirements of the logistics environment for high-tech manufacturing, including cooperation between universities and high-tech manufacturers.[584] Vocational training schemes could be set up with standardized curricula, provided, for example, by international bodies such as FIATA, CILT, or at the regional level by the ASEAN Freight Forwarders Association.[585] The new logistics courses in universities could cover practical issues that applicants will face in daily

[580] Interview with Vietnamese logistics expert from the public sector, June 2019
[581] cf. World Bank Group et al. 2018, xi
[582] Interview with Vietnamese LSP, Hanoi, Jan. 2019; corroborated by interview with Vietnamese LSP, Hanoi (2), July 2019
[583] Interview with Vietnamese LSP, Hanoi (2), July 2019
[584] Interview with Ha Pham, Foreign Trade University Hanoi, Nov. 4, 2019
[585] Victoria University Melbourne 2014, 19; corroborated by interview with Ha Pham, Foreign Trade University Hanoi, Nov. 4, 2019

logistics operations, e.g., how to complete a customs declaration and how to use SAP applications.[586] To ensure comparability of training levels, standards-based certification could be adopted through, e.g., CILT or FIATA for international standards, or by the ASEAN Freight Forwarders Association for regional standards.[587]

Connections could be strengthened among universities, colleges, and businesses to train logistics experts.[588] Good practices already exist in the form of a network (established in 2017) of professors and lecturers teaching logistics and led by the Ministry of Industry and Trade which, for instance, organizes national logistics competitions for students in cooperation with LSPs.[589] This could be expanded. It might be worthwhile to introduce "train-the-trainer" schemes, for example, on the basis of the FIATA training curriculum.[590]

Incentives could be offered to LSPs and high-tech companies carrying out logistics functions to offer on-the-job training for logistics in general, and logistics related to high-tech manufacturing in particular.[591] Support could be provided for offering training on digitalization, especially for logistics staff working on customs clearance and warehouse management.[592] Content and financial support could be provided to companies for the training of experienced logistics staff to expand their knowledge with insights on best practices, for instance, in warehousing and trucking management, ideally via practical training, e.g., in warehouses.[593] Courses could be offered on import–export-related issues such as tax policy.[594] A summary of the main results of this chapter can be found in section 8.1.3.

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586 Interview with Vietnamese LSP, July 2019
587 Interview with Ha Pham, Foreign Trade University Hanoi, Nov. 4, 2019
588 Interview with Vietnamese logistics expert, Hanoi, August 2019
589 Interview with Ha Pham, Foreign Trade University Hanoi, Nov. 4, 2019
590 Interview with Vietnamese logistics expert, April 2019; corroborated by interview with Ha Pham, Foreign Trade University Hanoi, Nov. 4, 2019
591 Interview with Ha Pham, Foreign Trade University Hanoi, Nov. 4, 2019; corroborated by interview with Vietnamese logistics expert from Ministry of Industry and Trade, Dec. 2019
592 Interview with Vietnamese logistics professional, Nov. 1, 2019
593 Interview with Vietnamese logistics professional, Nov. 1, 2019
594 Interview with Vietnamese branch of an international manufacturer of electrical equipment, July 2019

6 CASE STUDY 2: MOROCCO

6.1 Rationale for selecting Morocco as a case study

Morocco's geographical position on the Strait of Gibraltar in close proximity to Europe makes it uniquely positioned to act as a connector between Europe and North and West Africa. Turning the country into a logistics hub has been the goal of Moroccan policymakers for the past decade, however, with high logistics costs and comparatively low trade volumes, the country has not yet reached its full potential. A national strategy for the upgrading of the logistics sector was introduced in 2010.[595] This is recent enough to still be relevant, and long enough ago to see whether the measures have shown effects since the most recent large surveys of logistics performance in Morocco, for example, those by CETMO (2010) and by World Bank and Ministère de l'Equipement et du Transport du Maroc (2006). This case study gives an update regarding the country's logistics environment and avenues for its reform, with a focus on the automotive sector. Suggested reform measures are identified by applying the decision framework (section 6.4).

6.2 Country profile

Situated in northern Africa, Morocco has a surface area of 446,550 km^2.[596] As of 2020, it had a population of 37 million. Morocco's economic structure is polycentric, with Casablanca as the main business hub and smaller hubs in Rabat (the capital), Marrakech, Agadir, and around Tangier, where Morocco's automotive industry is centered. The corridor between Rabat and Casablanca, both situated on the western coast of the country, is the location for 70 % of economic activity in Morocco.[597] In 2018, GNI in Morocco was US$112.9 billion.[598] This

[595] Ministère de l'Equipement et du Transport du Maroc 2010, 4
[596] Excludes all disputed territories in the Western Sahara.
[597] OECD 2015, 11
[598] World Bank 2020; calculated using Atlas method (current US$)

equaled a per capita GNI of US$3,090.[599] Overall annual GNI growth between 2014 and 2018 averaged 2.9 % per year.[600] The growth rate of value added services (including logistics services) was 2.5 % annually between 2014 and 2018.[601]

With its ample access to the sea and proximity to Europe, the Middle East and western Africa, Morocco has an advantageous geographical position but is challenged regarding its inland transport by its mountainous eastern part and the relatively poor connectivity of its remote regions in the east and south. Morocco remains a country whose comparative advantage lies in its proximity to Europe, coupled with its labor costs, which are low compared to Europe. The distance between Morocco and Europe via the Strait of Gibraltar is only 15 km. With ever decreasing maritime transport costs, Morocco has a trump card vis-à-vis Asia as the cost of transporting a container from Shanghai to Antwerp or Hamburg is about twice as high as for the passage from Antwerp to Tangier or Hamburg to Casablanca.[602] Owing to the comparatively short transport times between Morocco and Europe, changes in demand for items produced in Morocco can be addressed more quickly than in more distant production locations and lead times are shorter.

Yet, as for any country, even one with a geographically advantageous position, logistics can make or break the country's integration into production networks. Participation in just-in-time production and attracting FDI are only feasible with sound logistics.[603] Since the 2000s, Morocco has invested heavily in its logistics infrastructure. The main goals were to pave the way for domestic exporters and to induce international firms to set up manufacturing in the country so that Morocco could join global value chains. The automotive industry was one of the targeted sectors, along with textiles and electronics. Renault-Nissan was the first large

[599] World Bank 2020; calculated using Atlas method (current US$)
[600] World Bank 2020
[601] World Bank 2020
[602] World Bank and Ministère de l'Equipement et du Transport du Maroc 2006, ii
[603] Raballand et al. 2006, 1

Western car manufacturer to commence operations in Morocco. In 2012, Renault-Nissan began operating at a new factory in Tangier with a production capacity, geared towards exports, of 400,000 cars, mostly bound for Europe.[604] In 2019, Groupe PSA (Peugeot) began manufacturing cars in a factory in Kénitra on the western coast of Morocco; its goal was to serve 80 markets.[605] Several investment programs were set up in recent years to attract carmakers and suppliers to Morocco. Owing to weak internal demand, most Moroccan auto production remains destined for export.

Morocco is a net importer. Goods exports in 2018 were valued at US$24.6 billion.[606] Goods imports were valued at US$44.8 billion.[607] Morocco's foreign trade expanded after the signing of an Association Agreement with the European Union in 2000 and a free trade agreement with the United States in 2004. As of 2018, automobiles were Morocco's second most important export product by value, surpassed only by insulated wire, which is used in cable harnesses for cars (see Figure 6-1). With an export value of US$3 billion in 2018, insulated wire made up 9.4 % of the country's overall value of goods and services exports of US$31.8 billion, thus the country's top two export products are car-related.[608]

[604] Arvis et al. 2012, 23

[605] https://media.groupe-psa.com/en/start-production-kenitra-plant, accessed on August 1, 2020

[606] World Bank 2020. Measured in current US$ from Balance of Payments. Excludes services exports.

[607] World Bank 2020. Measured in current US$ from Balance of Payments. Excludes services imports.

[608] UN Comtrade data, retrieved via www.wits.worldbank.org on May 24, 2020. Exports refer to goods and services.

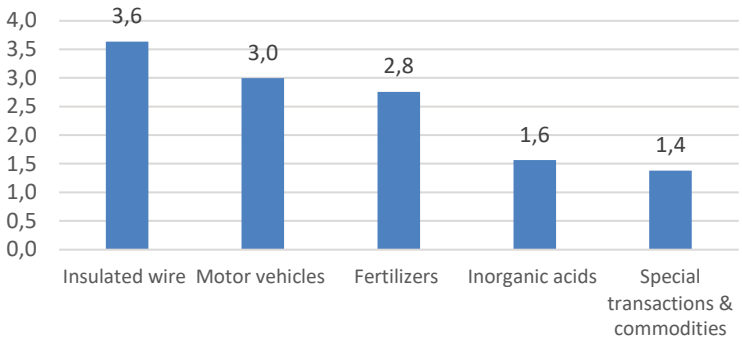

Figure 6-1: Morocco's Top 5 Export Products (in US$billion), 2018[609]

With persistent instability in the Middle East and North Africa region, Morocco—with its comparably stable political and legal system—has good prospects of becoming a base in the region for multinational companies for production and investment. Yet the fragmentation of logistics services and the small size of its home market are hobbling Morocco. There are few advanced logistics operators, and numerous companies in the logistics sector are mere transport operators. The share of outsourcing in the logistics sector in Morocco is currently at only 10 %, compared, for example, to 75 % in Japan.[610] Several factors contribute to explaining this:[611]

1. reluctance of firms to lose control of their distribution networks
2. lack of legislation protecting the interests of clients
3. limited availability of adequate logistics services, with issues including unsuitable vehicles that cause degradation of transported goods (wastage estimated at 2–3 %), low skills levels of employees, and restricted offerings of logistics services, beyond storage.

[609] Products classified at 4-digit SITC (Rev. 4) code. Source: UN Comtrade data, retrieved via www.wits.worldbank.org on May 24, 2020. The products refer to SITC codes 7731, 7812, 5629, 5223, and 9310 (in descending order).
[610] Ministère de l'Equipement et du Transport du Maroc 2010, 34
[611] Ministère de l'Equipement et du Transport du Maroc 2010, 34

All three factors contribute to high transaction costs for firms in Morocco wishing to outsource logistics services and cause the majority of firms to "make" rather than "buy" the needed services. Although about 15 of the world's top logistics providers are present in the country, most domestic Moroccan logistics companies are small.[612] They mainly deal with domestic shipments and have simple storage and distribution practices.[613] The number of illegal operators is high: Up to 30 or 45 % of transport volume is carried out by operators without proper invoicing or registration.[614]

Logistics costs in Morocco stood at 20 % of GDP as of 2019, i.e., at a high level, but one comparable with other middle-income-country peers such as Vietnam (20.8 % of GDP) and Kyrgyzstan (20–23 % of GDP).[615] One goal of the Moroccan national strategy for competitive logistics is to decrease this share to 15 % over the medium term. This would put Morocco on a level with European countries, where logistics costs tend to be between 10 and 16 % of GDP, including in the relatively new European Union member countries that joined in 2004.[616] Owing to low data availability, it is impossible to distinguish logistics costs in Morocco in terms of economy-wide and firm-level logistics costs (for manufacturing, retail, and third-party logistics providers).

6.3 Government plans for upgrading the logistics environment

Logistics features prominently in Moroccan policymaking. In 2010, Morocco adopted a "National Strategy for the Development of Logistics

[612] https://maroc-diplomatique.net/le-secteur-de-la-logistique-contribue/ (accessed on Dec. 31, 2019)
[613] OECD 2015, 23
[614] Based on interviews with logistics experts in the country and corroborated by numbers (30 % share of illegal transport) from Ministère de l'Economie et des Finances du Maroc 2013, 11
[615] For numbers on Morocco: https://www.medias24.com/logistique-la-competitivite-a-la-traine-1427.html, accessed on Dec. 31, 2019; for numbers on Kyrgyzstan: World Bank 2013, 10-11; for numbers on Vietnam: https://english.vietnamnet.vn/fms/business/192227/vietnam-s-logistics-costs-make-up-20-8--of-gdp.html, accessed on Nov. 15, 2018
[616] World Bank and Ministère de l'Equipment et du Transport du Maroc 2006, ii

Competitiveness" that sets out a path to improve the logistics environment over five years.[617] The strategy's horizon has since been extended to 2030 as only some of the intended investments have been realized so far (see 8.2.3).[618] The strategy aims at increasing the productivity of the logistics environment to improve the country's attractiveness for outside investors. This will be achieved by developing transport infrastructure, liberalizing transport modes, and upgrading logistics services. Railways are exempted from the liberalization plans; thus, the state-owned Office National des Chemins de Fer (ONCF) will keep its monopoly on rail. Coordinating the implementation of the strategy falls to the Moroccan Agency for Logistics Development (AMDL).

The main objectives of the logistics strategy are threefold:[619]

1. decrease the share of logistics costs in GDP from 20 to 15 %;
2. accelerate GDP growth by increasing value added, in particular through the emergence of a competitive logistics industry with integrated LSPs;
3. enable the logistics sector to contribute to environmentally sustainable development.

Upgrading logistics for automotive production receives special attention in the National Logistics Strategy. Owing to the high number of parts involved in production and the time sensitivity of just-in-time and just-in-sequence production, the automotive sector relies heavily on well-functioning logistics.[620] Moreover, the share of logistics in total production costs is higher than in other industries, all of which make adequate logistics services a prerequisite for attracting automotive production. Moroccan exports in the automotive sector suffer from the absence of integrated logistics providers and from the preponderance of fragmented

[617] Ministère de l'Equipement et du Transport du Maroc 2010, 4
[618] http://www.invest.gov.ma/?Id=27&lang=fr&RefCat=7&Ref=150, accessed on Dec. 31, 2019
[619] Ministère de l'Equipement et du Transport du Maroc 2010, 4
[620] A typical car contains about 20,000 individual parts (Kern and Wolff 2019, 4).

transport operators.[621] The Moroccan government plans to support logistics for automotive exports through five measures: (1) building logistics zones; (2) developing third-party logistics platforms to handle industrial exports, in particular automotive exports; (3) supporting the training of logistics professionals; (4) supporting consolidating shipments to Europe; and (5) encouraging the cooperation of logistics actors based on shared management of the logistics of the entire value chain.[622]

An overview of which of the intended measures have been implemented in Morocco between 2010 and 2019 is included in section 8.2.3. From interviews with Moroccan logistics experts it became apparent that the prominence of logistics in national policymaking might even be too high. Several ministries and state agencies have introduced programs aimed at strengthening the logistics environment, but not all of their efforts are coordinated. In the development of logistics zones, for instance, the efforts of two ministries (Transport and Commerce) sometimes counteract each other. Having more than one policymaking entity dealing with logistics is understandable, given that logistics is a cross-cutting function that does not easily fit into one single ministry; yet some actions jeopardize a structured approach to improving the logistics environment.

Another challenge arises if a divergence exists between government plans for improving the logistics environment and firms' logistics needs. The main reason for such a divergence lies with the private and public sectors' conflicting goals regarding logistics. Firms aim to minimize time, minimize cost, and maximize the reliability of logistics services. The main logistics goals for governments are not as straightforward. Some of them are similar to firms' goals: short delivery times, low costs to producers and consumers, and high reliability, so that manufacturing and consumption run smoothly. But they include broader goals, for example, sustainability, economic growth, job creation, and social cohe-

[621] Ministère de l'Equipement et du Transport du Maroc 2010, 28
[622] Ministère de l'Equipement et du Transport du Maroc 2010, 28-29

sion. Some of these can be at odds with firms' goals, such as when governments value ecological sustainability more highly than firms do. Governments will skew towards financing logistics interventions that are in line with their priorities.

For Morocco, no large divergence between the government's plans and those of firms is detectable. Firms agreed that most hard infrastructure needs have been met (or will be met once the investments projected under the National Logistics Strategy are complete) and that the focus now has to be on soft constraints. One of the remaining main constraints, namely raising the maturity of logistics operations at the company level, is in the realm of the private than the public sector.

With a view to the large role that public or public-private operators play in the Moroccan logistics sector, two main threats to private operators exist:[623]

- capture of an even larger share of the logistics market by public or near-public operators such as ONCF and SNTL (Société Nationale des Transports et de Logistique). The role of SNTL as a parastatal company is ambiguous: While it contributes a comparatively high level of sophistication to the industry, it also enjoys a quasi-monopoly in logistics services. Thus, it may lead to higher prices and crowd out other providers.
- crowding out of private investors, e.g., in logistics zones, due to the structural advantage for real estate that public entities enjoy, especially ONCF with its real-estate holdings.

During the interviews with Moroccan stakeholders, several interviewees mentioned the need for better coordination of government efforts to improve the logistics environment. While this may resonate with the central government, it might diverge from the views of individual departments eager to keep their role and funding.

[623] OECD 2015, 82

6.4 Application of decision framework to automotive products and Morocco

6.4.1 Level 1: Target set-up of logistics environment

The target set-up describes the ideal state of a well-functioning logistics environment (section 4.3.3). For automotive goods, it is characterized by a high degree of flexibility in the logistics environment, with short delivery times of a few weeks or days. Flexibility here refers to the capability to change based on a set of defined contingency scenarios.[624] The ideal automotive logistics environment is characterized by a high degree of reliability: The logistics environment is resilient in the face of, for example, port shutdowns and road congestion and still ensures on-time delivery quotas of close to 100 %. Reliability here relates to the degree of certainty in lead time, where lead time refers to the time it takes for goods to arrive at the purchaser after the order has been placed.[625] Lastly, the target set-up is characterized by a low level of logistics costs, on par with international standards (ca. 10–17 % of GDP, viewed across all sectors of the economy) or, ideally, lower.[626]

6.4.2 Level 2: Logistics concepts

This section links logistics concepts prevalent in the automotive product category to the target set-up of the logistics environment. The logistics concepts listed below are business practices, but they need an enabling environment made up of components from all functional categories:

- trade-off between responsiveness and efficiency of the logistics environment:[627] Responsiveness must be high to keep up with the pace of the industry, but cost pressure mandates efficiency: This links to the target set-up components flexibility, reliability, and cost.

[624] cf. OECD 2013, 50
[625] cf. Hausman et al. 2013, 241
[626] cf. Memedovic et al. 2005, 358
[627] cf. Ivanov et al. 2019

- pull-oriented production and distribution (make-to-order) rather than push-oriented production and distribution (make-to-stock):[628] This links to flexibility.
- just-in-time or just-in-sequence production (delivery of components based on production schedule for individualized products): This links to flexibility.
- ability to handle large volumes of imported inputs, most of them by sea:[629] This links to reliability and flexibility.
- ability to handle large volumes of finalized products for export, most of them containerized and by sea:[630] This links to reliability and flexibility.
- transmission of responsibility for quality assurance shifted from manufacturer to supplier or to 3PL, with high demands on quality of products and processes:[631] This links to reliability.

6.4.3 Level 3: Trends

Based on a literature review of automotive trends, the following trends were identified that may impact on logistics in the automotive sector in the next decade, i.e., until approximately 2030:

1. **rising cost pressure**: the need to optimize the logistics environment regarding cost, e.g., by moving production to low-wage locations and by lowering logistics costs (transport, warehousing, inventory, and administration).[632] Cost pressure will rise with the adoption of freight platforms that increase price transparency between transportation providers.[633]
2. **higher degree of complexity in car manufacturing**: higher number of parts, production lines, and individualization options and

[628] cf. Göpfert and Braun 2017, 29
[629] cf. Pham et al. 2013a, 42
[630] cf. Pham et al. 2013a, 42
[631] cf. Göpfert and Braun 2017, 28
[632] cf. Göpfert et al. 2017, 12
[633] cf. Straube (Ed.) 2019, 37

hence higher complexity of associated logistics processes owing to higher production flexibility.[634]

3. **switch to low carbon vehicle**s: to reduce greenhouse gas emissions by 55 % by 2030, the European Parliament and the European Commission in 2019 adopted strict emission performance standards for new passenger cars in the EU.[635] With the European Union being a key market for automobiles, these regulations will have ramifications for automotive manufacturers worldwide, and for their supply chains, due to the differences between manufacturing cars with combustion engines vis-à-vis those using electricity or hydrogen as fuel.
4. **rising share of local rather than global sourcing** for parts and components owing to local content rules[636] and high capacity utilization in plants, with production taking place at any plant with idle capacity. There will be a rising need for LSPs that can handle international operations to move cars quickly to buyers in their respective locations as well as increasing need for infrastructure suitable for import/export of components to and from international destinations.

Another trend that will impact the automotive logistics environment, but which is not specific to that product category is environmental sustainability. Both the demand and requirements for environmental sustainability in logistics operations will rise.[637] BMW, Audi, Mercedes, and Ford are examples of OEMs that have set ambitious targets to reduce their carbon footprints in the next few decades, including by requiring their suppliers to reduce their greenhouse gas emissions.[638] Measures to address sustainability in logistics operations are included in level 6.

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634 cf. Göpfert and Braun 2017, 33

635 https://ec.europa.eu/clima/policies/transport/vehicles/regulation_en, accessed on Nov. 17, 2020

636 cf. Köhne et al. 2017, 218

637 cf. Göpfert et al. 2017, 12

638 For BMW, Audi, and Mercedes: https://europe.autonews.com/automakers/bmw-mercedes-audi-others-race-make-entire-supply-chain-greener; For Ford: https://www.supplychaindive.

6.4.4 Level 4: Logistics requirements—Answer to research sub-question 1 with application to automotive products

This section lays out the requirements of the logistics environment for the automotive product category, without a focus on a particular country. It forms the answer to research sub-question 1, with an application to automotive products:

What are the logistics requirements of automotive products?

The full list of requirements is included in Appendix 10.6.4, and shows the requirements grouped by functional category and target set-up characteristic. Requirements applicable to all three product categories examined are included in section 4.7.

TRANSPORT- AND TRADE-RELATED INFRASTRUCTURE

The main infrastructure requirement to enable a flexible logistics environment for automotive production is the facilitation of intermodal transport, with the ability of ports to handle high container volumes (for parts and components) as well as roll-on roll-off traffic (for shipping of finished cars), and a large road network in good condition, especially within a 100 km radius of seaports and between major automotive production areas, logistics zones, and export gateways. This supports rapid and efficient transit of production inputs and finished outputs. Another requirement is the availability of reliable air transport to ensure short shipment times for products with high value density such as crucial parts, tools, and machinery for automotive production.[639] Special loading equipment tailored to the goods to be exported should be available, so that goods can be loaded fast and without suffering damage during handling.

com/news/ford-supply-chain-sustainability-partnership-suppliers/438182/ (accessed on August 4, 2020)

[639] cf. Blyde and Molina 2013, 12

INFORMATION AND COMMUNICATIONS TECHNOLOGY

Digital, rather than paper-based, methods are needed so that partners in the automotive supply chain can exchange information efficiently. To automate information exchange between companies (e.g., for advance shipment notices), it is imperative to integrate IT tools and data formats between suppliers and customers.[640] Data tools should span different transport modes.

ORGANIZATION OF THE LOGISTICS ENVIRONMENT ("ECO-SYSTEM")

As supply chain disruptions can have highly negative impacts on time-sensitive automotive exports, supply chain partners need to be able to estimate the impact of potential disruptions to be able to guard against them.[641] This issue has become more acute with automotive producers' growing dependence on few suppliers, which leads to greater threats to profitability in case of a disruption to one of those suppliers.[642] The impacts of disruptions on the performance of an automotive supply chain vary across supplier sites; thus, a country would be well-advised to help ensure that supplier sites within the country are minimally vulnerable.[643] Some of the supply chain disruption risks are largely outside the influence of the public sector, for example, earthquakes and hurricanes, although even they can be mitigated by increasing supply chain resilience; whereas other disruption risks, such as power outages, transportation breakdowns, and port closures, are partly influenceable by governments.[644]

Automotive production processes typically run around the clock rather than on a 9 to 5 schedule. Consequently, ports and airports should be open 24/7, or as close to 24/7 as possible. Reliable management of ports,

640 cf. Göpfert and Braun 2017, 28
641 cf. Simchi-Levi et al. 2015, 377
642 cf. Simchi-Levi et al. 2015, 286
643 cf. Simchi-Levi et al. 2015, 385
644 cf. Simchi-Levi et al. 2015, 386

airports and rail transport helps to keep these services cost-effective and dependable.[645] To increase the competitiveness of a country as a production location for automotive goods, logistics costs should be on par with international standards (ca. 10–17 % of GDP, viewed across all economic sectors) or, ideally lower.[646] This ties in with the trend of rising cost pressure in the automotive sector.

BUSINESS PRACTICES FOR HIGH-QUALITY LOGISTICS SERVICES

The complexity of a supply chain rises with the complexity of a product. For the highly complex automotive product category—where one finished automobile contains tens of thousands of parts—this requires that to ensure reliability and flexibility, logistics operators should adopt international standards in the use of advanced flow management, palletization, or advanced IT solutions, and should offer services tailored to the needs of original equipment manufacturers and suppliers.

Flexibility is needed from supply chain partners on various levels, in terms of, for instance: delivery speed (referring to the ability to modify delivery dates), supplier base (referring to available alternative suppliers), sourcing (referring to the ease with which a firm can change supply chain partners), and logistics (referring to the number of LSPs available to carry out logistics services for an automotive manufacturer).[647]

CUSTOMS PRACTICES

Customs, as a core government function, is the area with the clearest link between government action and the ease of exporting from and importing into a country. Similar to the need for ports and airports to open 24/7, customs services and border posts should have long and reliable opening hours to minimize time lost in the cross-border transport chain.

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645 cf. World Bank 2010, 45
646 For the numbers on logistics costs: cf. Memedovic et al. 2005, 358
647 cf. Qamar et al. 2018, 3979 and 3988

REGULATORY ENVIRONMENT

Within national governments, responsibility for logistics is often spread across different ministries (e.g., Transport, Trade, and/or Industry), so that legislative authority is scattered across entities. Legislation covering all aspects of logistics is needed to provide a dependable legal framework for logistics actors and thus improve the business environment. Enforcement of legislation is necessary to keep transaction costs low. Minimizing the number of illegal logistics providers, that is, those operating without proper invoicing or registration, is required to provide a level playing field. Subsidy schemes that are relevant to LSPs—if introduced at all—should be designed to minimize market distortions.

EDUCATION, SKILLS, AND PROFESSIONAL TRAINING

An adequate supply of trained logistics specialists is crucial to meet demand surges. Staff should possess both general logistics knowledge and specialized knowledge on the automotive supply chain. Adequate staffing of road transport is important as, in most countries, intra-country transportation relies mainly on this mode.

6.4.5 Level 5: Gap analysis—Answer to research sub-question 2 with application to automotive goods and Morocco

The gap analysis, the fifth stage of the decision framework, is product-category- and country-specific. It juxtaposes the logistics requirements from section 6.4.4 with the current state of the logistics environment for automotive goods in Morocco and identifies which logistics constraints are prevalent in the country for automotive goods. This section forms the answer to research sub-question 2, with application to Morocco and automotive goods:

Which country-specific constraints are prevalent in Morocco in the logistics environment for automotive products?

The full gap analysis for Morocco is included in Appendix 10.6.5. Data for this level were distilled from interviews with logistics experts based

in or familiar with the country. In addition to private sector firm representatives, interviews were conducted with organizations tied to logistics and trade, for example, AMDL, the agency responsible for implementing the Moroccan national logistics strategy, and PortNet S.A., the parastatal organization that developed the country's trade information portal. See Appendix 10.3 for a list of interviews. Further data for the gap analysis came from official country statistics and public databases and reports.

TRANSPORT- AND TRADE-RELATED INFRASTRUCTURE

Facilitation of intermodal transport is the infrastructure-related requirement that, in Morocco, has the largest gaps.[648] Intermodal transport is underdeveloped in the country, mainly owing to the short rail network (2,109 km); the only route connecting road to rail and maritime transport runs from Casablanca port to Tangier. The rail network exhibits varying density, with several regions as blind spots (e.g., around Agadir); hence, exports rely heavily on road transport, which has worse environmental consequences than rail or maritime transport. Although the road network is in overall good condition, road density (km of road per 100 km^2 of land area) is comparatively low: It was 13.1 in Morocco in 2011, compared with 191.6 in France or 180.3 in Germany,[649] and the importance of the transport and logistics sector regarding GDP is comparatively low (5.1 % of GDP[650] vs. the European average of 15 %), thus leaving the country with fewer options for road transport. As automotive production is centered around clusters on the western coast of Morocco, the road network does not need to be dense in all areas of the country, yet road

[648] Unless otherwise noted, information in this section is based on interviews with Moroccan logistics stakeholders by the author in November and December 2015.

[649] International Road Federation Geneva, World Road Statistics, accessed via World Bank, World Development Indicators (WDI) on Feb. 13, 2015 (not included in subsequent WDI updates; 2011 data are the latest available). Road density is the ratio of the length of the country's total road network to the country's land area. The road network includes all roads in the country: motorways, highways, main or national roads, secondary or regional roads, and other urban and rural roads.

[650] https://maroc-diplomatique.net/le-secteur-de-la-logistique-contribue/(accessed on Dec. 31, 2019)

links are missing even for some logistics zones in the northeast. As for air transport, the share of goods transported by air compared with other transport modes is low (5 % by value; 0.1 % by weight)[651], which is difficult for sectors relying on just-in-time production such as the automotive sector. There is a lack of transshipment facilities outside the port of Tanger-Med.

INFORMATION AND COMMUNICATIONS TECHNOLOGY

Some digital government services for import and export are available, in particular an IT system for customs and the PortNet National Single Window system, a digital platform that acts as a single entry point for regulatory information relevant to traders to allow paperless import and export processes, thus potentially reducing administrative costs.[652] Tracking and tracing technology is underused, which hampers the monitoring of reliability and supply chain visibility, that is, insights into which production components and outputs are available in what quantity at which location.

ORGANIZATION OF THE LOGISTICS ENVIRONMENT ("ECOSYSTEM")

None of the Moroccan ports is open 24/7, and the same holds for Moroccan airports. This restricts the times at which automotive imports and exports can be processed, including at the hubs of Tangier and Casablanca. A further hindrance is the weak competition in several transport modes: All logistics services suffer through competition from state-owned enterprises, especially from SNTL and Poste Maroc, which can underbid market prices by 30 % to 40 % owing to lower taxes and access to low-cost financing and prime real estate. This signifies limited alternatives for companies seeking logistics services, thus limiting flexibility and causing a lack of fallback options, which can reduce reliability. While the lower cost (owing to state subsidies) of state-owned en-

[651] World Bank and Ministère de l'Equipement et du Transport du Maroc 2006, 50

[652] https://portail.portnet.ma, accessed on March 23, 2019; cf. World Trade Organization 2014, 13

terprises seem, prima facie, to support the target set-up characteristic of low costs, in the long term this argument is likely to be dispelled by higher costs induced by a lack of competition. As for logistics costs: At 20 % of GDP (as of 2019), the level of logistics costs is high, above the level of 10–16 % of GDP of European countries.[653] Satisfaction with rail transport service providers is low.[654]

BUSINESS PRACTICES FOR HIGH-QUALITY LOGISTICS SERVICES

The number of advanced logistics operators is low: 98 % merely offer domestic, or even only regional, transport or storage services.[655] Fragmentation among transport operators is paramount: more than 90 % own only one or two trucks.[656] Although potentially contributing to higher competition and thus lower freight rates, this fragmentation is likely to drive up transaction costs for automotive suppliers and OEMs, as contracting out and coordinating logistics services is difficult with such fragmented providers.

CUSTOMS PRACTICES

Similar to ports and airports, customs services and border posts in Morocco are not open 24/7. Risk management procedures to concentrate control efforts on high-risk shipments are insufficient, as evidenced by the compulsory scanning of 100 % of merchandise leaving from Tanger-Med, with wait times between two and 24 hours. This adversely affects all characteristics of the target setup by increasing cost, lowering flexibility, and decreasing predictability and hence reliability.

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653 https://www.medias24.com/logistique-la-competitivite-a-la-traine-1427.html (accessed on Dec. 31, 2019). This number does not distinguish between economy-wide and firm-level logistics costs and no data were obtainable differentiating the two.

654 Arvis et al. 2016, 18

655 CETMO 2010, 21

656 CETMO 2010, 20

REGULATORY ENVIRONMENT

The number of illegal logistics operators (i.e., those operating without proper invoicing or registration) is high at an estimated 30 to 45 % of all operators.[657] One ramification of this is that these operators are incapable of scaling up as they are unable to obtain credit. Several existing subsidy schemes that are relevant to LSPs are not designed to minimize market distortions. For example, the truck scrappage scheme suffers from scrappage premiums that are lower than truck resale values, thereby keeping high-emission and dangerous trucks on the road. Moreover, a scheme to ease access to loans for small transport operators to purchase equipment is ineffective as the paperwork is too cumbersome.

EDUCATION, SKILLS, AND PROFESSIONAL TRAINING

The logistics environment for automotive goods in Morocco suffers from a shortage of trained logistics specialists, in particular forklift operators, truck drivers, material planners, order pickers, and team leaders. Although car maker Renault collaborated with a French education center (Institut de Formation aux Métiers de l'Industrie Automobile Tanger-Med), which also offers logistics courses, the paucity of structured training programs is hampering skills formation in the country.[658] No structured training is available at the company level. Instead, the focus is on tertiary education, leading to underinvestment in human capital and a lack of practical skills.

IMPLICATIONS OF GAP ANALYSIS RESULTS FOR MOROCCO

The gap analysis enables identifying the current shortcomings of Morocco's logistics environment vis-à-vis the logistics requirements of the automotive industry, in particular with a view towards flexibility, reliability, and cost efficiency. Infrastructure gaps persist despite large-scale infrastructure investments in Morocco over the past two decades, for

[657] Ministère de l'Economie et des Finances du Maroc 2013, 11

[658] For information on the Institut de Formation aux Métiers de l'Industrie Automobile Tanger-Med, see http://www.ifmia.ma (accessed Dec. 7, 2020).

example, the construction of Tanger-Med port, logistics zones in the northwest, and several access roads. A lack of intermodal transport options causes low flexibility and possibly higher costs for those seeking alternatives to road transport from the point of production to the export gateway. Air transport is available, but only in limited form with few connections and mainly from Casablanca airport, which causes difficulties for an industry as reliant on just-in-time and just-in-sequence production as the automotive one, which is clustered in the northwest of the country. Several other gaps drive up the cost of logistics in Morocco, for instance, the limited adoption of electronic data interchange in customs, or the mandate to scan 100 % of containers leaving Tanger-Med port, the associated wait times of which also reduce reliability.

The low number of diversified LSPs with wide service offerings and large fleets hampers flexibility and reliability for those seeking alternative logistics solutions. Regulatory issues and the organization of the logistics environment are two other areas where gaps exist. Weak competition in the logistics sector due to the dominance of state-owned enterprises limits flexibility and reduces the number of fallback options, thus constraining reliability. The fragmentation of the sector into mostly owner-operated truck firms, many of which operate without registration, entails high costs of contracting and coordination. Lastly, education and training of logistics personnel in Morocco exhibits gaps: the lack of structured training for logistics specialists leads to high costs for firms to find and train qualified personnel. The following section suggests logistics measures to close the gaps identified in section 6.4.5.

6.4.6 Level 6: Logistics measures—Answer to main research question with application to automotive goods and Morocco

This is the sixth and final stage of the decision framework. Based on the preceding gap analysis, the following measures are suggested for Morocco to meet the logistics requirements of automotive goods and foster exports in that product category. This section forms the answer to the

main research question, with application to automotive goods and Morocco:

Which country-specific logistics measures should the government of Morocco take to foster automotive exports?

The full list of suggested measures is included in Appendix 10.6.6.

TRANSPORT- AND TRADE-RELATED INFRASTRUCTURE

***Focal area**: Facilitation of intermodal transport and availability of large road and rail network so that production inputs and finished outputs can be transported to and from the place of production using the most efficient combination of transport modes*

In light of the data collected as part of the gap analysis for Morocco, equipping logistics zones with more links to the main road and rail networks would seem a sensible option, and zones could offer services including providing warehousing, customs facilities, truck centers, and value-adding services such as packaging and labeling and container loading facilities. Dry port and/or storage facilities could be established close to Tanger-Med port, which is located close to the two main automotive plants in the country—the Renault-Nissan plant in Tangier and the PSA Peugeot Citroën plant in Kénitra.[659] More private sector participation could be secured in the set-up of logistics zones. For locations where full-blown logistics zones are not warranted, but container loading facilities are needed, ICDs could be constructed for transshipment, i.e., multimodal logistics platforms for the loading and unloading of containers, with linkages for trucks and trailers. It would be beneficial to have loading equipment, tailored to automotive goods, that could be used across firms in the automotive supply chain. Tax incentives could

[659] Dry ports as defined by Nguyen and Notteboom (2016, 23) are "inland terminals that have strong connections to gateway seaports by high capacity and frequent transport services." For guidelines on how to select dry port locations, see Nguyen and Notteboom (2016, 26).

be used to purchase such equipment, and mechanisms for sharing equipment could be supported, for example, digital logistics platforms.

***Focal area**: Availability of reliable air transport to ensure that critical inputs can be swiftly brought in (to avoid production stoppages) and products with high value density can be quickly exported out of the country*

Based on the outcome of the gap analysis, investments in airport facilities and upgrading air cargo facilities might be warranted, including warehouses at airports and pallet scanners to facilitate the examination of air freight, mainly in Casablanca and Tangier.[660] If pure air transport is too expensive, sea–air bridges could be fostered, that is, maritime transport for the first part of the trip, then transloading of products at an air hub for air transport to the final destination; or, alternatively, air–sea bridges, for instance, using the south of France or Spain as the destinations for air transport for incoming inputs and subsequent maritime transport to Tangier across the Strait of Gibraltar.

INFORMATION AND COMMUNICATIONS TECHNOLOGY

***Focal area:** Enabling the integration of IT and data tools between suppliers and customers to facilitate and automate cross-company information exchange and tracking and tracing across transport modes*

Increased collaboration of automotive supply chain partners could be enabled via digital logistics platforms by strengthening the broadband internet infrastructure necessary for online coordination. Cloud computing could provide fast and convenient access to shared information among supply chain partners.[661] The private sector could be incentivized to introduce predictions of estimated time of arrival for the entire

[660] cf. Banomyong et al. 2008, 366
[661] cf. Kern and Wolff 2019, 4

transport chain, potentially by using AI and machine learning.[662] IoT devices can support route optimization as IoT enables objects to communicate their location or status online.[663]

In terms of IT tools for government services, it would be worthwhile to introduce online options for government services, including e-signatures for government approvals.[664] Further guidance on ICT applications specific to the automotive sector can be found via the Odette platform, a not-for-profit organization that brings together logistics professionals and technology experts.[665] Odette, of which Morocco is an associate member, provides tools for assessing logistics performance, using radio frequency identification (RFID) and CO_2 emissions reporting, among others.[666]

ORGANIZATION OF THE LOGISTICS ENVIRONMENT ("ECOSYSTEM")

***Focal area**: Provision of flexible, cost-effective, and reliable trade-enabling services*

Ports (at least Casablanca and Tanger-Med) and airports would ideally be open 24/7. If border traffic does not warrant such long hours, opening times should at least be reliable and match the private sector's needs, including weekend opening times if production and export schedules require this. Where not introduced already, commercial management could be introduced in port, airport, and potentially rail operations.[667] Private sector participation to build and maintain public infrastructure should be increased.[668]

662 cf. Poschmann et al. 2019, 162
663 cf. Kern and Wolff 2019, 4
664 cf. World Bank 2010, 44
665 https://www.odette.org, accessed on Nov. 17, 2020
666 https://www.odette.org/about-us/, accessed on Nov. 17, 2020
667 cf. World Bank 2010, 45
668 cf. World Bank 2010, 45

***Focal area**: Establishment of a level playing field for all logistics actors and tight coordination of logistics-related government entities to ensure low prices and high reliability*

To ensure competitive freight handling, trucking, shipping, and warehousing services, it would be beneficial if state-owned enterprises in transport and logistics did not enjoy advantages vis-à-vis private operators, especially regarding taxes and access to finance and real estate. The coordination of logistics-zone development could be improved by reducing overlap in the development of logistics zones advanced by the state. Currently, there are two parastatal actors that both develop zones (ONCF, the public rail operator, and SNTL, a parastatal logistics company), whereas a single developer might be more economical. The coordination of government efforts to foster the logistics environment and the automotive sector could be improved. This includes better coordination by the relevant ministries of investment-promoting programs, especially between the Ministry of Transport, Equipment and Logistics and the Ministry of Industry, Commerce, Investment and Digital Economy.

***Focal area:** Reduction of logistics costs to international best practice*

International best practice suggests that logistics costs should not exceed 10 to 17 % of GDP.[669] Policymakers in Morocco could work towards the reduction of logistics costs from the 2019 level of 20 % of GDP by fostering healthy competition in all transport modes, lowering transaction costs of transit (customs and handling charges), and increasing reliability and predictability in the logistics environment.

[669] cf. Memedovic et al. 2005, 358

BUSINESS PRACTICES FOR HIGH-QUALITY LOGISTICS SERVICES

Focal area: *Enabling efficient intra-company processes*

To enable increased collaboration of logistics partners, digital logistics platforms could be fostered by, for instance, offering tax incentives and strengthening broadband internet infrastructure. The role of government in this area is limited as the focal area refers to intra-company processes. Supply chain volatility could be mitigated by concentrating on outliers and identifying the reasons, as well as by creating incentives, for customers to share stock levels to increase forecasting accuracy.[670] The introduction of automated guided vehicles could be supported, that is, means of conveyance for raw materials inside warehouses that are guided automatically and driven without direct contact.[671]

Another suggested measure is to incentivize the use of additive manufacturing to produce spare parts to reduce lead times and the cost of safety inventory.[672] Robotics, that is, machines able to perform complex series of actions, could further increase the efficiency of intra-company processes.[673] The implementation of warehouse management systems could be supported to enable just-in-time and just-in-sequence delivery via real-time visibility of inventory and track-and-trace functionality of the entire supply chain.[674] Blockchain applications could facilitate verifiable and permanently storable information about transactions between two supply chain parties, be they part of the public or private sector.[675]

[670] cf. Nitsche 2018, 19
[671] cf. Kern and Wolff 2019, 4
[672] cf. Liu et al. 2014, 1169
[673] cf. Kern and Wolff 2019, 4
[674] cf. Barreto et al. 2017, 1249
[675] cf. Kern and Wolff 2019, 4

CUSTOMS PRACTICES

***Focal area**: Provision of efficient and predictable border management procedures to enable fast export processes without undue cost burdens*

To support the round-the-clock production schedule of automotive manufacturing, border control entities should be open 24/7. If such long opening hours are not warranted, they should at least be reliable, in line with the opening hours of other trade-enabling services (e.g., ports and airports), and match the private sector's needs, including weekend opening times if production or export schedules require this. A single point of entry for information used in the clearance of cargo would be good, that is, completion of the PortNet application.[676] Electronic data interchange for customs could be offered to eliminate the need for duplicate data entry, and customs could accept scanned copies for supporting documents and e-signatures.[677]

As a long-term measure, blockchain technology could be introduced for archiving customs documents to prevent unauthorized modifications, expedite the flow of information, and improve confidence in customs documentation.[678] Coupled with IoT sensors, blockchain-enabled applications could be used to further expedite customs processes.[679] New customs zones ("aires de dédouanement") could be established outside the port to allow exporters and importers to complete customs and other formalities closer to their places of business. Risk management programs could be introduced to expedite clearance, including reduced inspections to remove the need to scan 100 % of merchandise leaving Tanger-Med port.[680]

[676] cf. World Bank 2010, 44
[677] cf. World Bank 2010, 44
[678] cf. Ivanov et al. 2019, 500
[679] cf. World Economic Forum 2020, 23
[680] cf. World Trade Organization 2014, 8

REGULATORY ENVIRONMENT

***Focal area**: Adaptation of the regulatory environment to logistics and minimization of market distortions*

A draft logistics law was being considered by the Moroccan parliament in 2019. Policymakers should ensure that the final law includes rules on logistics zones, and that it allows increased scales of logistics providers through mergers and acquisitions.[681] Air cargo could be facilitated by deregulating air freight services and by introducing "fifth freedom" or other bilateral freedoms.[682] The truck scrappage scheme could be modified, either by raising scrappage premiums so they are higher than truck resale values or by ending the program.[683] The main regulatory challenge in Morocco is the high number of illegal logistics providers, that is, those operating without invoicing or registration. This number could be reduced by favoring official operators through the following measures: reducing fees and taxes to incentivize operators to register; increasing controls on illegal activities such as unofficial warehousing in city centers; lightening administrative burdens for logistics operators; and improving export facilitation.

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[681] For the portion on increased scale of logistics providers: cf. World Bank 2010, 43

[682] Fifth freedom refers to "the right or privilege, in respect of scheduled international air services, granted by one State to another State to put down and to take on, in the territory of the first State, traffic coming from or destined to a third State" (source, also for other freedoms of the air: https://www.icao.int/Pages/freedomsAir.aspx, accessed on June 19, 2020)

[683] Havenga et al. (2020, 199) suggest a scrappage scheme where owners receive a relatively high scrap value rebate on their old vehicles upon purchasing a new one. Their recommendations are not tied to Morocco but are offered as general advice on fleet management policies.

EDUCATION, SKILLS, AND PROFESSIONAL TRAINING

Focal area: *Ensuring the supply of trained specialists with knowledge of automotive logistics*

Skills and competency development will have to ready the future workforce for the effects that digitalization will have on the automotive supply chain. Software, data skills, and future-oriented production elements such as robotics should become more prominent in curricula, both those of public education providers and private companies supplying on-the-job training. Gamification could motivate younger job seekers in particular to enhance their skills, and could be exploited by governments for public training programs.[684]

Vocational education, formal jobs training, and skills upgrading could be improved to increase the number of trained freight forwarders, forklift operators, truck drivers, material planners, order pickers, and team leaders skilled in logistics for automotive products. Policymakers would be well-advised to ensure that training is available not only at tertiary level, but also as vocational and on-the-job training, with logistics providers and shippers providing some of the training, rather than just universities.[685] Professional standards and certifications for LSPs could be introduced to ensure the quality of education and training.[686] Educating young people in areas such as analytical thinking, openness towards new technologies, and a mindset for lifelong learning could be incorporated even into high-school curricula. A summary of the main results of this chapter can be found in section 8.1.4.

[684] cf. Kern and Wolff 2019, 16
[685] cf. McKinnon et al. 2017, 61
[686] cf. World Bank 2010, 43

7 CASE STUDY 3: KYRGYZSTAN

7.1 Rationale for selecting Kyrgyzstan as a case study

As a landlocked country, Kyrgyzstan faces large trade logistics challenges, as all exports except for those by air must pass through transit countries. The country suffers from high logistics costs and comparatively low traded volumes. The country's government has begun to address these constraints with the 2018 Sustainable Development Strategy of Kyrgyzstan, but gaps remain.[687] The case study will focus on perishable agricultural goods, as this product category holds the highest potential for higher-value exports for Kyrgyzstan, a country whose mountainous terrain renders it unsuitable for large-scale manufacturing.

7.2 Country profile

Kyrgyzstan is a small, mountainous, landlocked country in Central Asia with a population of 6.6 million in 2020. It borders Kazakhstan to the north, China to the east, Tajikistan to the south, and Uzbekistan to the west. The capital and industrial center Bishkek is located in the country's north. In 2018, GNI in Kyrgyzstan was US$7.7 billion.[688] This equaled a per capita GNI of US$1,220.[689] Overall annual GNI growth between 2014 and 2018 averaged 4.6 % per year.[690] The annual growth rate of value-added services (i.e., including logistics services) was 3.4 % between 2014 and 2018.[691] The country's economic structure is monocentric with a strong emphasis on the capital, Bishkek. The prevalence of Russian as a first or second language lowers the barriers to entry for companies from Russia and other predominantly Russian-speaking countries.

[687] National Council for Sustainable Development of Kyrgyzstan 2018
[688] World Bank 2020; calculated using Atlas method (current US$)
[689] World Bank 2020; calculated using Atlas method (current US$)
[690] World Bank 2020
[691] World Bank 2020

Kyrgyzstan is a net importer. In 2018, the country exported goods valued at US$1.9 billion.[692] Goods imports were valued at US$4.9 billion.[693] Russia, China, and Kazakhstan are its main trading partners. In 2015, Kyrgyzstan joined the Eurasian Economic Union (EAEU), a partnership of five countries (Armenia, Belarus, Kazakhstan, Kyrgyzstan, and Russia). The EAEU created a single market of over 180 million people with a GDP of roughly US$4 trillion (PPP). It introduced free movement of goods, capital, services, and people. As of 2018, gold was by far Kyrgyzstan's main export product by value (see Figure 7-1).

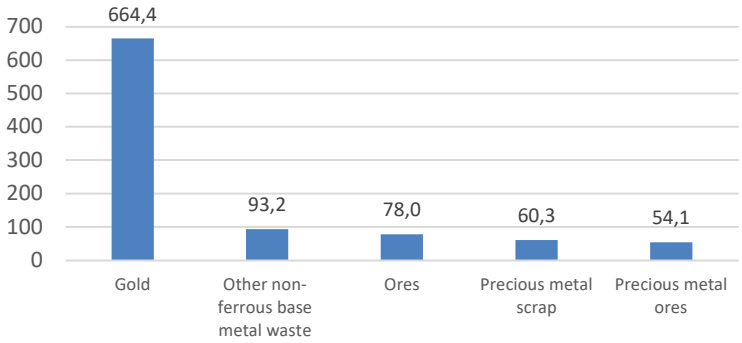

Figure 7-1: Kyrgyzstan's Top 5 Export Products (in US$million), 2018[694]

Owing to the mountainous landscape, road transport accounts for more than half of cargo transported in Kyrgyzstan, by some estimates even 97 % of all cargo transported.[695] The country's logistics structure can be

[692] World Bank 2020. Measured in current US$ from Balance of Payments. Excludes services exports.

[693] World Bank 2020. Measured in current US$ from Balance of Payments. Excludes services imports.

[694] Products classified at 4-digit SITC (Rev. 4) code. Source: UN Comtrade data, retrieved via www.wits.worldbank.org on May 24, 2020. The products refer to SITC codes 9710, 2882, 2879, 2892, and 2891 (in descending order).

[695] Number referring to more than half of cargo: Asian Development Bank 2013a, 1; number referring to 97 % of all cargo: Interview with Freight Operators Association of Kyrgyzstan, Bishkek, April 11, 2016

characterized as at an intermediate stage, typical of a transitional country.[696] Strong development potential is countered by a supply of logistics services that vary regarding cost, breadth, quality, and reliability. Most demand for logistics services is at a non-sophisticated level. The logistics services sector is fragmented, with almost no advanced domestic operators and fewer than 25 companies owning more than ten trucks.[697] Most companies in the logistics sector are mere transport operators, and many are owner-operator, one-truck companies, some of them operating illegally, that is, without invoicing or registration. The share of outsourced logistics in Kyrgyzstan is low and there are only a few third-party logistics providers, most of them located in Bishkek. As of 2016, the only international LSPs with a presence in Kyrgyzstan were the express carriers DHL Worldwide Express and TNT Express. Other large LSPs, e.g., DB Schenker, UPS and FedEx, were represented by local companies.

As a landlocked country, Kyrgyzstan does not have direct access to maritime transport. The nearest accessible maritime port was, for a long time, Novorossiysk (Russia), which is 4,200 km from Bishkek and requires transit through Kazakhstan. Ports in Pakistan provide a newer option; these are geographically closer but also entail a more dangerous route involving transit through Uzbekistan and Afghanistan. As for inland waterways, none of the country's rivers are navigable and there are no canals. There are 420 km of railway tracks in the country.[698] Technical standards and gauges are compatible with the rail systems in the Russian Federation, Kazakhstan, and Uzbekistan, but not with that in China.[699] As for air transport, there are four international and seven domestic airports in Kyrgyzstan.[700] Out of safety concerns, all Kyrgyz air-

[696] cf. Figiel et al. 2014, 14. Figiel et al. are referring to cities rather than countries.
[697] World Bank 2013, 24
[698] Asian Development Bank 2013a, 1
[699] Asian Development Bank 2013a, 1
[700] Asian Development Bank 2013a, 1

lines are banned from flying within the European Union.[701] Little intermodal transport takes places in Kyrgyzstan owing to a lack of integrated transport systems and the fragmented rail system.

Logistics costs for exports in Kyrgyzstan are estimated at 20 to 23 % of GDP, much higher than in Europe, where logistics costs on average make up 11 % of GDP, but in line with other middle-income country peers such as Vietnam (20.8 % of GDP) and Morocco (20 % of GDP).[702] Logistics costs for imports to Kyrgyzstan are estimated as slightly lower (15 to 18 % of GDP) than those for exports.[703] Export logistics costs are made up of transportation costs (13 % of GDP in Kyrgyzstan) and other logistics costs (7 to 10 % of GDP).[704] "Other logistics costs" include, for instance, the cost of safety inventory due to supply chain disruptions, as well as the cost of maintaining normal amounts of cycle and safety stock to balance fluctuations. Owing to low data availability, it is impossible to distinguish logistics cost in Kyrgyzstan by economy-wide and firm-level costs (manufacturing and retail vs. third-party logistics providers).

Arvis et al. (cf. 2010, 2) point out the challenges of landlocked countries such as Kyrgyzstan: higher transportation costs (by up to 50 %), as the cheapest transport mode (maritime) is unavailable and land transport involves transaction costs due to the customs and handling charges involved in border crossings with transit countries. Regional and multilateral conventions to ensure freedom of transit can mitigate the problem but are difficult to achieve, especially when border disputes are involved, as is the case between Kyrgyzstan and Uzbekistan. Arvis et al. (2010) underline the high importance of logistics services efficiency

[701] https://ec.europa.eu/transport/modes/air/safety/air-ban/search_en, accessed on Feb. 26, 2021

[702] For numbers on Kyrgyzstan and Europe: World Bank 2013, 10-11; for numbers on Morocco: https://www.medias24.com/logistique-la-competitivite-a-la-traine-1427.html, accessed on Dec. 31, 2019; for numbers on Vietnam: https://english.vietnamnet.vn/fms/business/192227/vietnam-s-logistics-costs-make-up-20-8--of-gdp.html, accessed on Nov. 15, 2018

[703] World Bank 2013, 11

[704] World Bank 2013, 11

versus infrastructure investments.[705] One of the main determinants of the competitiveness of exporters and importers is the level of logistics costs, which rely less on road infrastructure and more on the trucking market structure, the existence of market imperfections such as monopolies and oligopolies, as well as logistics reliability and predictability.[706] This comes into play in Kyrgyzstan, where the government's plans for upgrading the logistics environment focus on road rehabilitation rather than on optimizing logistics services (section 7.3).

Despite the limited prospects of Kyrgyzstan becoming a logistics hub, improving the current logistics environment is desirable to enable development of higher-value domestic production and to foster regional trade with its Central Asian neighbors, especially in agriculture. The agricultural sector was deemed a "strategic industry" by the Government of Kyrgyzstan in the National Sustainable Development Strategy 2013–2017.[707] The importance of the agricultural sector in Kyrgyzstan has steadily decreased since the early 1990s: The share of value added from agriculture, forestry, and fishing in GDP declined from 34.2 % in 2000 to 16 % in 2015.[708] As of 2018, food exports, as a percentage of Kyrgyz merchandise exports, accounted for only 16.8 %.[709] Nevertheless, this sector holds potential for Kyrgyzstan to increase higher value-added trade, as long as the focus is on high quality crops and products.

At 44 %, fruit and vegetables accounted for the majority of Kyrgyz agricultural exports in 2018.[710] Most exports are destined for other countries in Central Asia. The largest potential markets for increased agricultural exports are in Kazakhstan and northern Russia. Exports to Russia are cumbersome as they require transit through Kazakhstan. Kyrgyzstan's

[705] Arvis et al. 2010, 4–5
[706] Arvis et al. 2010, 6
[707] National Council for Sustainable Development of Kyrgyzstan 2013, 86–91
[708] World Bank 2020
[709] World Bank 2020
[710] UN Comtrade database, retrieved via wits.worldbank.org on May 23, 2020. Numbers refer to mirror data, i.e., imports reported by the rest of the world rather than exports reported by Kyrgyzstan. Agricultural products include SITC (Rev. 4) sections 0, 1, 2, and 4 minus divisions 27 and 28. Fruit and vegetables are SITC division 05.

accession to the EAEU has made it easier to access those markets with fewer obstacles; at the same time, accession implies that Kyrgyz products have to comply with EAEU quality and SPS measures, something that poses a challenge to many exporters, particularly small-scale ones. Several Kyrgyz districts have climates that are favorable for growing a variety of fruit and vegetables. Issyk-Kul district, for instance, is known for the quality of its berries, cherries, apples, pears, and apricots. These products are exported to Russia (especially to Moscow, Siberia, Krasnoyarsk, Omsk, Tomsk, and Vladivostok), Kazakhstan and, to a lesser extent, Germany and the Czech Republic.

There is potential for branding and export promotion efforts to bolster this comparative advantage and foster exports. Quality assurance could enable the products to reach high-value niche markets in urban centers abroad. Other products from Issyk-Kul include livestock products and grains. According to the stakeholders interviewed for this case study, Kyrgyzstan has the potential to increase exports of agricultural products to Russia and Kazakhstan and possibly beyond if several issues in transport and logistics (e.g., missing road links and lack of cold chains) and food safety are resolved.

7.3 Government plans for upgrading the logistics environment

Most plans for upgrading the Kyrgyz logistics environment are made within the framework of the Central Asia Regional Economic Cooperation (CAREC) program, which includes ten countries and six multilateral institutions that foster economic cooperation in the region and is administered by the Asian Development Bank. For each member country, CAREC's "Transport and Trade Facilitation Strategy 2020," published in 2014, spells out priority investment and technical assistance projects.[711] Kyrgyzstan has adopted the strategy, which includes eleven projects for Kyrgyzstan, for example, on road rehabilitation, railway

[711] Asian Development Bank 2014a, 33–38

electrification, airport reconstruction, and border crossing point improvements.[712] Of these eleven projects, only one deals with infrastructure related to logistics services—a planned logistics center in the city of Osh, the country's second largest city. Services offered would include storage, consolidation, and deconsolidation. The focus on improving hard infrastructure for road and rail in Kyrgyzstan is warranted given the poor state of transport infrastructure. Going forward, more emphasis is merited on logistics facilities that enable higher-value-added activities and go beyond storage, warehousing, and transshipment.[713]

As for the upgrading plans of the Kyrgyz government, the pertinent document is the "National Sustainable Development Strategy 2018–2040."[714] The strategy does not include a dedicated logistics section, but mentions plans for improvements in transportation and logistics that will benefit the agri-industrial sector, particularly through improved processing, transportation, storage, and distribution practices.[715] Kyrgyzstan has also adopted a Transport Sector Master Plan for 2010 to 2025. This plan includes improving the quality of the transport infrastructure as well as upgrading the performance of the transport sector administration and private sector entities related to transport industries, engineering, and construction.[716]

Logistics for landlocked countries resembles a vicious circle with four elements: low traded volumes, capture of rent in services (e.g., trucking and ports), high uncertainty in logistics chains, and increased inventories and high logistics costs (including transport prices).[717] These elements reinforce each other, thus exacerbating the problem of high transaction costs of trading. The focus on road rehabilitation in the Kyrgyz government's plans for upgrading the logistics environment is less optimal, as market imperfections for logistics services often form the more preva-

712 Asian Development Bank 2014a, 3
713 Asian Development Bank 2014a, 11
714 National Council for Sustainable Development of Kyrgyzstan 2018
715 National Council for Sustainable Development of Kyrgyzstan 2018, 5–6
716 Asian Development Bank 2013b, 9
717 Arvis et al. 2010, 6

lent constraint. Nevertheless, road rehabilitation will likely lead to higher reliability and predictability of the transport chain, which can reduce the cost of delays.

For Kyrgyzstan, a small, landlocked, and comparatively poor country inside the vast Central Asia region, it is far-sighted to anchor its transport and logistics investment projects in a regional approach such as the CAREC program that covers all Central Asian countries. Connectivity is paramount for a landlocked country and access to international gateways such as maritime ports is more feasible if regional cooperation works well and if regional freight corridors are well managed. The following sections derive reform proposals for the Kyrgyz logistics environment for perishable agricultural goods.

7.4 Application of decision framework to perishable agricultural goods and Kyrgyzstan

7.4.1 Level 1: Target set-up of logistics environment

The target set-up describes the ideal state of a well-functioning logistics environment. For perishable agricultural goods, it resembles the one for automotive goods and high-tech manufacturing in that it also focuses on flexibility, reliability, and cost, yet with different specifics: it is characterized by a high degree of flexibility in the logistics environment to balance fluctuations in supply (e.g., stemming from seasonality and weather fluctuations) and in demand (e.g., increased consumption around major holidays).[718] Flexibility here refers to the capability to change based on a set of defined contingency scenarios.[719] The ideal perishable agricultural goods logistics environment is also characterized by a high degree of reliability to ensure high food quality: delays of even a few hours or days can be detrimental to perishable goods such as fruit and vegetables that often rely on temperature control to maintain quality.

[718] A previous version of this section was included as an early publication of parts of the dissertation's results in Wiederer and Straube 2019.
[719] cf. OECD 2013, 50

Reliability here relates to the degree of uncertainty in the lead time, which refers to the time it takes for goods to arrive at the purchaser after the order has been placed.[720] Lastly, the target set-up is characterized by a low level of logistics costs, on par with international standards (ca. 10–17 % of GDP, viewed across all economic sectors) or, ideally, lower.[721]

7.4.2 Level 2: Logistics concepts

This section links logistics concepts prevalent in the product category of perishable agricultural goods to the target set-up of the logistics environment. The logistics concepts listed here are business practices, but they need an enabling environment made up of components from all seven functional categories:

- shelf-life constraints and perishability of products[722] and hence the need for an uninterrupted cold chain, and changes in product quality along the supply chain.[723] This links to the target set-up component reliability.
- trade-off between responsiveness and efficiency of the logistics environment:[724] For produce, right from picking the supply chain must be predominantly responsive (to minimize the time it takes to get produce cooled, to avoid loss of value). Post-cooling, quality declines more slowly and the focus should shift to cost efficiency of the supply chain.[725] This links to reliability, flexibility, and cost.
- traceability of inputs and final products. This links to reliability.
- ability to handle large volumes of exported products, most of them by road, in bulk, break-bulk, or containers.[726] This links to reliability and flexibility.

[720] cf. Hausman et al. 2013, 241
[721] cf. Memedovic et al. 2005, 358
[722] cf. Tsolakis et al. 2015, 5
[723] cf. Vorst et al. 2007, 17
[724] cf. Ivanov et al. 2019
[725] cf. Blackburn and Scudder 2009, 132
[726] cf. Pham et al. 2013a, 42

- seasonality in production, long production times (for growing crops), and variability of quality and quantity of supply.[727] This links to flexibility.
- dynamic inventory management to track product quality.[728] This links to flexibility.
- dynamic control of goods flow to optimize market fulfillment, e.g., redirecting products to markets with lower quality requirements.[729] This links to flexibility.
- cross-docking to consolidate, sort, and distribute shipments in regional hubs in agricultural production clusters. This links to the target set-up component flexibility.
- collaboration of logistics partners: sharing of distribution networks, infrastructure, and vehicles. This links to flexibility and cost.
- shelf-life constraints restrict buffer capacity.[730] This links to flexibility.

7.4.3 Level 3: Trends

As the framework aims to guide future investment decisions by governments, it is critical to look not only at the current state of logistics but to anticipate future trends. After reviewing the literature on trends in the agri-food sector, the following trends were discerned that may impact logistics for perishable agricultural goods in the next decade, that is, until approximately 2030:

1. **increased demand for transparency, traceability and complete information**: Consumers demand to know the origin of produce as well as the conditions of its production, transport, storage, and processing.[731]

[727] cf. Vorst et al. 2007, 17
[728] cf. Vorst and Snels 2014, 11
[729] cf. Vorst and Snels 2014, 11
[730] cf. Vorst et al. 2007, 17
[731] cf. Straube (Ed.) 2016, 14, also cf. Tsolakis et al. 2015, 14

2. **desire to cut food waste**: Globally, roughly a third of food produced for human consumption is lost per year.[732] Consumers are increasingly aware of this loss and request decreases of food waste along the logistics chain.[733]
3. **increased demand for convenience food**, e.g., pre-cut vegetables and fruit, and prepared salads.[734]

Another trend that will impact the logistics environment for perishable agricultural goods but is not specific to that product category is environmental sustainability. Both the demand and requirements for environmental sustainability in logistics will rise.[735] Measures to address sustainability in logistics operations are included throughout the functional categories of suggested measures in section 7.4.6.

7.4.4 Level 4: Logistics requirements—Answer to research sub-question 1 with application to perishable agricultural goods

This section lays out the requirements of the logistics environment for the perishable agricultural goods product category, without a focus on a particular country.[736] It forms the answer to research sub-question 1, with application to perishable agricultural goods:

What are the logistics requirements of perishable agricultural goods?

The full list of requirements is included in Appendix 10.7.4 and shows the requirements grouped by functional category and target set-up characteristic. Requirements applicable to all three product categories examined are included in section 4.7.

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[732] Jedermann et al. 2014, 3
[733] cf. Straube (Ed.) 2016, 22
[734] cf. Straube (Ed.) 2016, 19
[735] cf. Göpfert et al. 2017, 12
[736] A previous version of this summary was included as an early publication of parts of the dissertation's results in Wiederer and Straube 2019.

TRANSPORT- AND TRADE-RELATED INFRASTRUCTURE

Maintaining the cold chain to minimize spoilage is one of the main requirements related to transport- and trade-related infrastructure in the perishable agricultural supply chain. This entails the availability of temperature-controlled storage and transport (e.g., in reefer containers, refrigerated trucks, and railroad cars), including pre-cooling right after picking to maximize post-harvest life.[737] Equally important for the agricultural goods logistics environment is the facilitation of intermodal transport, including a large road network in good condition as well as reliable air transport to enable rapid and reliable transport between production area, processing facilities, and export gateways.

INFORMATION AND COMMUNICATIONS TECHNOLOGY

Technology to support an uninterrupted cold chain should be available. IT tools should be integrated between suppliers and customers in the agricultural value chain and should include methods for automating the exchange of information among companies, for example, advance shipment notices.[738]

ORGANIZATION OF THE LOGISTICS ENVIRONMENT ("ECOSYSTEM")

The main logistics requirement in this category relates to the availability of regional logistics hubs serving agricultural production hubs. Such logistics hubs serving agricultural production areas ensure that products can be processed and packaged close to their point of production, thus avoiding long wastage-inducing transport routes. Other requirements in this category are cooperation among logistics partners and tight coordination of government entities involved in fostering the logistics environment and the agribusiness sector. Logistics costs should be on par with international standards (ca. 10–17 % of GDP) or, ideally, lower.[739]

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[737] cf. Blackburn and Scudder 2009, 132
[738] cf. Göpfert and Braun 2017, 28
[739] For the numbers on logistics costs: cf. Memedovic et al. 2005, 358

BUSINESS PRACTICES FOR HIGH-QUALITY LOGISTICS SERVICES

Adequate quality management systems and practices must be in place, including traceability of all inputs and final products as well as maintaining sanitary practices from source to shelf. Post-harvest treatment of produce to extend shelf life should be standard.[740] Logistics operators would ideally adopt international standards regarding using advanced flow management, palletization, and following environmental standards. Business practices should be in place to mitigate supply chain volatility.[741]

CUSTOMS PRACTICES

Risk management practices should be adopted to minimize inspection rates and enable customs authorities to concentrate control efforts on high-risk shipments.[742] It should be ensured that customs services and border posts open 24/7 or close to 24/7 to minimize transit time and preserve food quality; this should be accompanied by the availability of electronic customs data exchange.

REGULATORY ENVIRONMENT

SPS measures should be characterized by low laboratory costs, short wait times to receive laboratory results, low incidence of re-inspection of exports at ports of entry, and reliable laboratory results to avoid rejection of products at ports of entry.[743] Transport regulation should be consistently implemented and should include the use of truck weigh stations to provide a level playing field.[744] Enforcement of legislation is necessary to keep transaction costs low.

740 cf. Jedermann et al. 2014, 2
741 cf. Nitsche and Durach 2018, 868
742 cf. World Trade Organization 2014, 8
743 cf. World Bank 2012, 13
744 cf. World Bank 2012, 29

EDUCATION, SKILLS, AND PROFESSIONAL TRAINING

Staff should possess both general logistics knowledge as well as specialized knowledge of the perishable agricultural goods supply chain, covering e.g., food packaging and issues related to temperature-controlled transport and warehousing, i.e., installing, maintaining, and managing cooling equipment. An adequate supply of trained logistics specialists is crucial to the success of agricultural logistics operations, and structured training (in the form of vocational education, formal jobs training, and skills upgrading) should be supported.

7.4.5 Level 5: Gap analysis—Answer to research sub-question 2 with application to perishable agricultural goods and Kyrgyzstan

The gap analysis as the fifth stage of the decision framework is product-category- and country-specific. It juxtaposes the logistics requirements from section 7.4.4 with the current state of the logistics environment for perishable agricultural goods in Kyrgyzstan and identifies which logistics constraints are prevalent in the country for perishable agricultural goods.[745] This section forms the answer to research sub-question 2, with application to Kyrgyzstan and perishable agricultural goods:

Which country-specific constraints are prevalent in Kyrgyzstan in the logistics environment for higher-value perishable agricultural goods?

The full gap analysis for Kyrgyzstan is included in Appendix 10.7.5. Data for this level were distilled from interviews with Kyrgyz logistics stakeholders in Bishkek and Osh in 2016. See Appendix 10.3 for a list of interviews. Further data came from official country statistics and public databases and reports.

[745] A previous version of this summary was included as an early publication of parts of the dissertation's results in Wiederer and Straube 2019

TRANSPORT- AND TRADE-RELATED INFRASTRUCTURE

The interviews with logistics stakeholders in Bishkek and Osh revealed discrepancies between the state of logistics in Kyrgyzstan and the requirements of a well-functioning logistics environment for perishable agricultural goods.[746] The main gaps observed were relevant to infrastructure: Too few refrigerated storage facilities and distribution centers are available close to rural production zones.[747] Perishable goods are often transported using non-temperature-controlled vehicles. Manas airport in Bishkek is not open 24 hours a day. No inland clearance facilities and dry ports are available; all clearance is done at one of the 20 land border posts or at the airports of Bishkek and Osh. Intermodal transport is underdeveloped, as most cargo is transported by road.[748] The only intermodal transport taking place is from rail to truck, for goods arriving from China and Korea via rail. The main transshipment point for these goods is Urumqi in China. At 200 km, the Chinese border is relatively close to the Kyrgyz capital Bishkek; goods are then transported through Kazakhstan. There are only two transshipment points in Kyrgyzstan: one at the railroad station in Chuy valley and one in Issyk-Kul.

INFORMATION AND COMMUNICATIONS TECHNOLOGY

Gaps in ICT with relevance for agricultural goods pertain to electronic information management; no such system is in place for customs. The low level of integration of IT tools between suppliers and customers means that information exchange is difficult among supply chain partners. Few companies have instituted enterprise resource planning systems that would enable them to integrate with their supply chain partners.[749]

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[746] Unless otherwise noted, information in this section is based on interviews with logistics stakeholders by the author in Bishkek and Osh (Kyrgyzstan) in April 2016.

[747] cf. World Bank 2012, 49

[748] According to an interview with the Freight Operators Association of Kyrgyzstan in Bishkek on April 11, 2016, road transport in Kyrgyzstan refers to 97 % of all cargo; according to Asian Development Bank 2013a, 1, it accounts for more than half of cargo.

[749] This is an intra-company gap, but some remedial measure can be taken by the public sector.

ORGANIZATION OF THE LOGISTICS ENVIRONMENT ("ECO-SYSTEM")

Coordination of government entities involved in fostering the logistics environment is limited. In August 2015, a freight strategy developed by the ministries of Agriculture, Transportation & Communications and Economic Development, as well as the Freight Operators Association, was approved, but, owing to a lack of funds, has not yet been implemented.[750] The degree of public–private cooperation in logistics is low; a Kyrgyz-Korean joint venture was one of the few public-private partnerships (PPPs) planned in the country as of 2016. Logistics costs in Kyrgyzstan are estimated at 20–23 % of GDP and thus higher than international standards (10–17 %), but comparable with other middle-income countries, e.g., Morocco (20 % of GDP in 2019) or Vietnam (20.8 % of GDP in 2016), despite differing economic structures.[751]

BUSINESS PRACTICES FOR HIGH-QUALITY LOGISTICS SERVICES

Quality management is inadequate, mostly because of an insufficient number of temperature-controlled storage facilities and trucks, and due to the low number of public and private food-testing laboratories. Broken cold chains hamper maintaining sanitary practices and contribute to product wastage. The Kyrgyz transport business is fragmented: as of 2013, only 25 companies owned more than ten trucks and the others are smaller.[752] Most companies in the logistics sector are mere transport operators, and many are owner-operated, one-truck companies.

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750 Email dated July 7, 2020 by Temirbek Shabdanaliev, Chairman of the Freight Operators Association of Kyrgyzstan, to the author, as a follow-up to an interview with him by the author in April 2016

751 For the number on Kyrgyzstan: World Bank 2013, 10-11; for the comparison of logistics costs: cf. Memedovic et al. 2008, 358; for the number for Morocco: https://www.medias24.com/logistique-la-competitivite-a-la-traine-1427.html, accessed on August 1, 2020; for the number for Vietnam: https://english.vietnamnet.vn/fms/business/192227/vietnam-s-logistics-costs-make-up-20-8--of-gdp.html, accessed on Nov. 15, 2018

752 World Bank 2013, 24

CUSTOMS PRACTICES

Limited operating hours of border posts are among the gaps in customs practices. Several customs border posts operate for only eight hours per day and opening times are not always reliable. Customs declarations must be submitted on paper. Although progress has been made since Kyrgyzstan's accession to the Eurasian Economic Union, data exchange between Kyrgyzstan and Kazakhstan (one of its main trade and transit partners) still does not work well. The application of risk management is not uniform and clearance times are long and variable.

REGULATORY ENVIRONMENT

Export certifications (e.g., SPS certificates) needed for selling agricultural goods abroad are difficult to obtain because of the low number of licensed laboratories performing SPS checks. State laboratories are not equipped to comply with the standards and requirements of the countries to which Kyrgyzstan exports. Export certifications issued by Kyrgyz authorities do not always comply with those demanded by other countries, either within or outside the Eurasian Economic Union. Moreover, there is no uniformly enforced weight limit for trucks: At several cross-border weighing stations the control of axle loads is done inconsistently and, despite trucks conforming to the maximum weight, drivers are sometimes compelled to pay fines for excessive truck weights.

EDUCATION, SKILLS, AND PROFESSIONAL TRAINING

Among the issues found in the realm of education, skills, and professional training is the small amount of structured training. Public support for university training in logistics is scarce.[753] The lack of qualified personnel is severe enough that vegetable storage facilities are reported to

[753] Email dated July 7, 2020 by Temirbek Shabdanaliev, Chairman of the Freight Operators Association of Kyrgyzstan, to the author, as a follow-up to an interview with him by the author in April 2016

curtail their operations as they are unable to find logistics specialists able to organize the supply chain to export markets.[754]

IMPLICATIONS OF GAP ANALYSIS RESULTS FOR KYRGYZSTAN

The gap analysis serves to identify inadequacies of Kyrgyzstan's logistics environment regarding the logistics requirements for perishable agricultural goods regarding flexibility, reliability, and cost efficiency. The main challenges are in infrastructure and chiefly relate to infrastructure gaps compromising the reliability of perishable agricultural goods supply chains because of a lack of cooling equipment, both for transport (e.g., trucks) and for storage (e.g., temperature-controlled warehouses). This also negatively affects flexibility, as produce needs to be sold right away to avoid spoilage, with no margin for longer storage times, for example, to wait for a price rise.

Flexibility in agricultural logistics is constrained by the lack of intermodal transport options, as the only intermodal option is a rail-to-road combination for goods entering Kyrgyzstan from China and Korea. Further infrastructure-related limits on flexibility stem from the lack of transshipment points and inland clearance facilities. The lack of an electronic information system for customs negatively affects all three target set-up characteristics of high flexibility, high reliability, and low cost, as exporters have to endure cumbersome paper-based transactions of varying length. Difficulties in obtaining SPS certificates and the scarcity of food-safety laboratories adversely affect the reliability of agricultural exports, as do difficulties with tracking and tracing.

The lack of collaboration among logistics partners for sharing distribution infrastructure and vehicles drives up costs associated with exporting from the country, as does the fragmentation of the logistics sector into

[754] Email dated July 7, 2020 by Temirbek Shabdanaliev, Chairman of the Freight Operators Association of Kyrgyzstan, to the author, as a follow-up to an interview with him by the author in April 2016

numerous small providers, of which few follow international performance standards. The lack of logistics personnel who are skilled in handling produce negatively affects the flexibility and reliability of agricultural supply chains in Kyrgyzstan. The following section suggests logistics measures to close the gaps identified in section 7.4.5.

7.4.6 Level 6: Logistics measures—Answer to main research question with application to perishable agricultural goods and Kyrgyzstan

This is the sixth and final stage of the decision framework. Based on the preceding gap analysis, the following measures are suggested for Kyrgyzstan to meet the logistics requirements of perishable agricultural goods and to foster exports in that product category.[755] This section forms the answer to the main research question, with application to perishable agricultural goods and Kyrgyzstan:

Which country-specific logistics measures should the government of Kyrgyzstan take to foster higher-value perishable agricultural exports?

The full list of suggested measures is included in Appendix 10.7.6.

TRANSPORT- AND TRADE-RELATED INFRASTRUCTURE

Focal area: *Support to maintain the cold chain both during transport and storage to preserve product quality*

To maintain the cold chain, including in locations beyond the shippers' and receivers' control, the introduction of temperature-controlled vehicles, especially trucks, could be supported. Refrigerated storage facilities and distribution and processing centers close to rural production zones are needed.[756] It would be helpful if distribution and processing centers

[755] A previous version of this summary was included as an early publication of parts of the dissertation's results in Wiederer and Straube 2019

[756] cf. World Bank 2012, 49

offered the whole service suite of grading, packaging, and storing agricultural goods. Power supply should be reliable, for instance, via generators or thermal batteries that can be recharged from intermittent power sources. Pre-cooling should begin right after picking produce. Access to credit to enable investment in modern equipment could be facilitated.

Incentives could be provided to monitor and record temperature in transport vehicles and storage via machine-to-machine technology to track and trace shipments of perishable goods, thus ensuring that products with a broken cold chain are disposed of rather than transported further.[757] The introduction of Hazard Analysis Critical Control Points could also be supported;[758] these help to ensure cold chain integrity in a supply chain. The process consists of identifying hazards (e.g., higher temperatures during unloading), identifying which hazards are critical, and setting up control procedures (e.g., temperature measurements by loaders, drivers, and unloaders).[759] PPPs could be used to address low private sector investment, and could help to improve the transport network, build storage and collection centers, and purchase equipment such as cooling units at regional collection centers.[760]

***Focal area**: Availability of reliable air transport to ensure that products with high value density can be swiftly exported out of the country*

Investments in airport facilities and upgrading of air cargo facilities are recommended, including establishing refrigerated warehouses at airports and installing pallet scanners to facilitate the examination of air freight.[761] It is recommended that the government puts in place better flight-safety measures and works towards the removal of Kyrgyz airlines' from the EU's air safety list, which amounts to a ban on Kyrgyz airlines flying within the European Union and thus hinders airborne ex-

[757] cf. Ivanov et al. 2019, 488-489
[758] cf. Smith and Sparks 2004, 194
[759] cf. Smith and Sparks 2004, 194
[760] cf. World Bank 2016, 10
[761] cf. Banomyong et al. 2008, 366

ports, including agricultural ones. If pure air transport is too expensive, air-sea bridges could be fostered, that is, air transport for the first part of a trip, then transloading of the produce to maritime transport for shipping to the final destination.

***Focal area**: Facilitation of intermodal transport and availability of large road and rail network so that inputs and outputs can be transported to and from the place of production using the most efficient combination of transport modes*

In light of the data collected during the gap analysis, intermodal transport could be enabled by developing logistics zones, that is, zones providing warehouses, customs, truck centers, value-added services such as packaging and labeling, and container loading facilities. For locations where full-blown logistics zones are not warranted, but container loading facilities are needed, ICDs for transshipment could be constructed, that is, multimodal logistics platforms for the loading and unloading of containers, and linkages for trucks and trailers. To further enable trade, inland clearance facilities could be established at regional agricultural production hubs.[762]

To improve the road network, new transport links could be constructed and existing ones upgraded.[763] As an example, the road connection of about 500 km between Cholpon-Ata (Issyk-Kul region) and the Kazakh capital Almaty, one of the main destinations for agricultural exports from Issyk-Kul, could be upgraded, or a shorter route (through mountainous terrain) of 280 km could be built.[764]

[762] cf. World Bank 2010, 45
[763] cf. World Bank 2010, 45
[764] National Council for Sustainable Development of Kyrgyzstan 2013, 99-100. This measure is planned under the CAREC framework.

Focal area: *Accomplishing environmental sustainability in logistics*

Instead of diesel-powered generators, solar-powered mobile refrigeration units could be used to support an unbroken cold chain in places where energy supply is unreliable. Leakage of refrigerant gases should be minimized. A switch to new energy sources, such as wind energy and biofuels, could be enabled.[765]

INFORMATION AND COMMUNICATIONS TECHNOLOGY

Focal area*: Integration of IT tools among supply chain actors to support information exchange in an uninterrupted cold chain*

Information exchange concerning market demand with upstream parties in the supply chain using ICT collaboration tools could be improved.[766] Improved planning and ICT implementation could be supported to avoid the "bullwhip effect," in which small demand fluctuations lead to large inventory buildup owing to long lead times.[767] Technologies to support an uninterrupted cold chain could be fostered, for example, active and passive temperature monitoring. The potential for using blockchain technology to manage product recalls in food supply chains could be explored.[768] Blockchain technology could also be introduced to enhance confidence in food safety by documenting the entire production process.[769] Supply chain disruptions, which are particularly detrimental for perishable goods, should be avoided, rather than mitigated once they have occurred. Poschmann et al. (2019) underline the need for predicting dependable values for the estimated time of arrival of transport orders across the full transport chain.[770] They suggest prediction measures based on AI and machine learning, using data on infrastructure (e.g.,

[765] cf. Vorst and Snels 2014, 8
[766] cf. Vorst et al. 2007, 11
[767] cf. Vorst et al. 2007, 11
[768] cf. Verhoeven et al. 2018, 14
[769] cf. Ivanov et al. 2019, 500
[770] Poschmann et al. 2019, 162

route length and traffic), resources (e.g., type of transport vehicle), order characteristics (e.g., load type or priority), and weather data.[771]

***Focal area**: Establishment of e-services for government services to reduce time and cost involved in export processes*

An electronic information management system for customs would be beneficial. Imports and exports could be facilitated by introducing online options for government services, including e-signatures for government approvals.[772]

***Focal area:** Accomplishing environmental sustainability in logistics*

Incentives or mandates could be provided for companies to integrate environmental sustainability criteria into e-procurement tools.[773]

ORGANIZATION OF THE LOGISTICS ENVIRONMENT ("ECOSYSTEM")

***Focal area:** Enabling increased and low-cost collaboration of supply chain partners via online logistics platforms*

To enable increased collaboration of supply chain partners, an online logistics platform could be set up to facilitate sharing of distribution networks, infrastructure, and vehicles. This should entail removing regulatory barriers to sharing infrastructure, building broadband internet infrastructure necessary for online coordination, and possibly introducing tax incentives to share equipment, for instance, reefer containers for producers whose yield is too low to fill a refrigerated container on their own.

771 cf. Poschmann et al. 2019, 162
772 cf. World Bank 2010, 44
773 cf. Straube et al. 2011, 46

Focal area: *Reduction of logistics costs to international best practice*

Policymakers could work towards a reduction of logistics costs from the current level of 20–23 % of GDP by fostering healthy competition in all transport modes and by lowering transaction costs of transit (customs and handling charges). It would be advantageous to implement the freight strategy developed in August 2015 by an inter-agency task group comprising the ministries of Agriculture, Transportation & Communications and Economic Development as well as the Freight Operators Association.

Focal area: *Accomplishing environmental sustainability in logistics*

To ensure environmental sustainability in logistics, reverse logistics could be mandated, i.e., recycling, reducing, and reusing materials.[774] Waste in agricultural supply chains could, for instance, be used as animal feed.[775] Another option would be incentives or mandates for companies to introduce a supplier-audit method with enhanced environmental sustainability criteria.[776]

BUSINESS PRACTICES FOR HIGH-QUALITY LOGISTICS SERVICES

Focal area: *Enabling efficient intra-company processes*

Facilities for certifications of origin could be created to enable traceability of all inputs and final products. The adoption of practices to manage variability in availability and quality of produce could be supported, chiefly the FEFO (first-expired-first-out) principle, to ensure that every item's remaining shelf life is matched to the remaining transport duration.[777] To put in place adequate quality management systems and prac-

[774] cf. Bourlakis and Bourlakis 2004, 226
[775] cf. Tsolakis et al. 2015, 17
[776] cf. Straube et al. 2011, 46
[777] cf. Jedermann et al. 2014, 2

tices, including maintaining sanitary practices from source to shelf, it would be advisable to create or upgrade control laboratories, create facilities for certification of origin, and consider certification of private laboratories for performing microbiological tests.[778] Moreover, it would be advantageous for each supply chain partner to install ICT and quality control systems and adopt RFID technology to ensure visibility at the level of a single unit (e.g., produce crate).[779] By mandating consistent labeling of produce and supporting the introduction of facilities and practices to treat produce post-harvest, the government could further support efficient intra-company processes for perishable agricultural goods.[780]

Focal area: *Accomplishing environmental sustainability in logistics*

A reduction of shipping weights could be supported, for example, through packaging management.[781] The reduction of CO_2 emissions from vehicles could be achieved by incentivizing the reduction of empty trips, increasing load factors, improving vehicle efficiency, utilizing lower carbon fuels,[782] and monitoring tire pressure.[783]

CUSTOMS PRACTICES

Focal area*: Provision of efficient and predictable border management procedures to enable fast export processes without undue cost burdens*

To minimize wastage of produce from waiting times at border crossings, it would be advantageous if border control entities were open 24/7. If border traffic does not warrant such long hours, opening times should at

778 cf. World Bank 2012, 51
779 cf. Tsolakis et al. 2015, 15
780 cf. Jedermann 2014, 2
781 cf. Asian Development Bank and Gesellschaft für Internationale Zusammenarbeit 2014, 22
782 cf. Asian Development Bank and Gesellschaft für Internationale Zusammenarbeit 2014, 22
783 cf. Clean Air Asia 2017, 27

least be reliable. Border posts' opening times would ideally be harmonized on both sides of the border, for instance, between Kyrgyzstan and Kazakhstan. Accepting scanned copies for supporting documents and e-signatures would facilitate exports.[784] Customs authorities could further contribute to streamlined procedures by harmonizing international customs systems and ensuring seamless interaction with SPS measures.[785]

REGULATORY ENVIRONMENT

***Focal area**: Introduction of consistent and efficient SPS measures and standard procedures to ensure food security and high quality*

Procedures for SPS certificates and for standards certification could be automated and simplified, for example, using GLOBALG.A.P. or British Retail Consortium standards.[786] Agricultural export goods that have been tested in the country of origin and are not related to any current disease outbreaks could be pre-cleared, re-tested upon entry into the import country, and recalled only in case tests are positive.[787]

***Focal area**: Provision of comprehensive and high-quality SPS laboratory infrastructure covering all geographic areas that have agricultural production*

New SPS laboratories could be set up and old ones upgraded to enable an increase in agricultural exports. The most pressing needs are in and around Bishkek and Osh. Mobile laboratory units could be set up that can reach remote areas. In light of the evidence collected during the interviews in Kyrgyzstan, state laboratories should be equipped to comply with the standards of the countries to which Kyrgyzstan exports, and laboratory staff could be trained to increase compliance with regulations.

[784] cf. World Bank 2010, 4
[785] cf. World Bank 2012, 50
[786] cf. Vorst and Snels 2014, 18
[787] cf. World Bank 2012, 51

***Focal area**: Adaptation of regulatory environment to logistics and minimization of market distortions*

It would be worthwhile to introduce comprehensive logistics legislation along with a review of import and export restrictions. The number of illegal logistics operators (i.e., those operating without proper invoicing or registration) could be reduced by favoring official operators, for instance, through lighter administrative burdens for logistics operators, improved facilitation of exports, and reduced fees and taxes. To ensure fair competition among road transport operators from the EAEU, of which Kyrgyzstan is a member, enforcing weighing standards is recommended to ensure that no transport operators can undercut others by loading more than allowed.

***Focal area:** Accomplishing environmental sustainability in logistics*

To ensure environmental sustainability in logistics, targets for reducing energy consumption could be introduced. Air, water, and soil pollution limits should be determined.[788]

EDUCATION, SKILLS, AND PROFESSIONAL TRAINING

***Focal area:** Ensuring supply of trained specialists with knowledge of food logistics*

On-the-job and vocational training could be encouraged, with a focus on food handling and logistics for perishables; logistics providers and shippers should provide some of the training. To ensure a high level of food logistics knowledge at the company level, it is recommended to develop the knowledge and capacity of logistics operators in applying good handling practices to produce, and to train packers in the selection of produce.[789] Formal jobs training and skills upgrading in logistics profes-

[788] cf. Straube et al. 2011, 45
[789] cf. Vorst and Snels 2014, 19

sions could be improved to increase the number of trained freight forwarders. To ensure good availability of well-trained logistics managers able to organize the movement of agricultural exports across borders, academic training should be available and publicly supported.[790] A summary of the main results of this chapter can be found in section 8.1.5.

[790] Email dated July 7, 2020 by Temirbek Shabdanaliev, Chairman of the Freight Operators Association of Kyrgyzstan, to the author, as a follow-up to an interview with him by the author in April 2016

8 RESULTS: IMPLICATIONS FOR POLICYMAKERS

8.1 Improving logistics to foster higher-value exports — Answer to main research question

8.1.1 Overview

This dissertation's purpose is to enable national governments to improve their country's logistics environments with the goal of facilitating higher-value exports. To this end, the dissertation has developed a decision framework guided by theory and insights from selected countries enabling the identification of interventions that can correct weaknesses in the logistics environment for product categories that lend themselves to higher-value exports. The framework is applied to three product categories: high-tech manufacturing, automotive, and perishable agricultural goods. It defines what is required for "adequate" logistics in these product categories and matches these requirements with policy interventions that national governments can implement to improve the logistics environment for them. The focus on government action implies that intra-company processes are mostly excluded.

The main results from the dissertation are the decision framework and its outputs from the applications to three product categories and three countries. The dissertation shows that a structured process to identify logistics requirements, gaps, and measures is warranted if a country aims to improve its logistics environment as it takes into account both the needs of the private sector and the options for governments to improve conditions for all logistics actors. The decision framework proposed in this dissertation embodies such a structured process.

Using the results of the updated decision framework (section 8.1.2) and its applications, the following sections form the answer to the main research question:

Which country-specific logistics measures should governments of middle-income countries take to foster exports in three selected product categories that lend themselves to higher-value exports?

The following sections include insights from the framework applications in Vietnam, Morocco, and Kyrgyzstan; implications for policymakers in other countries; and the results of the framework's validation.

The measures suggested in section 8.1.3 are designed to close the gaps in the logistics environment for high-tech products in Vietnam. Policymakers in other countries wishing to improve the logistics environment for high-tech products will be able to use several of the results from the decision framework: the target set-up (section 5.4.1), logistics concepts (5.4.2), trends (5.4.3), and logistics requirements (5.4.4) are applicable independently of the country.[791] The same applies to the results for the other two product categories. Sections 6.4 (automotive products) and 7.4 (perishable agricultural products) include the target set-up, logistics concepts, trends, and logistics requirements for those product categories, and they are applicable independently of the country.[792]

Section 8.1.4 includes measures suggested for improving the logistics environment for automotive products in Morocco, and section 8.1.5 includes measures designed to better the logistics environment for perishable agricultural goods in Kyrgyzstan. The gap analysis, which these measures are based on, must be conducted separately for each country. The measures suggested for Vietnam, Morocco, and Kyrgyzstan might serve as inspiration for other countries aiming at increasing their high-tech manufacturing, automotive, or perishable agricultural exports. Section 8.1.6 includes guidance to policymakers in countries other than the ones explored in the case studies regarding measures that national governments can take to improve the logistics environment for high-tech

[791] See Appendix 10.5 for more details on the framework application's results for Vietnam and high-tech manufacturing.

[792] Appendix 10.6 has more details for Morocco and automotive goods, while Appendix 10.7 has more details for perishable agricultural goods and Kyrgyzstan.

manufacturing, automotive, and perishable agricultural goods. Section 8.2 contains the validation of the results of the framework applications.

8.1.2 Implications of the case studies for the design of the decision framework

Using insights from the framework's application in the three case study countries, the decision framework was updated with respect to the initial version. Figure 8-1 includes a modified illustration of the framework and indicates which of the six framework levels have been updated as compared to the initial version. The decision framework as presented in Chapter 4 includes the updates that were made as a result of the framework's applications in the case study countries.

Level 1, the target set-up, was expanded to include three instead of two components (i.e., logistics costs in addition to flexibility and reliability), as the importance of cost efficiency to countries' competitiveness in terms of exports became apparent during the case study process. Although levels 2 (logistics concepts) and 3 (trends) remained unchanged except for minor updates, level 4 (logistics requirements) was altered based on insights from the framework applications in Vietnam, Morocco, and Kyrgyzstan. Whereas the majority of logistics requirements stem from product-category-specific literature reviews, to a lesser extent data also originate from suggestions by the author and the interviews carried out with logistics stakeholders in the three case study countries. Some of the requirements were derived from answers that interviewees identified as crucial to their companies or members' success. These inputs were checked against the requirements identified in the literature for the product category's logistics features to decide whether they merited inclusion in the list of requirements (which transcends the single-country focus). If a match with the literature occurred, these requirements were included.

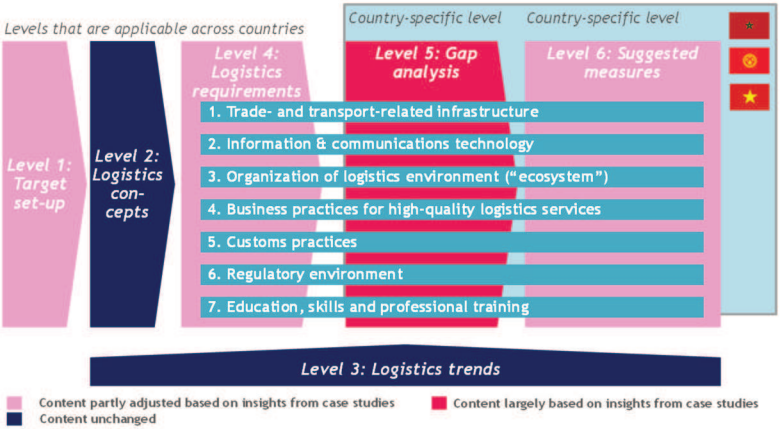

Figure 8-1: Overview of the decision framework with adjustments after applications in the case studies[793]

The content of the level 5 gap analyses depends entirely on the framework applications, as information on the country-specific gaps was gathered through interviews (structured and semi-structured) with logistics professionals as well as from secondary data analysis, both of which were carried out as part of the country case studies (highlighted in deep pink in Figure 8-1). Level 6 (suggested measures) was partly adapted after the case studies had been carried out. Similar to level 4 (logistics requirements), most of the entries for level 6 are based on a literature review of best practices in logistics for each respective product category, but some entries were formulated by the author based on the analysis of logistics requirements and country-specific gaps.

8.1.3 Logistics measures to foster high-tech manufacturing in Vietnam

The following is a summary of the results arrived at in section 5.4. When applying the decision framework to Vietnam with the aim of identifying measures for improving the logistics environment for high-tech

[793] Source: author

manufacturing to foster high-tech exports from the country, the results set out below emerge.[794]

Transport- and trade-related infrastructure: Air transport is of chief importance to high-tech goods due to their time sensitivity. Thus, in light of the data collected during the gap analysis for Vietnam, it would seem prudent to upgrade the air cargo handling facilities at Hanoi's Noi Bai and Ho Chi Minh City's Than Son Nhat airports.[795] Expanding storage capacity at airports and allowing air cargo agents as well as third party operators to offer warehousing on airport grounds would be beneficial. Intermodal transport could be facilitated by constructing or upgrading feeder roads to the main ports (Hai Phong, Da Nang, Cai Mep, and Cat Lai). A container depot system near Cai Mep port would also be useful. To ease congestion on the roads, the inland waterway from Cai Mep to Cat Lai port could be widened and deepened. Logistics zones that can directly serve export markets could be built in the vicinity of Cai Mep and Hai Phong ports as well as in Ho Chi Minh City, Hanoi, Nha Trang, Lam Dong, and in the Mekong Delta.[796]

Information and communications technology: Collaboration between partners in the high-tech supply chain could be fostered by incentivizing the development of IT standards and by introducing the e-airway bill nationwide. Incentivizing the development and introduction of IoT devices can help to prevent counterfeiting attempts of high-tech products. The introduction of predictions of estimated time of arrival could be supported for the entire transport chain.[797] These measures represent ways for governments to help increase supply chain visibility, which is needed so that companies can adequately react to problems in the supply chain.[798]

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[794] The full version is included in Appendix 10.5.6
[795] cf. Banomyong et al. 2008, 366
[796] Blancas et al. 2014, 49
[797] cf. Poschmann et al. 2019, 162
[798] See World Economic Forum 2020, 16 for a discussion of the role of supply chain visibility in manufacturing, especially in light of the COVID-19 crisis.

Organization of the logistics environment ("ecosystem"): Ports and airports would ideally be open 24/7, or at least have long and predictable opening times. State-owned enterprises in transport and logistics should best not enjoy tax or other advantages vis-à-vis private operators. Business cooperation between logistics companies could be improved by, for example, involving the Ministry of Trade and Industry as a facilitator. To make Vietnam an even more attractive location for high-tech manufacturers, policymakers could work towards a reduction of logistics costs from their 2016 level of 20.8 % of GDP by fostering healthy competition in all transport modes, lowering transaction costs of transit (customs and handling charges and time needed for documentary compliance), and by increasing reliability and predictability in the supply chain.

Business practices for high-quality logistics services: Digital logistics platforms could be fostered to enable increased collaboration of logistics partners by, for instance, offering tax incentives and strengthening broadband internet infrastructure. Detailed logistics data could be collected so that performance can be enhanced by tracking key performance indicators. Global standards for warehousing, trucking services, and freight forwarding could be adopted.

Customs practices: The pilot for automated customs management and air cargo monitoring could be expanded from Noi Bai airport to all cargo-handling airports. Introducing blockchain technology for archiving customs documents could expedite the flow of information.[799] E-customs, i.e., using electronic instead of paper-based procedures, could be introduced in all Vietnamese provinces and integration between agencies involved in border management (customs, port authorities, and the ministries of Transport and Science and Technology) could be increased, eventually leading to a national or ASEAN-wide Single Win-

[799] cf. Ivanov et al. 2019, 500. Blockchain is defined by Kern and Wolff (2019, 4) as "an open, distributed ledger that can record transactions between two parties efficiently and in a verifiable and permanent manner."

dow, that is, an option to provide all documents mandated for imports, exports, and transit through a single access point.[800]

Regulatory environment: Regulatory gaps in liability and insurance could be eliminated to increase the attractiveness of digital logistics platforms. Price reference guides for logistics services could be phased out, as could foreign capital limits for road transportation companies and mandates that truck drivers be Vietnamese citizens.[801] Gaps in legislation related to export and import processes for high-tech products could be filled. Rules and regulations in the Vietnam Trade Information Portal could be reviewed to ensure consistency and remove duplication.

Education, skills, and professional training: Courses focusing on the requirements of the logistics environment for high-tech manufacturing could be introduced to Vietnamese university curricula. Some university courses could cover practical issues that applicants will face in daily logistics operations. Vocational training, including standardized curricula, could be fostered and train-the-trainer schemes instituted. Internship programs aligned with company needs could be introduced. LSPs and high-tech companies could receive incentives for offering on-the-job logistics training.

8.1.4 Logistics measures to foster automotive products in Morocco

The following is a summary of the results arrived at in section 6.4. When applying the decision framework to Morocco with the aim of identifying measures to improve the logistics environment for automotive goods to foster automotive exports from the country, the following results emerge.[802]

Transport- and trade-related infrastructure: To ensure fast, reliable and cost-efficient transport times for automotive products from factory gate to port of exit and vice versa, intermodal transport could be en-

[800] cf. World Trade Organization 2014, 13
[801] cf. World Bank Group et al. 2018, xi
[802] The full version is included in Appendix 10.6.6

hanced by ensuring that logistics zones are connected to the road network. Dry port facilities could be created near Tanger-Med, the port closest to Morocco's largest automotive cluster. Casablanca and Tangier airports could be equipped with pallet scanners to facilitate air transport.[803]

Information and communications technology: Cloud computing could provide fast and convenient access to shared information among supply chain partners.[804] IoT devices can support route optimization as IoT enables objects to communicate their location or status online.[805] More online options for government services, including e-signatures, would facilitate government approvals.[806]

Organization of the logistics environment ("ecosystem"): State-owned enterprises in transport and logistics would ideally enjoy no advantages compared with private operators, for example, in terms of taxes or access to finance and real estate. Government entities involved in fostering logistics could align their activities better.

Business practices for high-quality logistics services: Incentivizing additive manufacturing might be a good idea, as it can reduce lead times and the cost of safety inventory. The same holds for the introduction of warehouse and transport management systems. The introduction of automated guided vehicles could be supported.[807] Blockchain applications can facilitate verifiable and permanently stored information about transactions between two supply chain parties, be they part of the public or private sector.[808]

Customs practices: The PortNet online application could be completed so that there is a single point of entry for the clearance of cargo. Coupled with IoT sensors, blockchain-enabled applications could be used to fur-

[803] cf. Banomyong et al. 2008, 366
[804] cf. Kern and Wolff 2019, 4
[805] cf. Kern and Wolff 2019, 4
[806] cf. World Bank 2010, 44
[807] cf. Kern and Wolff 2019, 4
[808] cf. Kern and Wolff 2019, 4

ther expedite customs processes.[809] Risk management could be adopted so that controls can be concentrated on high-risk shipments.[810]

Regulatory environment: The main challenge in terms of the regulatory environment will be to further reduce the number of logistics providers operating without proper invoicing or registration. It would be beneficial if the draft logistics legislation that was submitted to parliament in 2018 were to be adopted. The existing truck scrappage scheme could be modified to minimize market distortions.

Education, skills, and professional training: Software, data skills, and future-oriented production elements such as robotics should become more prominent in curricula to ready the future workforce for the effects that digitalization will have on the automotive supply chain. Vocational and on-the-job training could be expanded to complement tertiary education in logistics.

8.1.5 Logistics measures to foster perishable agricultural goods in Kyrgyzstan

The following is a summary of the results arrived at in section 7.4. When applying the decision framework to Kyrgyzstan with the aim of identifying measures to improve the logistics environment for perishable agricultural goods to foster Kyrgyz exports in that product category, the following results emerge.[811]

Transport- and trade-related infrastructure: To maintain the cold chain, the introduction of temperature-controlled vehicles, especially trucks, could be supported.[812] Refrigerated storage facilities and distribution and processing centers close to rural production zones are need-

[809] cf. World Economic Forum 2020, 23
[810] cf. World Trade Organization 2014, 8
[811] The full list of suggested measures is included in Appendix 10.7.6. A previous version of portions of this text were included in an early publication of parts of the dissertation's results in Wiederer and Straube 2019.
[812] cf. Blackburn and Scudder 2009, 132

ed.[813] Distribution and processing centers could offer grading, packaging, and storing of agricultural goods. The road connection between Cholpon-Ata (Issyk-Kul region) and the Kazakh capital, Almaty, one of the main destinations for agricultural exports from Issyk-Kul, could be upgraded. To foster trade, inland clearance facilities could be established at regional agricultural production hubs.[814] Investments in airport facilities and air cargo facilities are recommended, including refrigerated warehouses at airports and pallet scanners to facilitate the examination of air freight.[815]

Information and communications technology: Technologies to support an uninterrupted cold chain could be fostered, for instance, active and passive temperature monitoring. Blockchain technology could also be introduced to enhance confidence in food safety by documenting the entire production process.[816] An electronic information management system for customs could be set up. Supply chain disruptions, which are particularly detrimental to perishable goods, should be avoided.

Organization of the logistics environment ("ecosystem"): The freight strategy developed in August 2015 by the Ministries of Agriculture, Transportation & Communications and Economic Development as well as the Freight Operators Association, would ideally be implemented soon. To enable increased collaboration of logistics partners, an online logistics platform could be set up to enable sharing of distribution networks and equipment, for example, reefer containers. Policymakers could work towards a reduction of logistics costs from the current level of 20–23 % of GDP by fostering healthy competition in all transport modes and by lowering the transaction costs of transit.

Business practices for high-quality logistics services: Facilities for certifications of origin could be created to enable traceability of all in-

[813] cf. World Bank 2012, 49
[814] cf. World Bank 2010, 45
[815] cf. Banomyong et al. 2008, 366
[816] cf. Ivanov et al. 2019, 500

puts and final products. To ensure environmental sustainability in logistics, a reduction of shipping weights could be incentivized, e.g., by packaging management.[817]

Customs practices: It would be beneficial for border control entities to have 24/7 opening hours. If border traffic does not warrant such long hours, opening times would ideally at least be reliable. Border post opening times could be harmonized on both sides of the border, that is, between Kyrgyzstan and Kazakhstan. Risk management programs to expedite clearance, including reduced inspections and an Authorized Economic Operator program, could be tested.[818]

Regulatory environment: New SPS laboratories could be created and old ones upgraded to enable an increase in agricultural exports. The most pressing needs are in and around Bishkek and Osh. Mobile laboratory units could be set up that can reach remote areas. State laboratories could be equipped to comply with the standards and requirements of the countries to which Kyrgyzstan exports.

Education, skills, and professional training: Vocational education, formal jobs training, and skills upgrading in logistics with a focus on agri-logistics could be improved. To ensure the availability of well-trained logistics managers able to organize cross-border supply chains for agricultural exports, academic training (e.g., at master's level) would ideally be available and publicly supported.[819]

[817] cf. Asian Development Bank and Gesellschaft für Internationale Zusammenarbeit 2014, 22

[818] cf. World Trade Organization 2014, 8-9

[819] Email dated July 7, 2020 by Temirbek Shabdanaliev, Chairman of the Freight Operators Association of Kyrgyzstan, to the author, as a follow-up to an interview with him by the author in April 2016

8.1.6 Policy recommendations to improve the logistics environment for three product categories to foster higher-value exports in countries beyond Vietnam, Morocco, and Kyrgyzstan

8.1.6.1 Introduction

To achieve a logistics environment that fosters rather than impedes higher-value exports, policymakers would be well-advised to strive to fulfill the requirements of "adequate" logistics as described in section 1.3. The main implication for policymakers wishing to improve the logistics environment for higher-value product categories is to increase the flexibility and reliability of the logistics environment in their countries while keeping logistics costs low.

The following sections provide an overview of the measures and meta-measures that national governments can take to improve the logistics environment for three product categories that lend themselves to higher-value exports. The policy implications are general and can be used by policymakers and users of the decision framework in any country wishing to improve the logistics environment in one of the three product categories. Precise measures and priorities for a country require a gap analysis analogous to those in chapters 5, 6, and 7. The suggested measures will primarily be applicable to middle-income countries as they tend to have the (albeit limited) financial potential to carry out reforms of their logistics environment, but, at the same time, tend to have a need to improve their logistics performance to realize higher exports.

Section 8.1.6.2 includes the results of a clustering of logistics measures, arrived at in the framework applications, into meta-measures. Section 8.1.6.3 includes policy implications that refer to all three product categories examined (i.e., measures cutting across the product categories).

8.1.6.2 Synthesizing meta-measures to improve a country's logistics environment

To enable a quick overview and comparison of the themes dominating the individual logistics measures identified as part of the three frame-

work applications, the measures for each category were synthesized into a smaller set of meta-measures, i.e., higher-level measures synthesized from several individual suggested policy measures. Policymakers could use this overview of meta-measures to gain a first impression of possible measures that fall within the realm of government action that can improve a country's logistics environment. The clustering of measures was done for all three product categories using Q methodology.

The process involved sorting 350 logistics measures into 18 meta-measures.[820] A pre-sorting of the 350 measures had already taken place by matching the measures with different product-category-specific logistics requirements (see section 2.1.7 for details on the methodology).[821] As in Nitsche and Durach (2018), the sorting aimed at attaining homogeneity within each group of meta-measures and heterogeneity between groups.[822]

Figure 8-2, Figure 8-3, and Figure 8-4 show the results of the clustering process. When summarizing the measures suggested by the decision framework into meta-measures, it becomes apparent that several meta-measures show relevance for each product category, especially those for automotive and high-tech manufacturing, though with differing degrees of importance. This similarity is, to a large degree, due to the fact that the meta-measures are aggregated at a high level. The underlying measures exhibit a lower degree of similarity. The individual measures are included in the full version of the decision framework applications in Appendix 10, sections 10.5.6., 10.6.6, and 10.7.6.

The middle columns of Figure 8-2, Figure 8-3, and Figure 8-4 show the 18 meta-measures. The left-hand column shows which functional cate-

[820] 80 measures came from the framework application to automotive goods, 124 from the one to perishable agricultural goods, and 146 from the one for high-tech manufacturing. The full list of measures is included in Appendices 10.5.6 (for high-tech goods), 10.6.6 (for automotive goods), and 10.7.6 (for perishable agricultural goods).

[821] 29 logistics requirements were formulated for automotive, 40 for perishable agricultural goods, and 33 for high-tech manufacturing, i.e., 102 in total.

[822] cf. Nitsche and Durach 2018, 8

gories they fall into. A meta-measure covering more than one functional category signifies that measures from several categories were combined under one meta-measure. The indication of functional category gives an indication of which policy area or government department a meta-measure falls into. The right-hand columns of Figure 8-2, Figure 8-3, and Figure 8-4 indicate each meta-measure's estimated relative importance for the product category in question, with the green-colored scale ranging from "very important" to "somewhat important" to "less important or not important." Like the classification into 18 meta-measures, the classification of meta-measures by functional category and importance is based on the author's assessment following the literature review and interviews conducted as part of the three decision framework applications.

Functional category	Meta-measures	Importance for product category		
		Auto-motive	Perishable agric. goods	High-tech manuf.
Infra. Bus. Cust. Org. ICT Reg. Edu.	Facilitating **intermodal transport** and ensuring a large road and rail network so that production inputs and finished outputs can be transported to and from the place of production using the most efficient combination of transport modes	■	■	■
Infra. Bus. Cust. Org. ICT Reg. Edu.	Offering **reliable air transport** so that critical inputs can be swiftly brought in to avoid production stoppages and products with high value-to-weight ratio can be quickly exported out of the country	■	■	■
Infra. Bus. Cust. Org. ICT Reg. Edu.	Ensuring **availability of auxiliary equipment** to make efficient use of existing trade- and transport-related infrastructure	■	■	■
Infra. Bus. Cust. Org. ICT Reg. Edu.	Supporting the **maintenance of the cold chain** both during transport and storage to preserve product quality	■	■	■
Infra. Bus. Cust. Org. ICT Reg. Edu.	Enabling **customs clearance** at regional production hubs	■	■	■
Infra. Bus. Cust. Org. ICT Reg. Edu.	Supporting the **integration of IT and data tools** between suppliers and customers to facilitate and automate cross-company information exchange, tracking, and tracing across transport modes	■	■	■
Infra. Bus. Cust. Org. ICT Reg. Edu.	Offering **e-services** for customs and other government services to reduce time and cost involved in export processes	■	■	■
Infra. Bus. Cust. Org. ICT Reg. Edu.	Enabling **increased and low-cost collaboration** of supply chain partners via online logistics platforms	■	■	■

See bottom of figure for key to symbols

Figure 8-2: Clustering of measures into meta-measures, Part 1 of 3[823]

[823] Source: author

Functional category	Meta-measures	Importance for product category		
		Auto-motive	Perishable agric. goods	High-tech manuf.
Infra. Bus. Cust. **Org.** ICT Reg. Edu.	Providing flexible, cost-effective, and reliable **trade-enabling services**	■	■	■
Infra. **Bus.** Cust. **Org.** ICT Reg. Edu.	Providing incentives and regulations for **efficient warehousing**	■	■	■
Infra. Bus. Cust. **Org.** ICT **Reg.** Edu.	Establishing a **level playing field for all logistics actors** and tightly coordinating logistics-related government entities to ensure low prices and high reliability	■	■	■
Infra. Bus. Cust. **Org.** ICT Reg. Edu.	Reducing **logistics costs** to reach international best practice	■	■	■
Infra. **Bus.** Cust. Org. ICT Reg. Edu.	Enabling **efficient intra-company processes** to mitigate supply chain volatility and adopt international standards	■	■	■
Infra. **Bus.** Cust. Org. ICT Reg. **Edu.**	Supporting **business practices and equipment** that maintain the quality of perishable products	■	■	■
Infra. Bus. **Cust.** Org. ICT Reg. Edu.	Providing **efficient and predictable border management procedures** to enable fast export processes without undue cost burdens	■	■	■

See bottom of figure for key to symbols

Figure 8-3: Clustering of measures into meta-measures, Part 2 of 3[824]

[824] Source: author

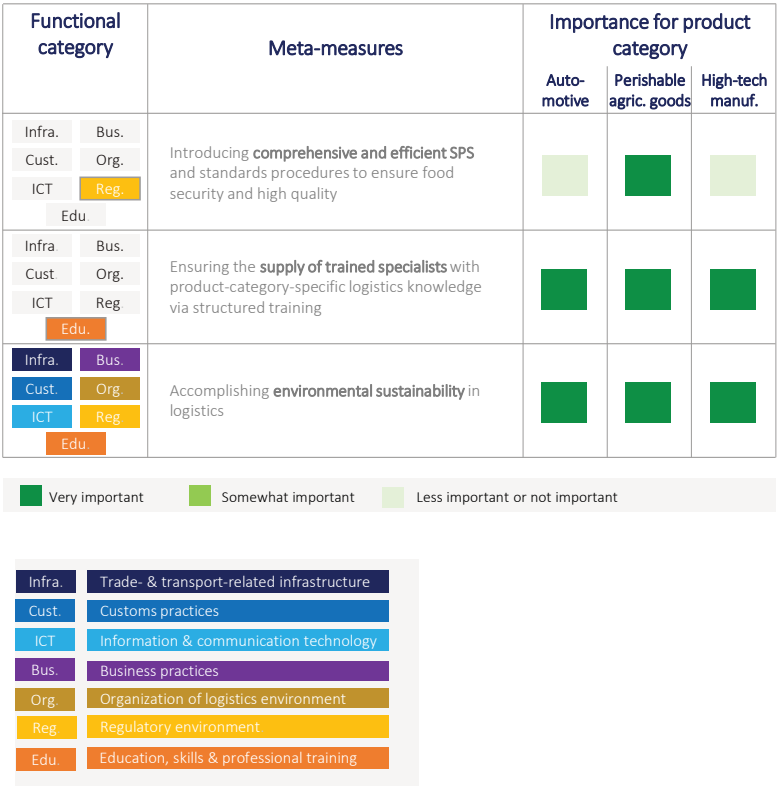

Figure 8-4: Clustering of measures into meta-measures, Part 3 of 3[825]

The highest number of meta-measures falls into the functional category of trade- and transport-related infrastructure. Facilitation of intermodal transport emerges as a key meta-measure, especially for the automotive and high-tech product categories as these rely on combinations of maritime, road, and air transport. Although intermodal transport is also important for perishable agricultural goods, it is categorized only as "some-

[825] Source: author

what important" owing to the product category's greater reliance on pure road transport.

Offering reliable air transport is a meta-measure showing a similar pattern: Though crucially important for the automotive and high-tech supply chain to avoid production stoppages due to missing parts, air transport is less important for the perishable agricultural goods category, in which this comparatively expensive transport mode is mainly used for the transport of produce with a high value density. The meta-measure covering infrastructure to support maintenance of the cold chain, in contrast, is one that has greater importance for perishable agricultural goods than for the other product categories. Other infrastructure-related meta-measures cover auxiliary equipment and customs clearance facilities at regional production hubs; the latter has the most relevance for perishable agricultural goods to avoid spoilage.

Several meta-measures were identified that have information and communications technology as their unifying theme. Among them is the integration of IT and data tools among all supply chain participants (including facilitation of tracking and tracing), the availability of digital logistics platforms to enable more and cheaper collaboration, and e-services for customs, almost all of them with high relevance for each product category. As for meta-measures related to the organization of the logistics environment, the provision of flexible, cost-effective, and reliable trade-enabling services emerges as a key theme for all three product categories, covering, for example, the management and opening times of ports and airports. Another measure relating to the organization of the logistics environment is the reduction of logistics costs to the level of international best practice. This measure was awarded its own meta-measure to underline its importance.

Spanning the organization of the logistics environment and the regulatory environment, the establishment of a level playing field for all logistics actors was identified as one of the meta-measures with high relevance for all three product categories and in which individual measures ranged

from the coordination of government entities to ensuring healthy competition in all transport modes. A meta-measure in the regulatory realm with importance exclusively for perishables relates to the introduction of comprehensive and efficient SPS measures and standards and procedures to ensure food security and quality.

As for business practices, the main meta-measure identified involves enabling efficient intra-company processes, including measures to mitigate supply chain volatility, ensure adoption of international standards by logistics operators, and use supply chain metrics and performance management. Though relevant for all three product categories, its importance is slightly less elevated for perishable agricultural goods, as the sector has a comparatively higher share of smaller and less sophisticated firms and, at least in places with weaker logistics environments, more emphasis should initially be put on cold-chain infrastructure investments, smooth customs processes, and training. A meta-measure with high relevance for agricultural goods refers to support for business practices that maintain the quality of perishable products.

The customs-related meta-measure "Providing efficient and predictable border management procedures to enable fast export processes without undue cost burdens" serves as the umbrella for measures ranging from customs services opening hours, to border clearance procedures, to risk management. It is highly relevant to all three product categories as all three are time-critical, be it for reasons of spoilage (agricultural products) or the risk of obsolescence (high-tech products). For education and training issues, one single meta-measure was formulated highlighting the importance of ensuring the supply of trained specialists with knowledge of the logistics of each product category. Additionally, a meta-measure that transcends the sorting into functional categories was included to highlight the need for increasing environmental sustainability in logistics.

Although product categories other than high-tech manufacturing, automotive, and perishable agricultural goods were not among the frame-

work applications, it is likely that the meta-measures identified as having a high relevance for these three product categories will also be important for other product categories, especially those with similar features to the ones studied (see section 4.4 regarding the representativeness of the selected product categories). This is because these meta-measures improve a country's logistics environment as a whole and contribute to increasing the country's competitiveness as a production location for several products. The meta-measures presented above can be used as a first overview of which measures to deploy to improve a country's logistics environment in a given product category. To obtain a precise set of measures, a full-scale application of the decision framework is required.

8.1.6.3 Policy implications for logistics for all three product categories examined

Level 6 of the decision framework suggests policy measures that national governments can adopt to improve the logistics environment for one of three product categories that lend themselves to higher-value exports. Some of the potential measures identified during the literature review and the interview phase of the case studies were similar across all three product categories. These cross-cutting measures are discussed below.

"Servitization," which is especially pronounced in the automotive and high-tech product categories, implies a combination of manufacturing and associated value-added services.[826] In the event of supply chain disruptions, servitization means that not only are physical goods flows disrupted, but also the service sector.[827] Governments can support the private sector in dealing with supply chain disruptions. Although the majority of the responsibility to come up with strategies for coping with such disruptions will fall to the manufacturing and service provider firms in a supply chain, governments will play a part in preventing them and mitigating their effects. Natural disruptions can be mitigated by, for

[826] cf. McKinnon 2018, 7
[827] cf. McKinnon 2018, 7

instance, introducing advance warning systems, mandating earthquake-proof buildings, or investing in public health to halt the spread of pandemics. Accidents such as airplane crashes and train derailments can be prevented by mandating air safety checks and properly maintaining transportation networks. Breakdowns of one transport mode can partially be mitigated by offering multimodal transport options so that providers can switch modes if needed. Providing reliable ICT networks and guarding against cyber-attacks ensures secure communications links.[828]

Customs, as a core government function, is the area with the clearest link between government action and the ease of exporting products from (and importing production inputs into) a country. Border clearance procedures should be streamlined and predictable, with customs procedures automated as far as possible and overlapping procedures removed. To increase transaction speed and avoid the need for duplicate data entry, customs could offer electronic data interchange, for example, by accepting scanned copies for supporting documents.[829] To reduce transaction speed and reduce cost and error rates, the World Customs Organization standards for classification, filing practices, and electronic data exchange could be introduced.[830] Risk management procedures could be adopted to concentrate control efforts on high-risk shipments.[831] It is recommended that customs personnel should possess high technical skills. In case there are multiple border protection agencies, inter-agency coordination should be efficient so that high-tech products can be swiftly processed for export.

Legislation covering all aspects of logistics helps to provide a dependable legal framework for logistics actors and thus improves the business environment. Within national governments, responsibility for logistics is often spread across different ministries (typically Transport, Trade, and/or Industry), so that legislative authority is scattered across entities.

[828] cf. Stecke and Kumar 2009, 208
[829] cf. Rushton et al. 2017, 751
[830] cf. Blancas et al. 2014, 123
[831] cf. World Trade Organization 2014, 8

Removing overlapping responsibilities among state agencies and improving cooperation and coordination between them helps to achieve this.

Healthy competition on all transport modes and in logistics should be ensured, with a focus on reforming fully or partially state-owned enterprises, which should not enjoy privileges vis-à-vis taxes, access to finance, or access to real estate when compared with privately-owned firms. This contributes to lower prices and higher reliability than under imperfect competition. To foster competition, governments could ensure the absence of restrictions to market entry for LSPs. To avoid collusive behavior, they could remove obligatory association membership for logistics professionals. Transport regulations should be well-designed and consistently implemented. The number of illegal logistics providers (i.e., those operating without invoicing or registration) could be kept low via a mixture of better law enforcement and incentives for illegal operators to register their business, for example, by lightening administrative burdens for logistics operators. If introduced at all, subsidy schemes should be designed to minimize market distortions.

Government services for import and export could be offered in digital form, for instance, e-signatures, to reduce the number of time-consuming paper-based transactions and to ensure swift trading processes.[832] Reliable management of ports, airports, and rail transport should be encouraged or mandated to ensure the cost-effectiveness and dependability of these services.[833] Public–private partnerships could be used to address the limited provision of public goods and low private sector investment, for example, for transport networks and storage facilities.

With road transport being the dominant mode for most intra-country transport (i.e., from the point of production to the export gateway, whether a border crossing, seaport, or airport), maintaining a large road network in good condition by constructing new transport links and up-

[832] cf. World Bank 2010, 44
[833] cf. World Bank 2010, 45

grading existing ones, especially those leading to and from major export gateways as well as those connecting production and logistics zones to the road network, is recommended for all three product categories.[834] Logistics zones that serve exports markets could be set up or their operation incentivized. Optimizing port to hinterland connections is also recommended. Inland clearance facilities and dry ports could be set up to allow customs clearance at regional production hubs rather than at the border.[835]

Business practices refer to intra-company processes, hence the role of government here is limited to regulations and incentives. Collaboration among supply chain partners could be facilitated via digital logistics platforms. Data tools are recommended to support an uninterrupted supply chain across transport modes. These could include predictions of estimated time of arrival for the entire transport chain, potentially using AI and machine learning.[836] Information flow (e.g., Advance Shipment Notices) and collaboration among all supply chain partners could be encouraged.[837]

To support supply chain visibility, tracking and tracing technology should be available, ideally real-time tracking, and modern technology for tracking and tracing should be supported or, at least, not impeded.[838] To continually improve processes, the use of supply chain metrics and performance measurement could be encouraged, for example, using predictive analytics to foresee variations in input availability.[839]

Despite technological advances, logistics remains a labor-intensive activity. A high level of logistics knowledge at the company level could be promoted by introducing professional standards and certifications for

834 cf. World Bank 2010, 45
835 cf. World Bank 2012, 49
836 cf. Poschmann et al. 2019, 162
837 cf. Göpfert and Braun 2017, 28
838 cf. Kiwitt and Frankenberg, 2012, 160
839 cf. Ivanov et al. 2019, 40

LSPs.[840] Certification could be based on international standards, e.g., CILT or FIATA, or regional standards. Vocational education could be improved and formal jobs training and skills upgrading in logistics professions offered. Owing to its importance for intra-country transport (i.e., from the point of production to and from the export gateways), adequate staffing of road transport should be supported, including basic driver training.

To increase the competitiveness of a country as a production location for any product category, national governments could work towards lowering logistics costs to international best practice levels (ca. 10–17 % of GDP) by lowering transit transaction costs (customs and handling charges) and increasing reliability and predictability in the logistics environment.[841] (See section 4.3.2 regarding unintended consequences of a narrow focusing on the GDP share of logistics costs.) Adopting these cross-cutting measures would likely also foster the logistics environment for other product categories, though this cannot be verified as only three product categories were explored in depth.

OVERLAP BETWEEN THE SUGGESTED MEASURES FOR DIFFERENT PRODUCT CATEGORIES

It is no coincidence that the above implications for policymakers closely resemble the measures suggested for the three product categories in the decision framework (sections 5.4.6, 6.4.6, and 7.4.6) and that several themes appear in each of the three product categories. Areas such as facilitation of intermodal transport, digitalization of government services for traders, fostering real-time tracking and tracing, encouraging digitally enhanced collaboration among logistics actors, and improving skills and training for logistics professionals are fields in which national governments should concentrate their efforts to increase the performance of the logistics environment in their country if they intend to foster high-

[840] cf. World Bank 2010, 43
[841] For the numbers on logistics costs: cf. Memedovic et al. 2005, 358

value exports. The overlap between the recommendations for automotive and high-tech goods is particularly pronounced, as both product categories are characterized by supply chains that span multiple countries, the time sensitivity of inputs, and reliance on air transport for at least part of their inputs.

For policymakers wishing to improve the logistics environment for automotive or high-tech manufacturing, there are potential economies of scale in terms of the other product category being supported by the same logistics measures, for example, measures to facilitate air cargo aimed at supporting the automotive sector will also facilitate high-tech manufacturing. This also means that, whereas a detailed plan (as can be created by applying the decision framework) would be the best option to improve the logistics environment for a particular product category in a country, a second-best move would be to start with some of the general guidelines (as laid out above) and then incrementally improve later on, ideally by using a detailed gap analysis as the guidepost. This would save time and be preferable to an outcome in which no logistics interventions are made at all, for instance, owing to institutional inertia or political infighting.

8.2 Validation of results

8.2.1 Introduction

The purpose of this section is to evaluate whether the decision framework proposed in this dissertation contributes to the goal of enabling national governments to identify the logistics measures necessary to foster higher-value international trade in selected product categories. For a full validation of the decision framework presented in section 4.3 in the countries examined, it would be necessary to implement all suggested measures, observe the trajectory of exports in the relevant product category in subsequent years, and eliminate all confounding variables that could have contributed to the rising export numbers (e.g., overall economic growth, sector effects, effects in competing neighboring coun-

tries, etc.). This is beyond the scope of this dissertation, as it would require an estimated minimum of five years to implement the measures and observe the subsequent changes in export patterns. Instead, the decision framework has been validated via a round of interviews with Vietnamese stakeholders, separate from the interviews carried out for the gap analysis in section 8.2.2, and via a comparison of logistics measures taken in Morocco since 2016 (section 8.2.3).

As for validating the decision framework's results with respect to the guiding theory: Transaction cost economics predicts efficient markets if transaction costs are low.[842] Efficient markets underlie economic growth. One source of economic growth is a rise in exports. The decision framework aims at identifying measures that can help spur an increase in exports in a given product category by improving the logistics environment. To validate the framework's results with respect to transaction cost economics, interviewees in Vietnam were presented with the measures identified using the decision framework and asked whether they judged the proposed measures capable of helping to increase exports of high-tech goods from Vietnam. In addition, in the analysis of the validation results for Vietnam, some measures were highlighted that can serve as examples for the four transaction cost categories covering initiation, agreement, control, and adjustment costs (see 4.2.1).[843]

8.2.2 Validation of results for Vietnam

To validate the results of the decision framework, eleven interviews were carried out between November 2019 and January 2020 with Vietnamese stakeholders, one of the countries examined in the case studies.[844] Vietnam was chosen over Morocco and Kyrgyzstan to serve as

[842] North 1992, 6
[843] cf. Picot 1982, 270
[844] Three of the validation interviews were carried out by the author. Eight of the validation interviews were carried out by Trịnh Thị Thu Hương, Associate Professor at the Faculty of Economics and International Business of Foreign Trade University Hanoi, Vietnam, on behalf and under the guidance of the author. All validation interviews

the focal country for the validation round on the basis that its logistics problems are the most complex of the three countries owing to its size and importance in global trade. With a population of close to 100 million people and a GNI of US$225.9 billion in 2018, Vietnam tops Morocco and Kyrgyzstan in terms of population and economic size.[845] Moreover, with merchandise trade making up 196 % of the country's GDP in 2018, Vietnam is unusually open to trade, more so than Morocco (where merchandise trade makes up 67.5 % of GDP) and Kyrgyzstan (88.1 %).[846] Although a validation in all three countries would have been preferable, the validation with Vietnamese stakeholders was seen as the most crucial given the pressure that the country's logistics environment is under to facilitate such high levels of trade.

Several Vietnamese stakeholders interviewed during the validation round had been part of the group of experts previously interviewed for the case study. Additional interviewees were added based on their expertise of, for example, high-tech manufacturing. They were asked for their feedback on the measures suggested to improve the logistics environment for high-tech manufacturing in Vietnam. The questions asked were:

1. Do you think the measures suggested will improve Vietnam's logistics environment for high-tech manufacturing?
2. Do you think the measures suggested will increase Vietnam's exports of high-tech goods?
3. Are any measures missing that you think should be included?

Owing to the high number of measures suggested for Vietnam (section 10.5.6), interviewees were not asked to provide their views on each measure. Instead, each interviewee was questioned about the measures in two to three of the seven functional categories, for instance, customs,

were carried out as structured interviews. The author provided the questionnaires, selected the interviewees, and carried out the analysis of findings alone.

845 World Bank 2020; calculated using Atlas method (current US$)

846 World Bank 2020. All numbers refer to 2018.

regulatory issues, and education and skills; or other combinations. The selection was done by the author and was partly randomized to ensure equal coverage and partly based on the functional area for which the interviewees had mentioned the highest number of deficiencies during the first interview round. A list of the stakeholders interviewed during the validation round is included in Table 10-5. The interviews revealed that all interviewees broadly agreed with the proposed measures; no one disagreed in general terms, but some interviewees made qualifications or additions to the recommendations.

Suggested measures on trade- and transport-related infrastructure: Three interviewees from the logistics industry confirmed that all suggested measures in the infrastructure category were sensible, would improve the logistics environment for high-tech companies in Vietnam, and could be expected to increase Vietnam's exports of high-tech goods.[847] Another interviewee, representing the Vietnam Electronics Industry Association, also endorsed the suggested infrastructure improvements.[848] One interviewee stressed the importance of speed and safety in supply chains for high-tech manufacturers and confirmed that the measures suggested would improve the speed and safety of logistics operations in Vietnam.[849]

One interviewee suggested two further measures to strengthen intermodal transport: improving the inland waterway between the ports of Cat Lai and Cai Mep, and improving road access to Cai Mep port from Ho Chi Minh City and Doi Nang province.[850] Some of the measures regarding the deepwater port of Hai Phong were updated based on information received during a validation interview with a logistics profes-

[847] Interview with Vietnamese logistics professional, Nov. 1, 2019, interview with Hanoi (Vietnam) branch of multinational LSP, Nov. 28, 2019, and interview with Vietnamese LSP, Hanoi, Jan. 2020

[848] Interview with Executive Board Member of the Vietnam Electronics Industries Association, Dec. 2019

[849] Interview with Hanoi (Vietnam) branch of multinational LSP, Nov. 28, 2019

[850] Interview with Vietnamese logistics professional, Nov. 1, 2019. The suggestions were incorporated into the recommendations for Vietnam.

sional based in the north of the country, as were measures targeting the road connection established by high-tech manufacturer Samsung to the main airport in the north of the country, Noi Bai.[851]

Measures regarding ports and airports in the south of the country were updated based on information received during a validation interview with a Ho Chi Minh City-based representative of a logistics company whose largest customer is Foxconn, the second-largest high-tech manufacturer in Vietnam, for which the company provides logistics services for three Vietnam-based factories.[852] The interviewee confirmed that the suggested measures would increase Vietnam's exports of high-tech goods, but added that there were several other developments that were supporting Vietnam's high-tech exports: the US–China trade dispute, tax incentives, low labor costs, the geographically advantageous location of Vietnam, and good transportation infrastructure.[853]

Suggested measures on information and communications technology: An interviewee from the high-tech industry endorsed the suggested measures, saying: "Moreover, the advances in ICT and upgrades in customs practices will be ideal solutions for some problems in terms of speed, simplicity and predictability, which high-tech production always prioritizes."[854] Another interviewee, representing the Vietnam Logistics Business Association, confirmed that the suggested ICT measures would improve Vietnam's logistics environment for high-tech manufacturing and would increase the country's exports of high-tech goods.[855] Two other interviewees, from the Vietnam Shippers Council and the Vietnam Electronics Industry Association, agreed with all suggested measures, though the former cautioned that some of the suggested measures would

[851] Interview with Hanoi (Vietnam) branch of multinational LSP, Nov. 28, 2019
[852] Interview with Vietnamese logistics professional, Nov. 2019. The largest high-tech company operating in Vietnam is Samsung.
[853] Interview with Vietnamese logistics professional, Nov. 2019
[854] Interview with Nguyen Thi Minh Phuong, Operational Purchasing Manager, ABB Vietnam, Nov. 2019
[855] Interview with Nguyen Tuong, Deputy General Secretary, Vietnam Logistics Business Association, Dec. 2019

be difficult to implement due to a low level of transparency among Vietnamese firms.[856]

Suggested measures on the organization of the logistics environment: A lecturer in logistics and supply chain in the Department of Economics and International Business of the Foreign Trade University in Hanoi encouraged the addition of additional sector-specific measures to address the needs of the high-tech industry and to help increase exports in that product category.[857] These were incorporated into the suggested measures. The interviewee endorsed the measures previously suggested for increasing the environmental sustainability of logistics in high-tech manufacturing.[858]

Suggested measures on business practices: One interviewee from the Vietnamese logistics industry confirmed that all suggested measures would improve the logistics environment for high-tech firms and could support higher levels of exports in that sector, but expressed doubts about the relevance of the measures suggested on environmental sustainability—these measures would have to take into consideration that customers for logistics services in Vietnam did not have a higher willingness to pay for sustainable logistics services, and the cost of, for example, new fuel-efficient trucks would be prohibitive for LSPs.[859]

Another interviewee from the logistics industry confirmed that all suggested measures in this section were relevant, as did the interviewee representing the Vietnam Electronics Industry Association.[860] Another interviewee, from the Vietnam Logistics Business Association, confirmed that the measures suggested would improve Vietnam's logistics environment

[856] Interview with Vietnamese logistics expert, Hanoi, Dec. 2019, and interview with Executive Board Member of the Vietnam Electronics Industries Association, Dec. 2019
[857] Interview with Ha Pham, Foreign Trade University Hanoi, Nov. 4, 2019
[858] Interview with Ha Pham, Foreign Trade University Hanoi, Nov. 4, 2019
[859] Interview with Vietnamese logistics professional, Nov. 1, 2019
[860] Interview with Hanoi (Vietnam) branch of multinational LSP, Nov. 28, 2019, and interview with Executive Board Member of the Vietnam Electronics Industries Association, Dec. 2019

for high-tech manufacturing and would increase the country's exports of high-tech goods.[861] He emphasized the importance of sharing information among all supply chain stakeholders and the need for logistics managers to anticipate the ramifications of decentralization via the use of 3D printing.[862] When viewed in terms of the transaction costs of doing logistics in the country, improved information sharing among supply chain stakeholders contributes to lowering initiation costs, in the sense that it will become easier to obtain information about potential transaction partners and their terms and conditions.[863] It can also lower agreement costs, in the sense that it can simplify contract negotiations.[864]

Suggested measures on customs practices: An interviewee from the Vietnam branch of a large multinational LSP confirmed that the measures suggested for customs practices were correct and stated that nothing had to be added.[865] Another interviewee, representing a Ho Chi Minh City-based logistics company serving high-tech manufacturers in Vietnam, added input to the gap analysis on customs practices; this related to the high number of customs regulations governing imports and exports, and he confirmed that the suggested measures were relevant, complete, and reasonable.[866] Reducing the number of customs regulations can be regarded as contributing to lowering transaction costs by decreasing initiation and control costs (when viewing customs authorities as transaction partners of exporters and LSPs).[867]

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[861] Interview with Nguyen Tuong, Deputy General Secretary, Vietnam Logistics Business Association, Dec. 2019

[862] Interview with Nguyen Tuong, Deputy General Secretary, Vietnam Logistics Business Association, Dec. 2019. See also World Economic Forum 2020, 16, for examples of how 3D printing can be used to decentralize manufacturing in times of crises such as the COVD-19 pandemic.

[863] cf. Picot 1982, 270

[864] cf. Picot 1982, 270

[865] Interview with Hanoi (Vietnam) branch of multinational LSP, Nov. 28, 2019

[866] Interview with Vietnamese logistics professional, Nov. 2019

[867] cf. Picot 1982, 270

A third interviewee, representing the Vietnam Electronics Industry Association, endorsed the suggested measures.[868] The interviewee underlined the need for customs clearance to be available 24/7, as electronics companies rely on timely clearance for imported consignments, and called for an expansion of the Authorized Economic Operator program.[869] Another interviewee from the logistics industry confirmed that all measures suggested in the customs category were relevant, would improve the logistics environment for high-tech companies in Vietnam, and could be expected to increase Vietnam's exports of high-tech goods.[870]

Suggested measures on the regulatory environment: An interviewee from the public sector endorsed the regulatory environment measures, confirming that they would improve Vietnam's logistics environment for high-tech manufacturing.[871] However, the interviewee cautioned that the suggested measures would not increase high-tech exports in the short term (though possibly in the long term) as high-tech manufacturing (and other sectors in the country) still faced difficulties in logistics.[872] A second interviewee from the public sector endorsed the measures and confirmed they could be expected to improve the logistics environment for high-tech products in Vietnam and contribute to rising exports in that product category.[873] A third interviewee, from the Vietnam Electronics Industry Association, endorsed the suggested measures for improving the regulatory environment for logistics.[874]

Suggested measures on education, skills, and professional training: A lecturer in logistics and supply chain at the Foreign Trade University in

[868] Interview with Executive Board Member of the Vietnam Electronics Industries Association, Dec. 2019
[869] Interview with Executive Board Member of the Vietnam Electronics Industries Association, Dec. 2019
[870] Interview with Vietnamese LSP, Hanoi, Jan. 2020
[871] Interview with Vietnamese logistics expert from the public sector, Dec. 2019
[872] Interview with Vietnamese logistics expert from the public sector, Dec. 2019
[873] Interview with Vietnamese logistics expert from the Ministry of Industry and Trade, Dec. 2019
[874] Interview with Executive Board Member of the Vietnam Electronics Industries Association, Dec. 2019

Hanoi confirmed that the measures suggested for education, skills, and professional training were reasonable as they covered both university education and practical training in the form of vocational training and internships.[875] She recommended making the measures more sector-specific, for example, by establishing direct links between high-tech companies and universities. Several measures were revised accordingly.[876] Regarding the certification of skills, she added that, in addition to certification by global bodies such as FIATA and CILT, certification in Vietnam could also follow regional standards, such as those of the ASEAN freight forwarders' association.[877] Introducing comparable and reliable standards for skills can contribute to lowering transaction costs, specifically control costs, which denote the costs of ensuring that agreements on quality (such as a training certificate) are honored.[878]

Two interviewees from the Vietnamese logistics industry confirmed that all measures in this section would improve the logistics environment for high-tech firms and would support higher export levels in that sector.[879] One of them suggested two ideas that were incorporated; on training for experienced logistics staff and on training to enhance the knowledge of existing staff regarding the digitalization of logistics processes, particularly in warehousing and customs clearance.[880] The interviewee from the Vietnam Electronics Industry Association endorsed the measures in this section and underlined the need for building logistics skills in Vietnamese high-tech companies.[881]

Overall comments on the proposed measures from stakeholders in Vietnam: None of the interviewees doubted the usefulness of the

[875] Interview with Ha Pham, Foreign Trade University Hanoi, Nov. 4, 2019
[876] Interview with Ha Pham, Foreign Trade University Hanoi, Nov. 4, 2019
[877] Interview with Ha Pham, Foreign Trade University Hanoi, Nov. 4, 2019
[878] cf. Picot 1982, 270
[879] Interview with Vietnamese logistics professional, Nov. 1, 2019, and interview with Nguyen Tuong, Deputy General Secretary, Vietnam Logistics Business Association, Dec. 2019
[880] Interview with Vietnamese logistics professional, Nov. 1, 2019
[881] Interview with Executive Board Member of the Vietnam Electronics Industries Association, Dec. 2019

measures. An interviewee representing the Vietnam branch of an international high-tech manufacturer endorsed the measures overall: "In my opinion, the suggested measures will have a positively intensive impact on Vietnam's logistics environment for high-tech manufacturing."[882] She expressed confidence that the measures would increase Vietnam's exports of high-tech goods, as the suggested improvements would help decrease transport time and therefore product costs, thereby increasing the competitiveness of exports.[883]

8.2.3 Validation of results for Morocco

As an additional validation method, the following section provides an overview of logistics measures that were taken in Morocco between early 2016 and the end of 2020, followed by a comparison of these measures with those suggested in application of the decision framework to Morocco (sections 6.4.6 and 10.6.6). The year 2016 was chosen because data collection for this dissertation took place in the country at the end of 2015. During this approximately 5-year timeframe, the logistics measures listed below were implemented in Morocco.

Transport- and trade-related infrastructure: In 2016, a 13-hectare logistics and industrial zone Tétouan Park, near the northern Moroccan city of Tétouan, was inaugurated.[884] In 2016, a logistics zone near Tanger-Med port was upgraded.[885] Work began on a road along the coast near the port of Casablanca to enable trucks to bypass Casablanca city center when entering and exiting the port.[886]

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[882] Interview with Nguyen Thi Minh Phuong, Operational Purchasing Manager, ABB Vietnam, Nov. 2019

[883] Interview with Nguyen Thi Minh Phuong, Operational Purchasing Manager, ABB Vietnam, Nov. 2019

[884] http://www.equipement.gov.ma/logistique/Actualites/Pages/Actualites.aspx?IdNews=1655 (accessed on Dec. 31, 2019)

[885] http://www.equipement.gov.ma/logistique/Actualites/Pages/Actualites.aspx?IdNews=2023, (accessed on Dec. 31, 2019)

[886] http://www.equipement.gov.ma/logistique/Grands-projets/Pages/Grands-projets.aspx (accessed on Dec. 31, 2019)

Information and communications technology: The four-year PME Logis program was launched in 2017 by the Moroccan Agency for Logistics Development to support the development of ICT applications for logistics operations for SMEs.[887]

Organization of the logistics environment ("ecosystem"): To ensure that key performance indicators in logistics are collected, the Observatoire Marocain de la Compétitivité Logistique (Moroccan Logistics Observatory) was instituted in 2014 and started work the following year.[888] In 2018, the Moroccan Ministry of Transport and Logistics bolstered PPPs by signing several contracts to solidify private-sector engagement in developing the Moroccan logistics sector.[889]

Business practices for high-quality logistics services: The PME Logis program (mentioned above) assists SMEs in outsourcing logistics services.[890]

Education, skills, and professional training: Skills formation in the logistics sector will be supported by a national training plan over the period 2020–2024.[891] A scheme for on-the-job training of 70 logistics professionals was announced in 2019 in the form of a cooperative initiative between the Moroccan Ministry of Transport and Logistics and the European Investment Bank.[892] The training focuses on SCM, business management, transport and warehousing and will incorporate interna-

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887 http://www.equipement.gov.ma/logistique/Actualites/Pages/Actualites.aspx?IdNews=2996 (accessed on Dec. 31, 2019). PME stands for "Petites et moyennes entreprises" (SMEs).

888 https://www.amdl.gov.ma/amdl/axes-strategiques/gouvernance-du-secteur/ (accessed on Dec. 31, 2019)

889 https://maroc-diplomatique.net/le-secteur-de-la-logistique-contribue/, (accessed on Dec. 31, 2019)

890 http://www.equipement.gov.ma/logistique/Actualites/Pages/Actualites.aspx?IdNews=2996 (accessed on Dec. 31, 2019). PME stands for "Petites et moyennes entreprises" (SMEs).

891 https://www.challenge.ma/ou-en-est-on-concretement-dans-le-deploiement-de-la-strategie-122145/ (accessed on Dec. 31, 2019)

892 https://www.salon-agriculture.ma/logistique-le-maroc-lance-une-grosse-operation-de-formation/ (accessed on Dec. 31, 2019)

tional standards.[893] The PME Logis scheme focuses on logistics skills building in SMEs.[894] In 2017, AMDL introduced a manual describing 21 logistics professions; this includes the tasks and skills required, and is intended to serve as a guide for the HR departments of hiring companies.[895] Moreover, AMDL increased its international outreach efforts and facilitated the set-up of a center for the certification of logistics skills in Morocco by the European Logistics Association.[896]

Cross-cutting topic: Increasing the environmental sustainability of logistics operations: To combat climate change, the Moroccan government has included in its logistics strategy projects aimed at limiting the environmental impacts of logistics activities, notably the Moroccan Green Logistics initiative of the Moroccan Agency for Logistics Development.[897] In 2016, the state-owned Société Nationale des Transports et de la Logistique signed an agreement with the Global Environment Facility to install solar panels, valued at US$500,000, on warehouses in the Zenata logistics zone to foster the use of renewable energy for refrigerated storage.[898]

Conclusion: All logistics measures taken by Morocco and identified above are in line with the recommendations made in the decision framework. Most measures fall into the categories of either (hard) infrastructure or skills and training. Although beneficial to the logistics environment, these measures should be complemented by improvements in soft infrastructure, for example, easing regulatory constraints and facilitating customs clearance—two areas in which reforms have not been forthcom-

[893] https://www.salon-agriculture.ma/logistique-le-maroc-lance-une-grosse-operation-de-formation/ (accessed on Dec. 31, 2019)
[894] http://www.equipement.gov.ma/logistique/Actualites/Pages/Actualites.aspx?IdNews=2996 (accessed on Dec. 31, 2019)
[895] http://www.equipement.gov.ma/logistique/Actualites/Pages/Actualites.aspx?IdNews=2750 (accessed on Dec. 31, 2019)
[896] http://www.equipement.gov.ma/logistique/Actualites/Pages/Actualites.aspx?IdNews=2996 (accessed on Dec. 31, 2019)
[897] https://maroc-diplomatique.net/le-secteur-de-la-logistique-contribue/ (accessed on Dec. 31, 2019)
[898] http://www.equipement.gov.ma/logistique/Actualites/Pages/Actualites.aspx?IdNews=2000, (accessed on Dec. 31, 2019)

ing in Morocco in the past five years. Moreover, some persistent shortcomings in trade- and transport-related infrastructure are not being addressed, especially regarding the facilitation of intermodal transport, for instance, rail connections for logistics zones, and better transshipment options around the port of Tanger-Med. As of late 2019, the progress level of the Moroccan National Strategy for Logistics Development (instituted in 2010) stood at only 14 %.[899] The Moroccan Agency for Logistics Development—the public body charged with implementing the strategy—cited financing difficulties as the main obstacles to completing the strategy, in particular those related to low financial incentives for private developers to invest in logistics zones.[900] Other obstacles included a lack of high-quality real estate for logistics training.[901]

8.2.4 Validation of results: Conclusion

The measures suggested by the decision framework are in line with the expectations of, and endorsed by, policymakers and practitioners in Morocco and Vietnam. To a certain extent, they can thus be expected to contribute to improving the logistics environment and fostering higher-value exports. Regardless of the product category studied, the decision framework aims at improving three key features of the logistics environment: time, reliability, and cost. As an additional issue, the framework's measures target the increase of environmental sustainability in logistics. Improvements in a country's logistics environment should improve all these objectives: lower the time needed to move goods; increase the reliability of goods arriving on time at the right place in the right quantity and quality; lower the cost of logistics; and increase the environmental sustainability of logistics.

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899 https://www.challenge.ma/ou-en-est-on-concretement-dans-le-deploiement-de-la-strategie-122145/, (accessed on Dec. 31, 2019)

900 https://www.challenge.ma/ou-en-est-on-concretement-dans-le-deploiement-de-la-strategie-122145/ (accessed on Dec. 31, 2019)

901 https://www.lavieeco.com/economie/strategie-nationale-de-la-competitivite-logistique-un-bilan-detape-peu-rassurant/ (accessed on Dec. 31, 2019)

Once measures are implemented, further options for validating the results emerge. One could directly measure output parameters of logistics performance, chiefly time (flexibility), reliability, and cost. Improvements in time can be measured by reductions in, for example, transportation and lead times. Improvements in shipment reliability can, for instance, be measured by the share of on-time arrivals, reduction in buffer storage, reduction in slack time, or customer satisfaction.[902] Logistics costs can be measured through, for instance, firm surveys. Environmental sustainability can be assessed by comparison with international best practices as well as with national and international targets, e.g., for CO_2 reductions.

[902] Pham et al. 2013a, 6

9 SUMMARY AND OUTLOOK

9.1 Essential results

This dissertation deals with the role of government in facilitating a logistics environment that enables higher-value exports. It illustrates the importance of a well-functioning logistics environment for a country to engage successfully in international trade. The dissertation builds on a definition, derived in section 1.3, of what "adequate logistics" means in the context of exports, in particular from the perspective of national governments rather than private companies. The dissertation's main result is the development of a decision framework to help countries determine measures for fostering higher-value exports, which, here, refer not just to more exports, but to a rise in their value added. The focus is on measures within the realm of policymaking, rather than on intra-company reforms.

The framework is applied to three product categories: high-tech manufacturing, automotive products, and perishable agricultural goods; and to three countries: Vietnam, Morocco, and Kyrgyzstan. The product categories were selected based on their potential to support higher-value trade and their suitability to each country's features. The countries were chosen to be representative with respect to world region, geography, population, and economic size. Logistics must have featured somewhat prominently in national policymaking between 2010 and 2020. For each product category, the analysis is divided into seven functional categories: infrastructure, ICT, organization of the logistics environment, business practices, customs, the regulatory environment, and education and training. These categories reflect the building blocks of "adequate logistics" for exports, as defined above.

Although the three country case studies take up a good part of the dissertation's main text and the majority of the appendices, the core contribution to research lies in the formulation and application of the framework. The country-specific results of the case studies will at some point be outdated, especially in an area as dynamic as logistics. Nevertheless, the case studies were indispensable to test the decision framework regarding the feasibil-

ity, timing, and validity of the results (see also section 8.2 for the validation). It was possible to show that the decision framework can serve as a useful approach, grounded in theory, for a structured, evidence-based formulation of policy measures in logistics.

Three results emanate from the application of the framework. The first is concerned with the formulation of the requirements of a well-functioning logistics environment in each of the product categories: high-tech goods (section 5.4.4 and Appendix 10.5.4), automotive products (section 6.4.4 and Appendix 10.6.4), and higher-value perishable agricultural goods (section 7.4.4 and Appendix 10.7.4). This first result is independent of the country in focus.

The second result comprises a set of country-specific measures to help policymakers address the reform needs in logistics in the three countries: Vietnam (for high-tech goods: section 5.4.6 and Appendix 10.5.6), Morocco (for automotive products: section 6.4.6 and Appendix 10.6.6), and Kyrgyzstan (for higher-value perishable agricultural goods: section 7.4.6 and Appendix 10.7.6).

The third result consists of guidelines for policymakers in middle-income countries other than the three countries examined on how national governments can improve the logistics environment for the three product categories (section 8.1.6). For tailored guidelines, it is necessary to conduct a gap analysis of the logistics environment for each country, as included in sections 5.4.5 (for Vietnam), 6.4.5 (for Morocco), and 7.4.5 (for Kyrgyzstan). Hence, the most detailed results are available for these three countries. Nevertheless, using the decision framework developed in this dissertation can provide orientation for policymakers in other countries: It enables them to analyze their countries' logistics environments and deduce recommendations for improving conditions in any of the three product categories to provide an advantageous logistics environment. It is up to the private sector to provide high-quality logistics services; however, national governments play a crucial role by providing modern infrastructure, efficient regulation, and good education for all logistics actors.

The three product categories selected vary in their degree of value added and level of integration into global value chains.[903] Participation in global value chains can take the form of backward and forward participation; backward participation means that a country's exports use imported intermediate products, whereas forward participation implies that a country exports intermediates that are used in the exports of another country.[904] Figure 9-1 shows where the three product categories examined in the case studies fall within a framework of backward and forward GVC integration, as suggested by the 2020 World Development Report "Trading for Development."[905]

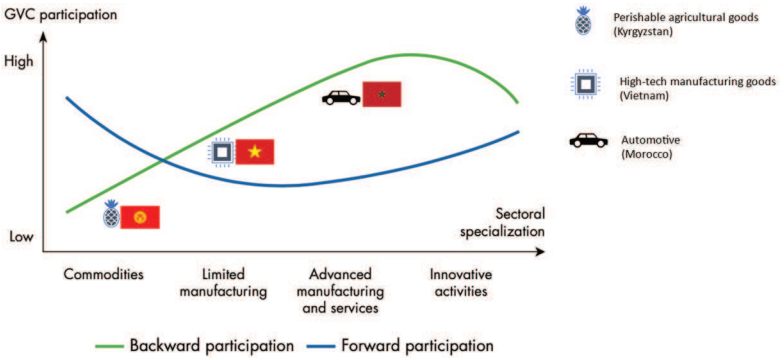

Figure 9-1: Backward and forward global value chain integration of the three product categories[906]

[903] "Integration" and "participation" into global value chains will be used interchangeably here, in keeping with the source literature (World Bank 2019).

[904] Backward GVC participation is defined by World Bank 2019, 23 thus: "Backward GVC participation, in which a country's exports embody value added previously imported from abroad. For example, if the bicycles exported by Taiwan, China, use imported intermediates, then its GVC participation is considered backward because the intermediates used in exports are from the previous stage." Forward GVC participation is defined by World Bank 2019, 23 thus: "Forward GVC participation, in which a country's exports are not fully absorbed in the importing country and instead are embodied in the importing countries' exports to third countries. In the bicycle example, if India sends aluminum tubing to Taiwan, China, where it is further used in the production of the bicycle later exported, then India's GVC participation is considered forward because the exporter is at the early stage of production of the bicycle."

[905] World Bank 2019, 23

[906] Adapted from World Bank 2019, 23, with product categories and countries added by the author. For the definition of taxonomy groups (commodities, limited manufacturing, advanced manufacturing and services, innovative activities), see World Bank 2019, 22–23

The policy recommendations in the three case studies varied as a result of the different logistics requirements of each product category and the diverse conditions in the countries. This was to be expected owing to the differing logistics requirements of the three product categories and on the basis of the differing geographic, demographic, and economic features of the countries. However, the policy recommendations were aligned with the level of GVC participation of each product category. Perishable agricultural goods—part of the taxonomy group of commodities—exhibit low backward GVC participation and fairly high forward participation. For Kyrgyzstan, this means that its agricultural good are mostly exported to other countries to be used as intermediates in their exports. The policy measures recommended for Kyrgyzstan underline the importance of basic logistics facilities, for example, temperature-controlled transport and warehousing infrastructure, as well as procedural issues within the public sector's purview, for instance, SPS measures. These suggestions are amplified by the low level of economic development in Kyrgyzstan, a landlocked developing country.[907] The recommendations are intended to improve Kyrgyzstan's agro-logistics environment such that a higher share of value addition can take place within the country by, for example, processing perishable goods locally.

In contrast, high-tech manufacturing, the product category examined for Vietnam, is a more advanced case of a GVC: It exhibits medium-high forward GVC participation and slightly higher (medium-high) backward participation. This is illustrated by the fact that Vietnam exports intermediate products that are used in other countries' exports (forward integration), for instance, electronic integrated circuits. At the same time, Vietnam uses intermediates imported from other countries (backward integration), such as electronic integrated circuits and semiconductor devices, to export smartphones and TVs.[908]

[907] See https://unctad.org/topic/landlocked-developing-countries/list-of-LLDCs (accessed on Feb. 26, 2021) for a list of landlocked developing countries.

[908] In 2018, telephones accounted for 8.83 % of Vietnamese exports, 13.77 % of export value was accounted for by transmission apparatuses for radio, telephone, and TV, and 5.7 % by electronic integrated circuits. Imports of electronic integrated circuits

In the case of Morocco, its production of automotive products entails medium-high forward GVC participation, as finalized automobiles are not used as inputs into other countries' exports (though automotive parts and components—also produced by Moroccan suppliers—are exported and used as intermediates elsewhere). At the same time, Morocco's automotive production exhibits high backward GVC integration, as intermediate products used in automotive manufacturing are imported from abroad. This emphasizes the importance of well-functioning logistics not only for exported, but also for imported products. A two-way (import- and export-focused) examination of Morocco's logistics environment would thus be a valuable area for further research.

The comparatively higher forward and backward GVC participation of high-tech manufacturing and automotive goods calls for a broader and deeper engagement of domestic and international supply chain partners, with higher reliance on ICT and advanced logistics services; and of governments in terms of improving the operational logistics environment. For all three countries examined, integration into more complex GVCs is desired. One factor driving this is the upgrading of the skills and competencies of the labor force.[909] Upgrading skills in the logistics sector is thus an important aspect of the policy measures recommended in the decision framework.

In Vietnam (section 5.4.6), the main gaps, when considering the logistics environment for high-tech manufacturing in terms of trade- and transport-related infrastructure, include persistent congestion on roads leading to and from seaports (which serve as the main export gateways for high-tech manufacturing), poor integration of inland waterways into intermodal transport, and insufficient availability of inland clearance facilities. Other gaps exist in the organization of the logistics environment, in particular

amounted to 9.07 % (all amounts by value); source: Atlas of Economic Complexity, https://atlas.cid.harvard.edu (accessed on Nov. 27, 2020). As of 2018, Vietnam is the world's second-largest smartphone exporter, and produces 40 % of Samsung's mobile phones (World Bank 2019, 37).

[909] World Bank 2019, 37

the prevalence of state-owned enterprises with substantial market power, especially in shipping. Further weaknesses persist in customs procedures (cumbersome customs clearance), regulation (gaps in logistics legislation), and training (lack of logistics staff with specialized handling skills for high-tech products). Recommendations for improving the logistics environment for high-tech manufacturing in Vietnam include upgrading cargo terminals to facilitate air freight; road infrastructure investments around the main ports in the north and south of the country; upgrading of ICDs in the north; overhauling competition legislation to create a level playing field for all logistics actors; more widespread adoption of risk management practices to speed up customs clearance; and incentives for enhanced on-the-job training for logistics staff.

The empirical results for Morocco show that the main needs for logistics interventions lie in three areas (section 6.4.6): (1) trade- and transport-related infrastructure, (2) regulatory environment, and (3) education, skills, and professional training. Following the investments in logistics-related infrastructure included in the 2010 National Strategy for Logistics Competitiveness of the Government of Morocco,[910] infrastructure deficiencies such as the dearth of logistics zones and roads connecting seaports to the main economic centers have been partly resolved, or at least planned and budgeted for. Nevertheless, several hard and soft infrastructure issues remain. Intermodal transport is underdeveloped, with the only route connecting road to rail and maritime transport running from Casablanca port to Tangier. Transshipment facilities are needed, especially around the port of Tanger-Med.

As for soft infrastructure, the mandate to scan 100 % of containers in the port of Tanger-Med increases congestion and should be scrapped in favor of more widespread adoption of risk management techniques to decrease inspection rates. The high proportion of illegal logistics providers (estimated at 30–45 % of all operators) in Morocco creates an uneven

[910] Ministère de l'Equipement et du Transport du Maroc 2010

playing field for formal logistics providers and should be reduced.[911] Moreover, illegal providers are unable to scale up their operations and offer diversified and specialized logistics services such as those required by sophisticated manufacturers owing to their inability to obtain credit. The supply of trained logistics specialists in Morocco is inadequate and human capital suffers from under-investment. Structured training could offer relief, with widespread on-the-job training and a focus on practical applications rather than the current over-reliance on tertiary education.

For Kyrgyzstan, the outcomes of the framework applications show that logistics infrastructure is the main area in which gaps exist (section 7.4.6). Given that Kyrgyzstan is a landlocked country, seamlessly functioning trade- and transport-related infrastructure is crucial to the country's trading opportunities. Transshipment facilities and logistics zones should ideally be upgraded. Increasing the number of cold storage facilities, securing an uninterrupted cold chain by upgrading the truck fleet to refrigerated vehicles, and expanding facilities for packaging and standardization are the main needs of the agribusiness sector in Kyrgyzstan. But the need for action in Kyrgyzstan extends beyond infrastructure. Minimizing delays at border crossings is paramount to the competitiveness of all exports, but especially so for perishable goods such as fruit and vegetables. For Kyrgyz food exporters, wait times at border posts and associated bureaucracy present a large obstacle. Truckloads of fresh berries spoil before they reach their destination while waiting at the Kyrgyz-Kazakh border. Other functional categories need to be optimized to improve the logistics environment, for example, skills upgrading for logistics employees, improved ICT infrastructure to enable paperless customs declarations, and comprehensive logistics legislation.

The advantage of the proposed framework is that it facilitates governments formulating policy recommendations in an area for which few standardized performance indicators are available, that is, performance metrics for the logistics environment of a particular product category.

[911] cf. Ministère de l'Economie et des Finances du Maroc 2013, 11

The framework presented uses a structured approach that enables drawing conclusions regarding recommended measures fairly systematically, even with a narrow empirical base, by using public statistical information, databases, and reports as well as interviews with key logistics stakeholders. Governments can use the logistics requirements presented to conduct their own gap analyses and identify measures to improve performance in the logistics environment for the three product categories that lend themselves to higher-value exports, with the potential to raise exports and thus foster economic growth.

9.2 Limitations

One limitation of the analysis is that, although designed to capture all major aspects of the logistics environments of the three product categories that governments can influence, the decision framework does not include all conceivable measures that a government can take to foster logistics. A decision framework in an area as dynamic as logistics can hardly be 100 % comprehensive. One course of action to remedy this is to continually screen new technologies and trends in the logistics sector for applicability to the three product categories and design measures accordingly. AI, for instance, will likely heavily impact on logistics operations, yet its potential is currently reflected in only a few of the suggested measures. There is also a trade-off between comprehensiveness (of measures) and manageability (of the framework, especially for the practitioners using it). The main goal was to provide a framework that—while grounded in theory—provides evidence-based support for practitioners at the country level; thus, some of its dimensions have been designed for simplicity, as the framework is already complex. The testing of the framework through the case studies showed that its results are reliable and that the focus on key elements has not jeopardized the validity of results derived from the framework.

A second limitation of the analysis is that interviewees were selected in a non-probabilistic way because of a limited number of potential interview partners. Financial and time constraints restricted the number of

countries and the sample size of interviewees per country. Moreover, validation of the suggested measures could only be carried out indirectly through interviews with Vietnamese stakeholders and a comparison of logistics measures taken in Morocco (section 8.2).

A further caveat is that the main research question and the two sub-questions are confined to those aspects of a country's logistics environment that a national government can influence. Using an entire country as the unit of analysis when examining logistics has become more challenging as trade, especially for manufactured products, is increasingly organized in complex value chains in which intermediate inputs cross multiple borders. Examining two-way flows (i.e., exploring inbound as well as outbound logistics) would be helpful for high-value product categories such as the ones explored here owing to their comparatively higher reliance on intermediate trade. This dissertation therefore does not include all aspects of an export product's logistics environment. Although more international cooperation in facilitating trade through high-quality logistics would be desirable, logistics policymaking still mostly happens at the level of individual countries, and this may justify the dissertation's focus on single countries as the unit of analysis.

Owing to the complexity of policymaking for logistics at the country level, with numerous actors and policy areas involved, the decision framework is not an automatic model; that is, it does not mechanically produce results upon inserting data. It is a guided model, involving expert judgment, in the sense that knowledge of logistics is required for carrying out the gap analysis. To obtain relevant country- and product-category-specific results, a user should be familiar with logistics, with the country, and with conducting semi-structured interviews. For users without this knowledge, for example, policymakers with broad portfolios and little expert knowledge, sections 5.4.6, 6.4.6, 7.4.6, and 8.1.6 provide an overview of the areas that should be considered when trying to improve the logistics environment for a particular product category.

This thesis has focused on interventions within the purview of national governments for improving a country's logistics environment. Several factors beyond the government's reach influence a country's logistics environment, chief among them intra-company decisions, which are not covered here. Other determining factors of logistics performance that are not treated here include the occurrence of natural disasters, cyber-attacks, political unrest, and exchange rate fluctuations. One last caveat applies to the findings presented in this document: Not all of them will be applicable to every middle-income country. The proposals should be evaluated individually to decide whether they are relevant for a particular national and regional context and may have to be adapted.

9.3 Outlook

Trade logistics reforms are difficult because a multitude of stakeholders from several sectors must agree on the objectives and methods. On the policy side alone, there are actors from numerous agencies: those in charge of transport, investment, commerce, industry, and border management. Logistics is based on networks—transport networks for the different transport modes, IT networks, educational networks, and networks of firms providing and demanding services. There is no one-size-fits-all approach that a national government could adopt to improve these networks, and reforms require time, resources, and sustained attention. Any reform must include buy-in from the private sector. To ensure that policy interventions are geared towards the private sector's needs and properly implemented, some countries have introduced logistics councils or other coordinating bodies: among these are Canada, Germany, Finland, China, Malaysia, and Morocco. Such coordinating bodies could be set up in other countries or at the multi-national level. The EU's Digital Transport and Logistics Forum provides an example.[912]

[912] See https://www.dtlf.eu/#home (accessed on Nov. 19, 2020) for information on the EU's Digital Transport and Logistics Forum

Policy intervention suggestions stemming from evidence-based policymaking are only as good as the evidence on which they are based. Evidence-based policymaking depends on the availability of timely, correct, and relevant data. These types of data are not always available for logistics and are often less available in countries with poor logistics environments whose needs are even more urgent. Data on freight volumes, routes, destinations, intermodal transport, and logistics performance are notoriously scarce. A suggestion to policymakers would be to provide incentives and resources to collect logistics-related data on a national basis. Data collection methods should be uniform across time. It is necessary to keep in mind that the choice of metrics can influence the outcomes; different metrics, for instance for freight transport, can lead to different performance results, as indicators such as productivity and utilization measures are inversely correlated.[913] Such uniform and comprehensive data collection could be ensured under the umbrella of national logistics councils, logistics observatories, or statistics agencies.

9.4 Questions for further research

There is scope for confirming and extending the results of this thesis. The framework could be used in other countries to obtain benchmark data for the gap analysis. Future research with a focus on other product categories would also be worthwhile. Logistics requirements change: It would be useful to update the "requirements" section of the decision framework in about five years (i.e., in about 2026) to reflect changing logistics concepts and technologies. Once a government has applied the framework and implemented the recommended measures, it would be beneficial to assess the framework's validity after the measures have had time to affect export patterns. Another research area would be to include a multidirectional examination of logistics at the country level, where the ease of inbound flows is examined in addition to that of outbound flows, and to investigate synergies between upgrading the logistics of both. This would be particularly useful for product categories organized in global value chains.

[913] cf. McKinnon 2015a, 20

Further research could also focus on ways for monitoring logistics performance at the country level, with indicators covering time, cost, and reliability, to provide a basis for determining areas for improvement, ideally in the form of uniform measurement for a high number of countries and with yearly updates to facilitate comparisons over time. As suggested by Rantasila and Ojala (2012), it would be useful to design a standardized method of measuring logistics costs at the country level.[914] Additionally, digitalization will have a large impact on logistics in the next few years. Its full impact on how logistics is conducted in middle-income countries has not been included in this work, but it could be included in further research.

Although it is too early to tell, it is likely that, in light of the COVID-19 pandemic, an aspect that will grow in importance is supply chain resilience, that is, the ability of supply chains to rebound quickly in the event of crises, be they related to health, the natural environment, political unrest, or other causes. COVID-19 has hit the automotive industry especially hard, both in terms of demand and regarding the supplier network.[915] The growing risks of such crises mean that companies will have to reevaluate the tradeoff between economic efficiency and resilience.[916] Policymakers can support improved supply chain resilience at the national level through, for instance, contingency planning (ideally jointly with businesses), planning and maintenance of transport infrastructure, and provision of law enforcement and emergency services.[917] Companies might draw as a lesson the need to internalize, or reshore (or at least near-shore) previously outsourced production activities. Events such as a pandemic also present the chance for middle-income countries to position themselves as alternative production locations as firms will expand their supplier network to more rather than fewer countries to keep several sourcing options available should supply falter from their established supplier locations.

[914] Rantasila and Ojala 2012, 7
[915] cf. World Economic Forum 2020, 8
[916] cf. McKinnon 2018, 8
[917] cf. McKinnon 2018, 15

10 APPENDIX

10.1 List of middle-income countries as of June 2020

For the 2020 fiscal year (July 1, 2019, to June 30, 2020), middle-income economies as defined by the World Bank are those with a 2018 GNI per capita of more than US$1,026 but less than US$12,375 (using the World Bank Atlas method). The number of middle-income countries in fiscal year 2020 was 107.

Albania	Georgia	Nigeria
Algeria	Ghana	North Macedonia
American Samoa	Grenada	Pakistan
Angola	Guatemala	Papua New Guinea
Argentina	Guyana	Paraguay
Armenia	Honduras	Peru
Azerbaijan	India	Philippines
Bangladesh	Indonesia	Romania
Belarus	Iran, Islamic Rep.	Russian Federation
Belize	Iraq	Samoa
Bhutan	Jamaica	Sao Tome and Principe
Bolivia	Jordan	Senegal
Bosnia and Herzegovina	Kazakhstan	Serbia
Botswana	Kenya	Solomon Islands
Brazil	Kiribati	South Africa
Bulgaria	Kosovo	Sri Lanka
Cabo Verde	Kyrgyzstan	St. Lucia
Cambodia	Lao PDR	St. Vincent and the Grenadines
Cameroon	Lebanon	Sudan
China	Lesotho	Suriname
Colombia	Libya	Thailand
Comoros	Malaysia	Timor-Leste
Congo, Rep.	Maldives	Tonga
Costa Rica	Marshall Islands	Tunisia

Cote d'Ivoire	Mauritania	Turkey
Cuba	Mauritius	Turkmenistan
Djibouti	Mexico	Tuvalu
Dominica	Micronesia, Fed. Sts.	Ukraine
Dominican Republic	Moldova	Uzbekistan
Ecuador	Mongolia	Vanuatu
Egypt, Arab Rep.	Montenegro	Venezuela
El Salvador	Morocco	Vietnam
Equatorial Guinea	Myanmar	West Bank and Gaza
Eswatini	Namibia	Zambia
Fiji	Nauru	Zimbabwe
Gabon	Nicaragua	

10.2 Guide to the semi-structured interviews

This section includes the questionnaires for the different stakeholder groups to be interviewed for the gap analysis (level 4) when applying the decision framework presented in chapter 4. More information on how to conduct the interviews and select interviewees is included in section 4.3.4.

It is recommended to obtain country-specific and precise answers in all interviews, i.e., specific reforms needed, including location (example: “Improve access road to port in city X” rather than “Improve transport infrastructure”). The average interview duration will be about 45 to 75 minutes, depending on e.g., the number of logistics issues in the country, the knowledge of the interviewee, and his/her time. In the following, “[country]” refers to the country to be covered in the interview. “[Product category]” refers to the product category to be covered in the interview.

QUESTIONNAIRE: LOGISTICS SERVICES PROVIDERS

1. What is the main mode of transport your company uses in [country]?
2. Do you use intermodal transport, and if so, which modes and which routes?
3. Which deficiencies in logistics do you encounter in [country] on a regular basis? In particular, which logistics deficiencies exist for logistics for [product category]?

   [If no answer, try prompts: e.g., weaknesses in road network, rail network, port facilities, air cargo facilities, inadequate warehousing, regulatory barriers, waiting time at customs, lack of human resources, other.]
4. What would be the top three to five logistics reforms that you would like to see happening in [country] to improve logistics? If possible, with a focus on improving logistics for [product category].

   [If no answer, try prompts: e.g., improve transport infrastructure, modernize port facilities, upgrade logistics education and training, simplify customs procedures, change logistics regulation, other.]
5. How could the environmental sustainability of logistics in [country] be increased?
6. Any other comments?

QUESTIONNAIRE: MANUFACTURERS OF PRODUCT CATEGORY IN QUESTION

1. Do you outsource logistics?

   If so, what share?
   If not: What is the main mode of transport your company uses in [country]?

If not: Do you use intermodal transport? If so, which modes and routes?

2. Which deficiencies in logistics do you encounter in [country] on a regular basis? In particular, which logistics deficiencies exist for logistics for [product category]?

   [If no answer, try prompts: e.g., weaknesses in road network, rail network, port facilities, air cargo facilities, inadequate warehousing, regulatory barriers, waiting time at customs, lack of human resources, other.]

3. What would be the top three to five logistics reforms that you would like to see happening in [country] to improve logistics? If possible, with a focus on improving logistics for [product category].

   [If no answer, try prompts: e.g., improve transport infrastructure, modernize port facilities, upgrade logistics education and training, simplify customs procedures, change logistics regulation, other.]

4. How could the environmental sustainability of logistics in [country] be increased?

5. Any other comments?

QUESTIONNAIRE: PUBLIC SECTOR (MINISTRY OF TRANSPORT ETC.) OR PROFESSIONAL ASSOCIATIONS

1. What are [country's] main strengths in logistics?

   [If no answer, try prompts: e.g., geographical location, state of road/rail/port/air infrastructure, warehousing facilities, manpower/skills, other.]

2. Which deficiencies in logistics are present in [country]? In particular, which logistics deficiencies exist for logistics for [product category]?

[If no answer, try prompts: e.g., weaknesses in road network, rail network, port facilities, air cargo facilities, inadequate warehousing, regulatory barriers, waiting time at customs, lack of human resources, other.]

3. What would be the top three to five logistics reforms that you would like to see happening in [country] to improve logistics? If possible, with a focus on improving logistics for [product category].

   [If no answer, try prompts: e.g., improve transport infrastructure, modernize port facilities, upgrade logistics education and training, simplify customs procedures, change logistics regulation, other.]

4. If you could directly advise the government entity responsible for the logistics environment on where to put public funds to improve the logistics environment for [product category], what would you recommend?

   [If no answer, try prompts: these can refer to both "hardware," such as infrastructure, or "software," such as logistics services regulations, other.]

5. How could the environmental sustainability of logistics in [country] be increased?

6. Any other comments?

10.3 List of interviews

Table 10-1: List of semi-structured interviews with Vietnamese stakeholders

#1	Date	April 5, 2019
	Entity	Vietnam Logistics Business Association
	Entity type	Industry association
	Interview partner	Deputy Secretary General
	Interview type	By phone (in English)
#2	Date	March 1, 2019
	Entity	Vietnam branch of international LSP
	Entity type	LSP
	Interview partner	Director of northern Vietnam branch
	Interview type	By phone (in English)
#3	Date	July 16, 2019
	Entity	Vietnamese LSP
	Entity type	LSP
	Interview partner	Director of southern Vietnam branch
	Interview type	By phone (in English)
#4	Date	February 25, 2019
	Entity	Department of Economics and International Business, Foreign Trade University Hanoi
	Entity type	Higher education institution
	Interview partner	Lecturer in Logistics and Supply Chain Management
	Interview type	By phone (in English)

Interviewer: All semi-structured interviews with Vietnamese stakeholders (listed above) were carried out by the author.

Table 10-2: List of structured interviews with Vietnamese stakeholders

#1	Date	June 2019
	Entity	Ministry of Industry and Trade of the Socialist Republic of Vietnam
	Entity type	Public sector
	Interview partner	Deputy Director, Information Center for Industry & Trade
	Interview type	In person
#2	Date	July 2019
	Entity	A research institute affiliated with the Ministry of Transport of the Socialist Republic of Vietnam
	Entity type	Public sector
	Interview partner	Staff member
	Interview type	In person, with follow up by phone and email
#3	Date	August 2019
	Entity	Vietnam Shippers Council
	Entity type	Industry association
	Interview partner	Secretary General
	Interview type	By phone, with follow up by email
#4	Date	July 2019
	Entity	ABB Ltd, Bac Ninh Branch
	Entity type	High-tech manufacturer (production of high voltage electrical equipment)
	Interview partner	Senior order handling & export logistics staff member
	Interview type	In person, with follow-up by email
#5	Date	June 2019

	Entity	Azoom Vietnam Co., Ltd
	Entity type	High-tech manufacturer (production of electronic components; supplier to Samsung)
	Interview partner	Sales executive
	Interview type	By phone, with follow up by email
#6	Date	January 2019
	Entity	Hanel Joint Stock Company
	Entity type	High-tech manufacturer (state-owned Vietnamese electronics and IT company)
	Interview partner	Staff member
	Interview type	In person, with follow-up by email
#7	Date	August 2019
	Entity	M1 Viettel
	Entity type	High-tech manufacturer
	Interview partner	Staff member
	Interview type	By phone, with follow up by email
#8	Date	May 2019
	Entity	International high-tech manufacturer
	Entity type	High-tech manufacturer
	Interview partner	Import–export department staff member
	Interview type	In person, with follow-up by email
#9	Date	July 2019
	Entity	JAS Vietnam Co., Ltd.
	Entity type	LSP
	Interview partner	Sales development manager
	Interview type	By phone, with follow up by email

#10	Date	July 2019
	Entity	KTO Logistics
	Entity type	LSP
	Interview partner	Sales manager
	Interview type	By phone, with follow up by email
#11	Date	January 2019
	Entity	Nippon Express
	Entity type	LSP
	Interview partner	Staff member
	Interview type	In person
#12	Date	December 2018
	Entity	Vietranstimex Multimodal Transport Holding Company
	Entity type	LSP
	Interview partner	Staff member
	Interview type	In person, with follow-up by email
#13	Date	July 2019
	Entity	Vietnamese LSP
	Entity type	LSP
	Interview partner	Director of northern branch, based in Hanoi
	Interview type	In person, with follow-up by email
#14	Date	December 2018
	Entity	University of Transport and Telecommunications, Hanoi
	Entity type	Higher education institution
	Interview partner	Lecturer, Institute of Transport Planning and Management

	Interview type	In person
#15	Date	August 2019
	Entity	A university in Hanoi
	Entity type	Higher education institution
	Interview partner	Staff member
	Interview type	In person

For language reasons, the interviews listed in Table 10-2 were conducted as structured interviews by Trịnh Thị Thu Hương, Associate Professor at the Faculty of Economics and International Business at Foreign Trade University Hanoi, on behalf and under the guidance of the author. Trịnh Thị Thu Hương conducted the interviews in Vietnamese and provided an English translation of the responses. The author provided all questionnaires and carried out the analysis of the interview responses alone.

Table 10-3: List of semi-structured interviews with Moroccan stakeholders

#1	Date and location[918]	November 16, 2015, Rabat, Morocco
	Entity	Agence Marocaine du Développement de la Logistique
	Entity type	Public sector
	Interview partner	Director General
	Interview type	In person (in French)
#2	Date and location	November 19, 2015, Casablanca, Morocco
	Entity	PortNet S.A.
	Entity type	Public sector (PPP)
	Interview partner	Director General

[918] "Location" here refers to the location of the interviewee.

	Interview type	By phone (in French)
#3	Date and location	November 27, 2015, Rabat, Morocco
	Entity	Comité National de l'Environnement des Affaires
	Entity type	Public sector
	Interview partner	Project Lead
	Interview type	By phone (in French)
#4	Date and location	December 2, 2015, Tangier, Morocco
	Entity	A terminal operator in Tangier
	Entity type	Terminal operator
	Interview partner	A manager
	Interview type	By phone (in French)
#5	Date and location	November 27, 2015, Casablanca, Morocco
	Entity	Association Marocaine des Exportateurs (ASMEX)
	Entity type	Industry association
	Interview partner	Executive Director
	Interview type	By phone (in French)
#6	Date and location	November 12, 2015, Casablanca, Morocco
	Entity	Promotrans Maroc
	Entity type	Private training provider
	Interview partner	President and Director General
	Interview type	In person (in French)
#7	Date and location	November 11, 2015, Casablanca, Morocco
	Entity	Ecole Nationale des Ponts et Chaussées
	Entity type	Higher education institution
	Interview partner	Professor
	Interview type	In person (in English)

Interviewer: All interviews in Morocco were carried out by the author.

Table 10-4: List of semi-structured interviews with Kyrgyz stakeholders

#1	Date and location	April 18, 2016, Bishkek, Kyrgyzstan
	Entity	Ministry of Transport and Communications of Kyrgyzstan
	Entity type	Public sector
	Interview partner	Department head
	Interview type	In person (in Russian, using a translator)
#2	Date and location	April 11, 2016, Bishkek, Kyrgyzstan
	Entity	Freight Operators Association of Kyrgyzstan
	Entity type	Industry association
	Interview partner	Chairman
	Interview type	In person (in Russian, using a translator)
#3	Date and location	April 14, 2016, Osh, Kyrgyzstan
	Entity	Industry association for agribusiness (1)
	Entity type	Industry association
	Interview partner	Executive Director
	Interview type	In person (in English)
#4	Date and location	April 19, 2016, Bishkek, Kyrgyzstan
	Entity	Industry association for agribusiness (2)
	Entity type	Industry association
	Interview partner	Director
	Interview type	In person (in English)
#5	Date and location	April 19, 2016, Bishkek, Kyrgyzstan
	Entity	Business organization, Committee on Transport and Committee on exports and infrastructure
	Entity type	Business organization
	Interview partners	Committee Chairmen
	Interview type	In person (in Russian, using a translator)

#6	Date and location	April 12, 2016, Bishkek, Kyrgyzstan
	Entity	Local (Kyrgyz) LSP (1)
	Entity type	LSP
	Interview partner	Project Sales Manager
	Interview type	In person (in English)
#7	Date and location	April 13, 2016, Bishkek, Kyrgyzstan
	Entity	Local (Kyrgyz) LSP (2)
	Entity type	LSP
	Interview partner	Director
	Interview type	In person (in English)
#8	Date and location	April 13, 2016, Bishkek, Kyrgyzstan
	Entity	Kyrgyz branch of international LSP (1)
	Entity type	LSP
	Interview partners	Sales Manager and Specialist
	Interview type	In person (in Russian, using a translator)
#9	Date and location	April 13, 2016, Bishkek, Kyrgyzstan
	Entity	Kyrgyz branch of international LSP (2)
	Entity type	LSP
	Interview partner	Manager
	Interview type	In person (in Russian, using a translator)
#10	Date and location	April 14, 2016, Osh, Kyrgyzstan
	Entity	Local (Kyrgyz) individual freight forwarder
	Entity type	LSP
	Interview partner	Individual freight forwarder
	Interview type	In person (in Russian, using a translator)

Interviewer: All interviews in Kyrgyzstan were carried out by the author (using a Russian–English translator where noted).

Table 10-5: List of structured validation interviews with Vietnamese stakeholders

#1	Date	December 2019
	Entity	Ministry of Industry and Trade of the Socialist Republic of Vietnam
	Entity type	Public sector
	Interview partner	Deputy Director, Information Center for Industry and Trade
	Interview type	In person
	Interviewer	Trịnh Thị Thu Hương
#2	Date	December 2019
	Entity	A Vietnamese ministry dealing, among others, with logistics
	Entity type	Public sector
	Interview partner	Staff member
	Interview type	In person, with follow-up by email
	Interviewer	Trịnh Thị Thu Hương
#3	Date	December 2019
	Entity	Vietnam Logistics Business Association
	Entity type	Industry association
	Interview partner	Deputy Secretary General
	Interview type	In person
	Interviewer	Trịnh Thị Thu Hương
#4	Date	December 2019
	Entity	Vietnam Shippers Council
	Entity type	Industry association
	Interview partner	Secretary General
	Interview type	By phone, with follow-up by email
	Interviewer	Trịnh Thị Thu Hương

#5	Date	December 2019
	Entity	Vietnam Electronic Industries Association
	Entity type	Industry association
	Interview partner	Member of the Executive Board
	Interview type	In person
	Interviewer	Trịnh Thị Thu Hương
#6	Date	November 2019
	Entity	ABB
	Entity type	High-tech manufacturer (production of high voltage electrical equipment)
	Interview partner	Operational Purchasing Manager
	Interview type	In person, with follow-up by email
	Interviewer	Trinh Trịnh Thị Thu Hương
#7	Date	November 2019
	Entity	Vietnam branch of international LSP
	Entity type	LSP
	Interview partner	Director of northern Vietnam branch
	Interview type	By phone
	Interviewer	Christina Wiederer
#8	Date	November 2019
	Entity	Vietnamese LSP
	Entity type	LSP
	Interview partner	Director of southern Vietnam branch
	Interview type	By phone
	Interviewer	Christina Wiederer
#9	Date	November 2019
	Entity	EMO Trans Vietnam Co. Ltd.
	Entity type	LSP

	Interview partner	Director
	Interview type	In person
	Interviewer	Trịnh Thị Thu Hương
#10	Date	January 2020
	Entity	Vietnamese LSP
	Entity type	LSP
	Interview partner	Staff member
	Interview type	In person, with follow-up by email
	Interviewer	Trịnh Thị Thu Hương
#11	Date	November 2019
	Entity	Department of Economics and International Business, Foreign Trade University Hanoi
	Entity type	Higher education institution
	Interview partner	Lecturer in Logistics and Supply Chain Management
	Interview type	By phone
	Interviewer	Christina Wiederer

The interviews were carried out between November 2019 and January 2020 to validate the results of the decision framework's application in Vietnam. All interviews were carried out as structured interviews. Three of them were conducted by the author (in English) and, for language reasons, eight interviews were conducted by Trịnh Thị Thu Hương, Assistant Professor at the Faculty of Economics and International Business at Foreign Trade University Hanoi, on behalf and under the guidance of the author (see entry on "Interviewer" in Table 10-5). Trịnh Thị Thu Hương conducted the interviews in Vietnamese and provided an English translation of the responses. The author provided all questionnaires and carried out the analysis of the interview responses alone.

10.4 Overview of the decision framework

LEVEL 1: TARGET SET-UP

This level delineates the ideal state of a well-functioning logistics environment for a given product category. It is short and focuses on three key notions: cost, flexibility, and reliability. The level sketches how these notions apply to a given product category. Cost here refers to logistics costs (see section 3.7 for details on logistics costs, and section 4.3.2 for how transaction cost economics enters the framework). Flexibility here refers to the capability to change based on a set of defined contingency scenarios.[919] It covers the concepts of agility and adaptability. Reliability here relates to the degree of uncertainty in the lead time, where lead time refers to the time it takes for goods to arrive at the purchaser after the order has been placed.[920] This level is product-category-specific, not country-specific. Data for this level originate in a review of the literature on ideal features of the logistics environment in the respective product category.

LEVEL 2: LOGISTICS CONCEPTS

This level links logistics concepts prevalent in the product category to the target set-up of the logistics environment. Examples of such concepts include make-to-order or just-in-time delivery, both used in the production of, for instance, automobiles. This level is product-category-specific, not country-specific. Data for this level originate in a review of the literature on logistics concepts in the product category in question.

LEVEL 3: TRENDS

This level includes product-category-specific trends. It explores which trends with relevance to a particular product category may impact logistics in the next decade, i.e., approximately until 2030. Given the speed of technological advancement, it is likely that the trends shaping logis-

[919] cf. OECD 2013, 50
[920] cf. Hausman et al. 2013, 241

tics will change even during the next decade; this has ramifications for logistics policymaking at the country level. It will be necessary to continually examine new trends concerning their applicability to the selected product categories.

This level is product-category-specific, not country-specific. As for non-product-category-specific trends: Section 4.5.2 includes a discussion of the ramifications of the trend of environmental sustainability in logistics. The three framework applications include suggested measures to enhance environmental sustainability in logistics for each product category. Data for this level originate in a review of the literature on trends in logistics for the product category in question.

LEVEL 4: LOGISTICS REQUIREMENTS

This level includes requirements of the logistics environment of a given product category. Only requirements that can be addressed by government action are included. Requirements are product-category-specific, not country-specific. Requirements are grouped by functional category (infrastructure, ICT, ecosystem, business practices, customs, regulatory environment, training).

Requirements are grouped by two of the target set-up characteristics (flexibility and reliability). Requirements related to costs (the third target set-up characteristic) are included in two ways: (1) explicitly (as an entry in the “Ecosystem” functional category), and (2) implicitly, via entries in all functional categories that cover how policymakers can contribute to lowering logistics costs by improving the reliability and flexibility of the logistics environment (see section 4.3.2). Data for this level originate in a review of the literature on the logistics requirements in the product category in question. If the person carrying out the assessment is knowledgeable in logistics for the targeted product category, he/she can provide additional inputs to the requirements.

LEVEL 5: GAP ANALYSIS

This level includes an analysis of gaps present in a particular country to fulfill logistics requirements for the chosen product category. The gap analysis is country- and product-category-specific. All entries refer to gaps that can at least partially be addressed by government action. Exemption: Entries under "Business practices" include those with limited scope for government action. Gaps are grouped by functional category (infrastructure, ICT, ecosystem, business practices, customs, regulatory environment, and training).

Data for this level originate in the following sources: (1) interviews carried out in the country where the framework shall be applied; (2) official country statistics (e.g., statistical yearbooks); and (3) public databases and reports. Caveat on data for this level: Some data for this level originate in interviews with different stakeholder groups (LSPs, manufacturers or producers of the product category in question, policymakers dealing with logistics issues, and industry associations). Answers across the stakeholder groups might be heterogeneous, thus reflecting the different perceptions and priorities of each group.

LEVEL 6: LOGISTICS MEASURES

This level includes measures to be taken to meet the logistics requirements of the chosen product category in a certain country, given the preceding gap analysis. The measures are country- and product-category-specific. The framework only includes measures that a government can take; i.e., it excludes those that rely purely on intercompany organization. It does include those that a government can take with the collaboration of the private sector. Measures are grouped by functional category (infrastructure, ICT, ecosystem, business practices, customs, regulatory environment, and training).

Data for this level come from the following sources: (1) a literature review of best practices in logistics in the product category in question; and (2) suggestions by the person carrying out the assessment, based on

the preceding product-category-specific analysis of logistics requirements and country-specific gaps, provided that the person carrying out the assessment is knowledgeable in logistics for the targeted product category.

10.5 Application of decision framework to high-tech manufacturing and Vietnam

10.5.1 Level 1: Target set-up of logistics environment

The target set-up describes the ideal state of a well-functioning logistics environment. See section 4.3.3 for an explanation of the framework's levels. Owing to their importance for modern logistics for high value-added products, the target set-up focuses on the same three characteristics (flexibility, reliability, and cost) for all product categories covered in the framework applications, though with partly different specifications.

Target set-up for product category high-tech manufacturing:

- High degree of flexibility in the logistics environment, with tight order cycles and short delivery times of a few weeks or days. Flexibility here refers to the capability to change based on a set of defined contingency scenarios.[921]
- High degree of reliability: The logistics environment is resilient in the face of, e.g., port shutdowns and road congestion. Reliability here relates to the degree of uncertainty in the lead time; lead time refers to the time it takes for goods to arrive at the purchaser after the order has been placed.[922]
- Low level of logistics costs, on par with international standards (ca. 10–17 % of GDP, viewed across all sectors) or, ideally, lower.[923]

10.5.2 Level 2: Logistics concepts

This section links logistics concepts prevalent in the high-tech product category to the target set-up of the logistics environment.[924] The following concepts are business practices (i.e., they come into play at the intra-company level), but they need an enabling environment made up of

[921] cf. OECD 2013, 50
[922] cf. Hausman et al. 2013, 241
[923] cf. Memedovic et al. 2005, 358
[924] In the list below, the arrows behind each concept point to the relevant target set-up component(s).

components from all seven functional categories (e.g., infrastructure, ICT, customs etc.):

- ability to handle large volumes of imported inputs, most of them by sea[925] (→ reliability and flexibility);
- ability to handle large volumes of exported finalized products by air and sea[926] (→ reliability and flexibility);
- trade-off between responsiveness and efficiency of the logistics environment:[927] Responsiveness must be high to keep up with the pace of the technology industry, though cost pressure mandates cost efficiency of the logistics environment (→ reliability, flexibility, and cost).
- storage buffer capacity restricted to a few weeks due to high cost of inventory (→ flexibility);
- collaboration of supply chain partners: sharing of distribution networks, infrastructure, and vehicles (→ flexibility and cost);
- adoption of just-in-time production and total quality management[928] (→ reliability and flexibility);
- fragility of product requiring high-quality packaging (→ reliability).

10.5.3 Level 3: Trends

This section includes product-category-specific trends. It explores which trends with relevance to high-tech goods may impact logistics in the next decade (until approximately 2030).

Product-category-specific trends:

- Increasing speed of technology cycles: increasing demands on logistics providers regarding getting products to market. This will at least partly be facilitated by increased interorganizational data exchange.[929]

[925] cf. Pham et al. 2013a, 42
[926] cf. Pham et al. 2013a, 42
[927] cf. Ivanov et al. 2019
[928] cf. Wu and Weng 2010, 392
[929] cf. Straube (Ed.) 2019, 40

- Fluctuating consumer demand: need for flexible supply chains that can adapt to rising and falling demand as consumer demand is closely linked to economic up- and downturns.[930]
- Changing geographic makeup of key markets: stronger growth in emerging markets in East and Southeast Asia coupled with slower growth in established markets (US, EU, and Japan), with implications for product flows and associated transport needs.[931]

Non-product-category-specific trend:

- Higher demand and higher requirements for environmental sustainability in logistics:[932] Measures to address environmental sustainability in logistics operations are included throughout the functional categories of measures.

10.5.4 Level 4: Logistics requirements—Answer to research subquestion 1 with application to high-tech manufacturing

This section includes the requirements of the logistics environment for high-tech goods that can be (partly) addressed by government action. Requirements are product-category-specific (not country-specific). They are grouped in two ways:

1. by functional category (infrastructure, ICT, ecosystem, business practices, customs, regulatory environment, and training);
2. by the target set-up characteristics flexibility and reliability. Requirements related to costs (the third target set-up characteristic) are included in two ways: (1) explicitly (as an entry in the "Ecosystem" functional category), and (2) implicitly, via entries in all seven functional categories that cover how policymakers can contribute to lowering logistics costs by improving the reliability and flexibility of the logistics environment (see section 4.3.2 for details).

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930 cf. Bargenda and Jandhyala 2011, unpaginated
931 cf. Bargenda and Jandhyala 2011, unpaginated
932 cf. Göpfert et al. 2017, 12

This section forms the answer to research sub-question 1, with an application to high-tech goods: What are the logistics requirements of high-tech goods? See section 4.3.3 for a description of the origin of the data for this level.

REQUIREMENTS: TRANSPORT- AND TRADE-RELATED INFRASTRUCTURE

Flexibility:

- availability of reliable air transport to ensure short shipment times[933]
- facilitation of intermodal transport
- ability of ports to handle high container volumes
- availability of distribution and consolidation centers (logistics zones) directly serving export markets
- availability of inland clearance facilities to allow customs clearance at regional production hubs rather than at the border

Reliability:

- large road network in good condition, at least between major production sites and export gateways

REQUIREMENTS: INFORMATION & COMMUNICATIONS TECHNOLOGY

Flexibility:

- integration of IT tools between suppliers and customers, including for automation of cross-company information exchange, e.g., advance shipment notices, to increase supply chain visibility[934]

[933] cf. Blyde and Molina 2013, 12
[934] cf. Göpfert and Braun 2017, 28

Reliability:

- prevention of counterfeiting and tampering with high-tech products
- availability of data tools to support an uninterrupted supply chain across transport modes
- availability of tracking and tracing technology

REQUIREMENTS: ORGANIZATION OF THE LOGISTICS ENVIRONMENT ("ECOSYSTEM")

Flexibility:

- 24/7 or close to 24/7 opening of trade-enabling services, e.g., ports and airports
- healthy competition on all transport modes and in logistics services, including competitive freight handling, trucking, shipping and warehousing services[935]
- seamless cooperation of supply chain actors to increase the speed of the supply chain

Reliability:

- reliable management of ports, airports, and rail transport[936]
- access to advanced logistics services and efficient warehousing, with logistics providers offering the following functions: "receiving, sort and direct put-away, directed put-away, wave management, merge and pack-out, manifest documents, label or bar code printing, kitting, and pick/pack activities" (Vaidyanathan 2005, 91)
- tight coordination of government entities involved in fostering the logistics environment

[935] cf. World Bank 2012, 14
[936] cf. World Bank 2010, 45

Cost:

- logistics costs on par with international standards (ca. 10–17 % of GDP) or, ideally, lower[937]

REQUIREMENTS: BUSINESS PRACTICES FOR HIGH-QUALITY LOGISTICS SERVICES

Flexibility:

- adoption of international standards by logistics operators, including regarding efficient inventory management
- information flows to all supply chain partners, i.e., suppliers and customers[938], and supply chain partners collaborate, e.g., by sharing distribution networks, infrastructure, and vehicles
- business practices in place to mitigate supply chain volatility, defined by Nitsche and Durach (2018) as "unplanned variation in upstream and downstream material flows resulting in a mismatch of supply and demand at the focal firm"[939]

Reliability:

- use of supply chain metrics and performance measurements

REQUIREMENTS: CUSTOMS PRACTICES

Flexibility:

- 24/7 or close to 24/7 opening hours of customs services and border posts
- availability of electronic data interchange for customs to eliminate the need for duplicate data entries, increase transaction speed, and reduce cost and error rates[940]

[937] cf. Memedovic et al. 2005, 358
[938] cf. Lee 2004, 4
[939] Nitsche and Durach 2018, 868
[940] cf. Rushton et al. 2017, 751

Reliability:

- streamlined and predictable border clearance procedures
- availability of risk-management practices to minimize inspection rates[941]
- high technical skills of customs personnel[942]
- efficient inter-agency coordination in case there are multiple border protection agencies

REQUIREMENTS: REGULATORY ENVIRONMENT

Flexibility:

- legislation covering all aspects of logistics
- absence of restrictions to entry and absence of obligatory association membership for logistics professionals to avoid collusive behavior

Reliability:

- easy access to trade laws and regulations, consistency of guidelines, and absence of duplicate rules

REQUIREMENTS: EDUCATION, SKILLS, AND PROFESSIONAL TRAINING

Flexibility:

- availability of structured training to ensure an adequate supply of trained logistics specialists, including those with specialized knowledge of the high-tech supply chain

Reliability:

- high level of logistics knowledge at company level, with on-the-job training widespread and regarded by companies as value enhancing
- adequate staffing of road transport

[941] cf. World Trade Organization 2014, 8
[942] cf. World Bank 2012, 36

10.5.5 Level 5: Gap analysis—Answer to research sub-question 2 with application to high-tech manufacturing and Vietnam

The gap analysis is product-category-specific and country-specific: It juxtaposes the logistics requirements from Appendix 10.5.4 with the current state of the high-tech manufacturing logistics environment in Vietnam and identifies which logistics constraints are prevalent in the country for high-tech goods. All entries refer to gaps that can (partially) be addressed by government action. Exemption: entries under "Business practices" include those with limited scope for government action. Gaps are grouped by functional category (infrastructure, ICT, ecosystem, business practices, customs, regulatory environment, and training).

Data for this level originate in the following sources: (1) interviews carried out with Vietnamese stakeholders, (2) official country statistics, and (3) public databases and reports. This section forms the answer to research sub-question 2 with an application to Vietnam and high-tech goods: Which country-specific constraints are prevalent in Vietnam in the logistics environment for high-tech goods?

GAP ANALYSIS: TRANSPORT- AND TRADE-RELATED INFRASTRUCTURE

Requirement: Availability of reliable air transport to ensure short shipment times

- Only 4 of the country's 21 airports have cargo terminals; at the others, air cargo is handled in the passenger terminal.[943]
- Cargo terminals at several airports need upgrading to better accommodate air freight; cold storage facilities and facilities for dangerous goods are only available at the airports of Hanoi and Ho Chi Minh City, and even there are limited.[944]

[943] Vietnam Logistics Business Association 2018, 154

[944] Banomyong et al. 2015, 40. Lack of quality air cargo facilities corroborated by interview with Vietnamese logistics expert from the public sector, June 2019

- 100 % of air freight has to be scanned at the airport; no risk management is applied. The scanner at Hanoi airport is too small and frequently pallets do not fit and have to be unpacked for physical checks.[945]
- Limited capacity of storage at airports: lack of storage areas, lack of application of modern air cargo technologies, cumbersome paperwork, and overcrowded warehouses, especially around holidays.[946]
- Air cargo agents and third-party providers (e.g., LSPs) are not allowed to offer storage and warehousing within the airport. All warehousing is controlled by airport operators. Storage prices are set by the government.[947]

Requirement: Facilitation of intermodal transport

- freight transport heavily dependent on road, with low rail volumes (about 1 % of freight in 2018)[948]
- missing links between ports with air and rail transport (holds for all ports in Vietnam)[949]
- missing road connections between seaports and facilities in the hinterland[950]
- low connectivity between logistics nodes and few multimodal linkages[951]
- Inland waterways suffer from low draft at several inland ports.[952]
- ICDs in the north are only accessible by road, not by any other transport mode.[953]
- Border gates are too narrow for waiting trucks to flow smoothly.[954]

[945] Interview with Hanoi (Vietnam) branch of multinational LSP, March 2019
[946] Interview with Vietnamese LSP, Hanoi, Jan. 2019
[947] Interview with Hanoi (Vietnam) branch of multinational LSP, March 2019
[948] Interview with Hanoi (Vietnam) branch of multinational LSP, March 2019
[949] Interview with Vietnamese LSP, July 2019
[950] Interview with Vietnamese logistics expert, April 2019
[951] Victoria University Melbourne 2014, 12; lack of multimodal linkages corroborated by interview with M1 Viettel, Vietnamese manufacturer of communications and electronic devices, August 2019
[952] Interview with Vietnamese logistics expert, Hanoi, August 2019
[953] Vietnam Logistics Business Association 2018, 151

Requirement: Ability of ports to handle high container volume

- port capacity insufficient, especially for sectors relying on just-in-time production; delays are frequent[955]
- several ports with a draft of only 9-10 m, limiting the size of incoming ships[956]
- high cost of accessing new deepwater port at Cai Mep. Cai Mep is less attractive to shippers than Cat Lai (the port closer to Ho Chi Minh City) as costs to clear in Cai Mep are higher than in Cat Lai, and transport from Cai Mep to factory is more expensive than from Cat Lai to factory because of the longer distance.[957]
- Port development in previous years was not synchronized: the focus was almost exclusively on berth length rather than on seaport connections.[958]

Requirement: Availability of distribution and consolidation centers (logistics zones) directly serving export markets

- lack of logistics zones in strategic positions (close to ports, airports, national highways, and production centers) with centralized warehouses and support services for import and export companies and LSPs[959]
- lack of logistics zones along major highways and near ports[960]
- lack of logistics zones in Ho Chi Minh City, Hanoi, Nha Trang, Lam Dong, and the Mekong Delta[961]
- locations of ports and locations of logistics and industrial zones not well aligned; road links vulnerable to traffic jams (owing to lack of alternative port entry and exit routes for trucks)[962]

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954 Ministry of Industry and Trade of the Socialist Republic of Vietnam 2017, 65
955 Interview with Vietnamese LSP, Ho Chi Minh City, Dec. 2018; corroborated by interview with Vietnamese logistics expert, Hanoi (2), August 2019
956 Interview with Vietnamese logistics expert, Feb. 2019
957 Interview with Vietnamese LSP, July 2019
958 Interview with Vietnamese logistics expert, Hanoi (2), August 2019
959 Interview with Vietnamese logistics expert, Hanoi (2), August 2019
960 Interview with Vietnamese logistics expert, Hanoi, Dec. 2018
961 Blancas et al. 2014, 49

Requirement: Availability of inland clearance facilities and dry ports to allow customs clearance at regional production hubs rather than at the border

- inadequate number of inland clearance facilities and dry ports given the sharp rise in container throughput (from about 6 million TEU in 2010 to more than 12 million TEU in 2017)[963], with subsequent congestion of ports and access roads. ICDs in particular in northern Vietnam are too small.[964]
- lack of modern loading and unloading facilities in the ICDs in the north, and limited scope of activities (mostly confined to road transport and warehousing)[965]
- There are twelve ICDs in the south of the country, but most of them are near Ho Chi Minh City, whereas container traffic is expected to shift from Ho Chi Minh City to Cai Mep and further south to Vung Tau.966
- Applying for ICD licenses is difficult, and few licenses are granted by the Government of Vietnam.[967]

Requirement: Large road network in good condition, at least between major production sites and export gateways

- frequent congestion on roads between ports and industrial centers, especially Ho Chi Minh City and Da Nang;[968] congestion related to inadequate highway infrastructure.[969]
- frequent congestion around Cat Lai port forces LSPs to accept long delays due to traffic jams or reorganize their transportation in and

962 Interview with Vietnamese LSP, July 2019
963 World Bank World Development Indicators, data.worldbank.org, accessed on Nov. 18, 2018
964 Nguyen and Notteboom 2016, 27
965 Vietnam Logistics Business Association 2018, 151
966 Banomyong et al. 2015, 41
967 Blancas et al. 2014, 49
968 Interview with Vietnamese logistics expert, April 2019
969 Interview with Vietnamese logistics expert, Hanoi, Dec. 2018

out of the port into routes using depots built near the port to enable fast truck turnaround times[970]

- insufficient road infrastructure around Cat Lai port. Only 50 % of the road leading up to Cat Lai port is an expressway, while the other half is a national road, i.e., too narrow for the high volume of traffic.[971]
- inadequate quality of highway from Hanoi to Hai Phong[972]
- inadequate quality of highways in general (in particular those leading to China), sometimes leading to damage to high-tech products, especially when transporting less than full truck loads.[973]
- low share of high-quality roads: 7.5 % of roads are graded as 1 or 2 (on a scale of 6), whereas 77.7 % are rated 3 or 4, and 14.8 % rated as low quality (5 or 6)[974]

The relevant LPI score for Vietnam is 3.01 out of 5 for the "Quality of trade- and transport-related infrastructure" component.[975]

GAP ANALYSIS: INFORMATION & COMMUNICATIONS TECHNOLOGY

Requirement: Integration of IT tools between suppliers and customers, including for automation of cross-company information exchange, e.g., advance shipment notices[976]

- limited use of ICT by LSPs[977]
- low levels of ICT-enabled innovation[978]
- no synchronized introduction of the e-airway bill[979]

970 Interview with Vietnamese LSP, Hanoi (2), July 2019
971 Interview with Vietnamese LSP, July 2019
972 Interview with Vietnamese logistics expert, Feb. 2019
973 Interview with Vietnamese branch of an international manufacturer of electrical equipment, July 2019
974 Clean Air Asia 2017, 19
975 Arvis et al. 2018, 47
976 cf. Göpfert and Braun 2017, 28
977 Ministry of Industry and Trade of the Socialist Republic of Vietnam and World Bank 2016, 19
978 Limbourg et al. 2016, 129

Requirement: prevention of counterfeiting and tampering with high-tech products

- [No information for Vietnam]

Requirement: Availability of data tools to support an uninterrupted supply chain across transport modes

- Most domestic IT systems are underdeveloped and unable to connect to external IT systems while guaranteeing the required security level.[980]

Requirement: Availability of tracking and tracing technology

- Tracking and tracing is not widespread.[981]

Relevant LPI score for Vietnam: 3.45 out of 5 for the "Ability to track and trace consignments" component[982]

GAP ANALYSIS: ORGANIZATION OF THE LOGISTICS ENVIRONMENT ("ECOSYSTEM")

Requirement: 24/7 or close to 24/7 opening of trade-enabling services, e.g., ports and airports

- [No information for Vietnam]

Requirement: Healthy competition on all transport modes and in logistics services, including competitive freight handling, trucking, shipping, and warehousing services

- Vietnamese ports are operated by state-owned enterprises: Saigon Newport Corporation, for instance, runs the port of Ho Chi Minh City and offers port operations, handling, and container transshipment, accounting for more than half of Vietnam's container mar-

979 Ministry of Industry and Trade of the Socialist Republic of Vietnam 2017, 58
980 Ministry of Industry and Trade of the Socialist Republic of Vietnam 2017, 57
981 Banomyong et al. 2015, 45
982 Arvis et al. 2018, 47

ket.[983] Vinalines, the national shipping company, offers trucking, warehousing, and forwarding services and operates ports that account for 30 % of the length of Vietnam's piers.[984] This holds a risk of lack of competitive neutrality and abuse of power to exclude competing downstream cargo holders.[985]

Requirement: Seamless cooperation of supply chain actors to increase the speed of the supply chain

- In several ports (e.g., in Hai Phong), different port terminals are run by different providers, including different customs offices, with little integration between them, thus making it difficult for LSPs to move cargo between terminals owing to the complicated customs procedures involved.[986]
- Local trucking industry provides low service quality.[987]
- Most LSPs are SMEs, with low capital, little experience, and few management skills.[988]

Requirement: Reliable management of ports, airports, and rail transport[989]

- [No information for Vietnam]

983 World Bank Group et al. 2018, 12
984 World Bank Group et al. 2018, 12
985 World Bank Group et al. 2018, 53
986 Interview with Hanoi (Vietnam) branch of multinational LSP, March 2019
987 Banomyong et al. 2015, 45
988 Interview with M1 Viettel, Vietnamese manufacturer of communications and electronic devices, August 2019
989 cf. World Bank 2010, 45

Requirement: Access to advanced logistics services and efficient warehousing

- lack of warehousing and storage space throughout the country[990]
- partially inadequate warehousing[991]

Requirement: Tight coordination of government entities involved in fostering the logistics environment

- low level of coordination of logistics services as no national logistics council exists[992]

Requirement: Logistics costs on par with international standards (ca. 10–17 % of GDP) or, ideally, lower[993]

- Logistics costs in 2016 in Vietnam were 20.8 % of GDP.[994]
- In many cases, transportation costs account for 40–50 % of production costs.[995]

GAP ANALYSIS: BUSINESS PRACTICES FOR HIGH-QUALITY LOGISTICS SERVICES

Requirement: Adoption of international standards by logistics operators, including efficient inventory management

- low degree of professionalism of LSPs, e.g., limited knowledge of customs regulations[996]

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990 Ministry of Industry and Trade of the Socialist Republic of Vietnam 2017, 65; corroborated by interview with Vietnamese logistics expert, Feb. 2019, and by interview with Azoom Vietnam Co, Ltd., June 2019, and by interview with Vietnamese logistics expert from the public sector, June 2019

991 Interview with Vietnamese LSP, Ho Chi Minh City, Dec. 2018

992 Victoria University Melbourne 2014, 12

993 cf. Memedovic et al. 2005, 358

994 https://english.vietnamnet.vn/fms/business/192227/vietnam-s-logistics-costs-make-up-20-8--of-gdp.html, accessed on Sep. 15, 2019

995 Interview with Vietnamese LSP, Hanoi, July 2019

996 Interview with Vietnamese branch of an international high-tech manufacturer, Hanoi, May 2019

- Warehousing, trucking services, and freight forwarding do not meet global standards.[997]
- There are too few companies providing auxiliary services for high-tech companies.[998]
- Fragmentation of logistics services businesses: Most Vietnamese LSPs are SMEs, often inexperienced, and not professional enough; they provide only basic services, competing mainly on price rather than quality; and development of transport services for high-tech goods has not been fast enough in view of the rising importance of e-commerce in the high-tech manufacturing sector.[999]
- The majority of Vietnamese 3PLs are small-scale providers (average capital of US$18,750 to US$31,250).[1000]
- Many logistics companies do not have a comprehensive service offering, and instead only offer customs clearance and simple shipment of orders.[1001]
- Local logistics providers have limited technical know-how.[1002]
- Demand for value-added logistics services is rising, but most services are carried out in-house, as outsourcing is uncommon.[1003] If logistics is outsourced, it is mostly for basic services; in 2013, 70 % of the 130 logistics companies in Da Nang city provided only 1PL and 2PL services.[1004]
- A large portion of the commercial trucking fleet is more than 10 years old.[1005]

997 Pham et al. 2013a, 132
998 Interview with Vietnamese logistics expert, Hanoi (2), August 2019
999 Interview with Vietnamese logistics expert, Hanoi (2), August 2019
1000 Interview with Vietnamese logistics expert, Hanoi, Dec. 2018
1001 Pham et al. 2013a, 53
1002 Banomyong et al. 2015, 52
1003 Limbourg et al. 2016, 125
1004 Limbourg et al. 2016, 125
1005 Banomyong et al. 2015, 38

Requirement: Information flows to all supply chain partners, i.e., suppliers and customers,[1006] and supply chain partners collaborate, e.g., by sharing distribution networks, infrastructure, and vehicles.

- low level of openness and transparency of businesses in the country.[1007]
- In Da Nang, one of Vietnam's most developed regions, cooperation between supply chain partners is rare, and most companies act as subcontractors for foreign logistics companies.[1008]

Requirement: Business practices in place to mitigate supply chain volatility

- Insufficient adoption of business practices to mitigate supply chain volatility, e.g., to deal with unstable production processes, inaccurate forecasting, supply variability, missing supply chain coordination and visibility, long and variable lead times, and seasonality.[1009]

Requirement: Use of supply chain metrics and performance measurements

- [No information for Vietnam]

Relevant LPI scores for Vietnam: 3.16 out of 5 on the "Ease of arranging competitively priced international shipments" component and 3.67 out of 5 on the "Timeliness" component (e.g., frequency with which shipments reach consignees within the scheduled/expected delivery time)[1010]

[1006] cf. Lee 2004, 4
[1007] Interview with Vietnamese logistics expert, Hanoi, Dec. 2019
[1008] Limbourg et al. 2016, 125
[1009] cf. Nitsche 2018, 3–4
[1010] Arvis et al. 2018, 47

GAP ANALYSIS: CUSTOMS PRACTICES

Requirement: 24/7 or close to 24/7 opening hours of customs services and border posts

- No 24/7 opening hours of customs services and border posts[1011]

Requirement: Availability of electronic data interchange for customs to eliminate need for duplicate data entries, to increase transaction speed, and to reduce cost and error rates[1012]

- The customs clearance process has been improved in recent years, yet customs declarations still cannot be done fully electronically. Several stages have to be completed manually, e.g., submitting the yearly settlement report of export companies.[1013]
- Customs and border management agency processes are only partially automated and paper-based declarations presented in person are often still required.[1014]
- Customs IT systems do not offer the range of functionality necessary to support modern customs approaches, e.g., incomplete application of ASYCUDA (Automated System for Customs Data).[1015]
- Acceptance of digital signatures for administrative procedures currently is only available for goods entering/exiting through marine terminals[1016]

[1011] Interview with Executive Board Member of the Vietnam Electronics Industries Association, Dec. 2019
[1012] cf. Rushton et al. 2017, 751
[1013] Interview with Vietnamese LSP, Hanoi, Jan. 2019. Note: Following Circular No. 39, customs clearance via the "yellow channel" can be done using electronic signatures, i.e., no hard copies anymore (source: Interview with Vietnamese branch of an international manufacturer of electrical equipment, July 2019)
[1014] Ministry of Industry and Trade of the Socialist Republic of Vietnam and World Bank 2016, 15
[1015] Pham et al. 2013a, 73
[1016] Ministry of Industry and Trade of the Socialist Republic of Vietnam 2017, 22

- Few companies use an electronic customs declaration system (36.4 % of companies in a 2017 survey) owing to the perceived lack of reliability of the system.[1017]
- EDI between logistics companies and customs offices is not as effective as expected.[1018]
- If companies (e.g., freight forwarders) encounter technical problems while using the customs platform, it is difficult to find a person in charge at customs to solve the issue, leading to the entire customs declaration process being held up.[1019]

Requirement: Streamlined and predictable border-clearance procedures

- Customs formalities at borders are cumbersome, despite recent improvements in border procedures. This is due to missing coordination between Vietnam and neighboring countries, and reliance on paper-based processes.[1020]
- overlapping customs procedures[1021]
- Clearing customs for imported cargo takes long.[1022]
- Lack of agreement between customs staff and importing/exporting companies on which HS codes to use often leads to hold-ups in customs clearance.[1023]

[1017] Clean Air Asia 2017, 41. The survey cited was carried out for Clean Air Asia.
[1018] Ministry of Industry and Trade of the Socialist Republic of Vietnam 2017, 57
[1019] Interview with Hanoi (Vietnam) branch of multinational LSP, March 2019
[1020] Interview with Vietnamese logistics expert, April 2019; information on delays/time spent with customs formalities corroborated by interview with Hanel Joint Stock Company (state-owned Vietnamese electronics and IT company), January 2019, by interview with Azoom Vietnam Co, Ltd., June 2019, by interview with Vietnamese LSP, Ho Chi Minh City, July 2019, and by interview with Vietnamese LSP, Hanoi, July 2019
[1021] Interview with Vietnamese logistics expert, Hanoi, August 2019
[1022] Interview with Hanel Joint Stock Company (state-owned Vietnamese electronics and IT company), Hanoi, January 2019
[1023] Interview with Executive Board Member of the Vietnam Electronics Industries Association, Dec. 2019

- Average processing time at land borders is about 7 hours (of which customs clearance time is close to 2 hours), and 7.8 days at ports (of which customs clearance time is 14 hours).[1024]
- 51.7 % of LSPs in Vietnam cite complex document procedures as one of the main impediments to doing business in the country.[1025]
- high incidence of informal payments at customs clearance[1026]
- A pilot scheme for automated customs management and monitoring for air cargo was set up at the end of 2017. Currently only Noi Bai airport is included in the pilot.[1027]
- Lack of customs brokers: licensed customs brokers do not exist, and thus no system exists for brokers to obtain priority clearance.[1028]
- Lack of customs bonds: Except for a pilot program with FDI companies (such as Inditex), there are no customs bonds, which could lower clearance times and reduce the cost of customs inspection.[1029]
- Rules for completing certificate of origin are unclear.[1030]

Requirement: Availability of risk management practices to minimize inspection rates[1031]

- non-comprehensive adoption of Authorized Economic Operator system[1032]
- There are 350 legal documents from the Vietnam Customs Department governing the policies and inspections for import and export goods, including 39 regulations, 77 Government Decrees and Deci-

[1024] Pham et al. 2013a, 68
[1025] Vietnam Logistics Business Association 2018, 182
[1026] Pham et al. 2013a, 70; corroborated by interview with Vietnamese logistics expert, Feb. 2019, and by Blancas et al. 2014, 104
[1027] Ministry of Industry and Trade of the Socialist Republic of Vietnam 2017, 22
[1028] Interview with Vietnamese LSP, July 2019
[1029] Interview with Vietnamese LSP, July 2019
[1030] Interview with Hanoi (Vietnam) branch of multinational LSP, Nov. 28, 2019
[1031] cf. World Trade Organization 2014, 8
[1032] Interview with Hanoi (Vietnam) branch of multinational LSP, Nov. 28, 2019; corroborated by interview with Executive Board Member of the Vietnam Electronics Industries Association, Dec. 2019

sions/Directives by the Prime Minister, and 240 Circulars/Decisions of Ministries, leading to difficulties for traders in clearing imports and exports.[1033]

Requirement: High technical skills of customs personnel

- low skills levels of some government officials dealing with cargo movements[1034]

Requirement: Efficient inter-agency coordination in case there are multiple border protection agencies

- low degree of integration among border management activities[1035]
- long waiting times at customs, not only due to lengthy customs procedures but also because of the need for supporting documents from several other government agencies[1036]

Relevant LPI score for Vietnam: 2.95 out of 5 on the "Efficiency of customs and border management clearance" component[1037]

GAP ANALYSIS: REGULATORY ENVIRONMENT

Requirement: Legislation covering all aspects of logistics

- absence of legislation governing multimodal transport[1038]
- absence of legislation governing dry ports and logistics zones[1039]
- lack of legislation governing export and import processes for the high-tech industry, including for customs procedures[1040]

1033 Interview with Vietnamese logistics professional, Nov. 2019
1034 Interview with Vietnamese logistics expert, Hanoi, Dec. 2018; corroborated by Blancas et al. 2014, 82
1035 Pham et al. 2013a, 132
1036 Interview with Vietnamese LSP, Ho Chi Minh City, Dec. 2018
1037 Arvis et al. 2018, 47
1038 Pham et al. 2013a, 132
1039 Victoria University Melbourne 2014, 23
1040 Interview with Vietnamese logistics expert, Feb. 2019

- lack of insurance products for LSPs: For international freight there is liability insurance, but for inland transport there are no limits to liability for LSPs. If the shipper does not have insurance, LSPs are liable and smaller companies could be bankrupted by a single shipment gone wrong. This keeps digital logistics platforms from spreading because of the question of liability in case cargo is damaged while being transported on the truck of another company.[1041] Moreover, the lack of insurance services impairs logistics for high-tech manufacturing.[1042]

Requirement: Absence of restrictions to entry and absence of obligatory association membership for logistics professionals to avoid collusive behavior

- Price reference guides are in place for trucking services for public procurement contracts, with specific prices set for each province, type of road, distance, and material, thus potentially facilitating collusive agreements.[1043]
- Foreign capital for road transportation services is limited to 49 %; if a company with more than 49 % foreign capital wants to use its own fleet (i.e., obtain a trucking license), it has to apply for a special permit.[1044]
- All truck drivers that a company employs must be Vietnamese citizens.

Requirement: Easy access to trade laws and regulations, consistency of guidelines, and absence of duplicate rules

- Trade- and logistics-related regulations are difficult to understand for economic actors: numerous regulations overlap among state agen-

[1041] Interview with Vietnamese LSP, July 2019
[1042] Interview with Vietnamese logistics expert from the public sector, July 2019
[1043] World Bank Group et al. 2018, xi
[1044] World Bank Group et al. 2018, 31

cies.[1045] This especially holds for equipment imported under the authority of the Vietnamese Ministry of Information and Communications. For several imported goods, the cost of fulfilling legal requirements is higher than the value of the goods.[1046]

- International trade regulations (relating to commodity classification, commodity valuation, product inspection, licensing, and certification of certain products) are ambiguous, difficult to understand, and not transparent.[1047]

GAP ANALYSIS: EDUCATION, SKILLS, AND PROFESSIONAL TRAINING

Requirement: Availability of structured training to ensure an adequate supply of trained logistics specialists, including those with specialized knowledge of the high-tech supply chain

- lack of sufficient training and education[1048]
- lack of sufficient trainers and training sites for logistics education[1049]
- Current training schemes lack competency standards[1050]
- 60.5 % of Vietnamese LSPs report gaps in human resources as one of the main difficulties encountered in doing business in the country.[1051]
- estimated number of logistics professionals needed in Vietnam by 2030 (all levels and competencies): 200,000[1052]

[1045] Interview with Vietnamese LSP, Hanoi, Jan. 2019; corroborated by interview with Vietnamese LSP, Hanoi (2), July 2019
[1046] Interview with Vietnamese LSP, Hanoi, Jan. 2019
[1047] Blancas et al. 2014, 82
[1048] Limbourg et al. 2016, 125; corroborated by interview with Hanel Joint Stock Company (state-owned Vietnamese electronics and IT company), Hanoi, January 2019
[1049] Ministry of Industry and Trade of the Socialist Republic of Vietnam 2017, 111
[1050] Ministry of Industry and Trade of the Socialist Republic of Vietnam 2017, 111
[1051] Vietnam Logistics Business Association 2018, 182
[1052] Ministry of Industry and Trade of the Socialist Republic of Vietnam and World Bank 2016, 6

Requirement: High level of logistics knowledge at company level, with on-the-job training widespread and regarded by companies as value-enhancing

- lack of qualified logistics staff overall[1053]
- lack of professional logistics staff specifically in high-tech companies[1054]
- lack of logistics staff, specifically those that can handle business relations with international customers; these tasks are currently often carried out by foreign staff[1055]
- human resource development in logistics services lacking[1056]
- low skill level of workers in cargo-handling facilities and logistics zones[1057]
- insufficient cargo-handling skills of airport terminal workers[1058]
- level of technical knowledge about logistics services not up to par (in Da Nang)[1059]

Requirement: Adequate staffing of road transport as intra-country transportation relies mostly on road transport

- shortage of skilled truck drivers[1060]
- insufficient enforcement of standards for truck driver licensing and training[1061]

[1053] Interview with Vietnamese logistics expert, Hanoi, Dec. 2018; corroborated by interview with Vietnamese LSP, July 2019, and by interview with Vietnamese logistics expert, Hanoi (2), August 2019
[1054] Interview with Vietnamese logistics expert, Hanoi, August 2019
[1055] Interview with Vietnamese LSP, Hanoi (2), July 2019
[1056] Victoria University Melbourne 2014, 12; corroborated by interview with Vietnamese logistics expert, Hanoi (2), August 2019
[1057] Blancas et al. 2014, 49
[1058] Blancas et al. 2014, 89
[1059] Limbourg et al. 2016, 129
[1060] Ministry of Industry and Trade of the Socialist Republic of Vietnam and World Bank 2016, 6
[1061] Blancas et al. 2014, 84

Relevant LPI score for Vietnam: 3.40 out of 5 on the Logistics quality and competence component[1062]

10.5.6 Level 6: Logistics measures—Answer to main research question, with application to high-tech manufacturing and Vietnam

Based on the preceding gap analysis, the following country- and product-category-specific measures are suggested for Vietnam to meet the logistics requirements of high-tech goods and to foster exports in that product category. Measures were formulated by analyzing the gaps identified in Appendix 10.5.5 and selecting those that a national government (rather than the private sector) would be best placed to address. This meant excluding measures that rely purely on inter-company organization and including some measures that have the characteristics of a public good for other product categories, i.e., non-excludability and non-rivalry, e.g., improving border clearance procedures. The level includes measures that a government can take with the collaboration of the private sector.

Measures relating to costs are included in two ways: (1) explicitly, as an entry in the "Ecosystem" functional category, and (2) implicitly, through entries in all seven functional categories that cover how policymakers can contribute to lowering logistics costs by improving the reliability and flexibility of the logistics environment (see section 4.3.2 for details). See section 4.3.3 for a description of the origin of the data for this level. This section forms the answer to the main research question, with application to high-tech goods and Vietnam: Which country-specific logistics measures should the government of Vietnam take to foster high-tech exports?

[1062] Arvis et al. 2018, 47

MEASURES: TRANSPORT- AND TRADE-RELATED INFRASTRUCTURE

Requirement: Availability of reliable air transport to ensure short shipment times[1063]

- Upgrade cargo terminals at Noi Bai airport (Hanoi) and Than Son Nhat airport (Ho Chi Minh City) to better accommodate air freight,[1064] e.g., introduce larger pallet scanners at Noi Bai airport to avoid the need to unpack pallets for physical checks.[1065]
- Finalize construction of the new Long Thanh International Airport to ease congestion at Than Son Nhat airport and serve the air cargo needs of Ho Chi Minh City and the southern Vietnamese region.[1066]
- Plan logistics infrastructure for high-tech production units, especially airports. Example: the connections from Noi Bai airport to the Samsung production areas in Bac Ninh and Thai Nguyen provinces are convenient (on the Hanoi—Thai Nguyen highway), thus making Noi Bai the focal point for import and export goods with the largest throughput value nationwide.[1067] Once Long Thanh airport is open, transport infrastructure and land use around it must be developed such that high-tech production units find similarly favorable conditions.[1068]
- Construct logistics zones catering to air transport needs (including advanced sorting and loading/unloading facilities) around the airports of Noi Bai, Tan Son Nhat, and Da Nang, again, to enable easier access with less congestion for LSPs.[1069]

[1063] cf. Blyde and Molina 2013, 12
[1064] cf. Banomyong et al. 2008, 366
[1065] Interview with Hanoi (Vietnam) branch of multinational LSP, March 2019
[1066] Victoria University Melbourne 2014, 15
[1067] Interview with Vietnamese logistics expert from the public sector, July 2019
[1068] Interview with Vietnamese logistics expert from the public sector, July 2019
[1069] cf. Vietnam Logistics Business Association 2018, 132; corroborated by interview with Vietnamese logistics professional, Nov. 1, 2019

- Remove the airport operators' monopoly on airport storage by allowing cargo agents and third-party providers (e.g., LSPs) to offer storage and warehousing at the airport (with security scans).
- Review the role of the Ministry of Transport in price setting for airport storage.
- Apply risk management in customs clearance for air freight so the current level of 100 % scanned cargo can be lowered.[1070]
- Increase weight limits for express goods receiving accelerated customs clearance, if applicable,[1071] taking into account flight safety considerations.
- Consider negotiating freight traffic rights independently from passenger traffic rights in bilateral air services agreements to ease the establishment of air freight hubs in the country.[1072] Consider applying separate clauses in air services agreements to provide for all-cargo air services.[1073]

Requirement: Facilitation of intermodal transport

- Invest in road infrastructure, possibly incorporating congestion fees, to ease road congestion, especially around seaports. Priority road–port links: Hai Phong port to Hanoi to Lao Cai province (400 km), Cai Mep port to Ho Chi Minh City (100 km), and Da Nang port to Quang Ngai province (170 km).[1074]
- Construct or upgrade feeder roads between Cai Mep port and NH51, the main highway connecting Cai Mep with Ho Chi Minh City.

[1070] Cargo destined for the US and (from 2021 on) to Hong Kong needs to be scanned at 100 % following US and Hong Kong legislation
[1071] cf. Tsai et al. 2007, 619
[1072] cf. Bowen and Leinbach 2006, 156
[1073] Interview with Vietnamese logistics professional, Nov. 2019
[1074] Victoria University Melbourne 2014, 15

- To increase Cai Mep port's utilization rate, introduce a system of container depots around its terminals to entice more ocean shipping companies to add the port to their rotations.[1075]
- Improve access to Cat Lai port by road.[1076]
- Improve road access to Cai Mep from Ho Chi Minh City and Dong Nai province.[1077]
- Improve handling facilities at river ports to increase volume moved on rivers.[1078] Inland waterways to be upgraded: Quang Ninh-Hai Phong–Hanoi; Hai Phong–Ninh Binh; Ho Chi Minh City–Ca Mau.[1079]
- Deepen and widen the intermodal waterway connecting Cai Mep and Cat Lai port, ensuring that container ships are not blocked by stuck vessels.[1080]
- Check whether access by rail or inland waterways (in addition to road access) to ICDs in the north of the country would make sense and possibly construct access links.

Requirement: Ability of ports to handle high container volumes

- Add third and fourth berths for Hai Phong International Gateway Port.[1081]
- Enable the ports of Cai Mep, Da Nang, and Hai Phong to handle higher container volumes by improving handling efficiency through full-truck scanners, automated gate entry, and modern ICT systems.[1082]

[1075] Interview with Vietnamese logistics expert, Hanoi, Dec. 2018
[1076] Interview with Vietnamese LSP, July 2019
[1077] Interview with Vietnamese logistics professional, Nov. 1, 2019
[1078] Interview with Vietnamese logistics expert, April 5, 2019
[1079] Vietnam Logistics Business Association 2018, 131
[1080] Interview with Vietnamese logistics professional, Nov. 1, 2019
[1081] Interview with Hanoi (Vietnam) branch of multinational LSP, Nov. 28, 2019
[1082] Banomyong et al. 2015, 34; need for upgrading cargo handling equipment corroborated by interview with Vietnamese logistics expert, Hanoi, August 2019

- Ensure that the port hinterland can support port expansion by enhancing transport infrastructure, including increasing the capacity of the main corridors leading to and from the port and easing access to industrial and logistics centers.[1083]

Requirement: Availability of distribution and consolidation centers (logistics zones) directly serving export markets

- Build privately-owned logistics zones, particularly at Cai Mep and Hai Phong ports,[1084] as well as additional zones in Ho Chi Minh City, Hanoi, Nha Trang, Lam Dong, and the Mekong Delta. Ensure that zones are located close to as many as possible of the following: major ports, airports, national highways, and industrial zones/high-tech production centers.
- Ensure that logistics zones to be built include centralized warehouses and support services for LSPs as well as import and export companies.
- Set up a logistics hub in the south (Song Than area) with links to all transport modes.[1085]
- Ensure that land reserves are available around logistics zones to accommodate future processing centers.[1086]

Requirement: Availability of inland clearance facilities and dry ports to allow customs clearance at regional production hubs rather than at the border

- Establish inland clearance facilities and dry ports with modern loading and unloading facilities.[1087] Set up ICDs close to Cai Mep and Vung Tau areas.

1083 cf. Acciaro and McKinnon 2013, 12
1084 Interview with Vietnamese logistics expert, Dec. 2018
1085 Interview with Vietnamese LSP, July 2019
1086 Pham et al. 2013a, 60
1087 For guidelines how to select dry port locations, see Nguyen and Notteboom (2016, 26)

- Upgrade ICDs in the north that are too small.
- Simplify the process for applying for ICDs.

Requirement: Large road network in good condition, at least between major production sites and export gateways

- Improve road access from the China/Vietnam land border to seaports in Vietnam.[1088]
- Reduce traffic pressure on National Highway No. 5A (Hanoi–Hai Phong) by reducing fees for Highway No. 5B.[1089]
- Widen and strengthen roads and bridges between economic centers, e.g., Hanoi to Hai Phong and around Cat Lai port.[1090]
- Widen roads between ports and high-tech manufacturing factories, which are often located less than 100 km inland.[1091]
- Introduce fixed and/or mobile weighing stations, e.g., at border crossings and main access points to ports and cities.
- Implement an automatic toll collection system, thereby facilitating reduced transport times.[1092]
- Widen border gates so trucks can pass more easily.

Cross-cutting requirement: Ensure environmental sustainability in logistics

- Ensure that the large-scale infrastructure upgrades that are planned or ongoing in Vietnam are synchronized and have a long-term, environmentally sustainable vision.[1093]
- Incentivize increasing the carrying capacity of trucks by using longer and/or higher vehicles (bridge and tunnel height clearances permitting).[1094]

[1088] Interview with Vietnamese logistics professional, Nov. 1, 2019
[1089] Interview with Vietnamese logistics expert, Hanoi (2), August 2019
[1090] cf. Pham et al. 2013a, 46
[1091] Pham et al. 2013a, 97
[1092] Interview with Vietnamese logistics expert, Hanoi (2), August 2019
[1093] Interview with Vietnamese logistics expert, Hanoi (2), August 2019

- Incentivize upgrades or retrofitting of older trucks and planes to encourage adoption of energy-saving technology.[1095]
- Incentivize or mandate lower caps on sulfur content (SO_x) in marine (bunker) fuel (lower than those mandated by the International Maritime Organization) to decrease SO_x emissions.[1096]
- Incentivize use of port equipment with cleaner technology, e.g., gantry cranes with hybrid/alternative fuels (i.e., bioenergy or electric power).[1097]
- Offer preferential treatment to shipping companies with environmentally friendly ship designs, e.g., via improved engine design, waste heat recovery, double skin, or internal oil tanks.[1098]

MEASURES: INFORMATION & COMMUNICATIONS TECHNOLOGY

Requirement: Integration of IT tools between suppliers and customers, including for automation of cross-company information exchange, e.g., advance shipment notices[1099]

- Foster supply chain collaboration by establishing information systems to share real-time information.[1100]
- Incentivize the development of IT standards for e-business to foster interoperability and support their introduction at firm level.
- Incentivize the development of cloud-based IT applications to facilitate low-cost, secure access to ICT systems for LSPs.[1101]
- Introduce an e-airway bill nationwide.

1094 cf. McKinnon et al. 2015, 166
1095 cf. McKinnon 2014, 7
1096 cf. McKinnon et al. 2015, 186
1097 cf. Roh et al. 2016, 111
1098 cf. Roh et al. 2016, 111
1099 cf. Göpfert and Braun 2017, 28
1100 cf. Fawcett et al. 2008, 99
1101 Ministry of Industry and Trade of the Socialist Republic of Vietnam and World Bank 2016, 19

Requirement: Prevention of counterfeiting and tampering with high-tech products

- Support the development and introduction of IoT devices to help prevent counterfeiting attempts of high-tech products.

Requirement: Availability of data tools to support an uninterrupted supply chain across transport modes

- Support the introduction of predictions of estimated time of arrival for the entire transport chain, potentially using AI and machine learning, taking into account infrastructure, resources, order characteristics, and weather.[1102]
- Introduce a database on logistics and freight transport at national and provincial levels.[1103]

Requirement: Availability of tracking and tracing technology

- Permit new technologies related to tracking and security;[1104] ideally, real-time tracking.[1105]

Cross-cutting requirement: Ensure environmental sustainability in logistics

- Set up common interface to ease information exchange on hazardous parts of products in the supply chain.[1106]

MEASURES: ORGANIZATION OF THE LOGISTICS ENVIRONMENT ("ECOSYSTEM")

Requirement: 24/7 or close to 24/7 opening of trade-enabling services, e.g., ports and airports

[1102] cf. Poschmann et al. 2019, 162
[1103] Interview with Vietnamese logistics expert, Hanoi, Dec. 2018
[1104] cf. World Bank 2010, 43
[1105] cf. Kiwitt and Frankenberg, 2012, 160
[1106] cf. Wittstruck and Teuteberg 2012, 155

- Open ports and airports 24/7; if this is not warranted by traffic, ensure that opening times are reliable.

Requirement: Healthy competition in all transport modes and in logistics, including competitive freight handling, trucking, shipping, and warehousing services[1107]

- Ensure that state-owned enterprises in transport and logistics enjoy no advantages vis-à-vis private operators.
- Overhaul competition legislation and ensure that it covers all transport modes.

Requirement: Seamless cooperation of supply chain actors to increase the speed of the supply chain

- Set up a nationwide online port community system to foster collaboration among supply chain actors.[1108]
- In ports where terminals are operated by different providers, customs and port operators should allow seamless movement of cargo (when handled by LSPs) from one terminal to another.
- Provide incentives to professionalize trucking industry by reducing number of illegal operators.
- Improve business cooperation between logistics companies (beyond the work of the Vietnam Logistics Business Association),[1109] e.g., by

[1107] cf. World Bank 2012, 14

[1108] Victoria University Melbourne 2014, 15; call for close collaboration between supply chain actors (manufacturers, importers, exporters, LSPs) corroborated by interview with M1 Viettel, Vietnamese manufacturer of communications and electronic devices, August 2019. More information on port community systems available at http://tfig.unece.org/contents/port-community-systems.htm, accessed on Nov. 17, 2019

[1109] Interview with Vietnamese LSP, Hanoi (2), July 2019; corroborated by interview with Ha Pham, Foreign Trade University Hanoi, Nov. 4, 2019

encouraging information exchange through involving the Ministry of Industry and Trade as a facilitator.[1110]

Requirement: Reliable management of ports, airports, and rail transport[1111]

- Introduce commercial management in port and airport (and potentially rail) operations.[1112]
- Increase private-sector participation in building and maintaining public infrastructure.[1113]

Requirement: Access to advanced logistics services and efficient warehousing

- Ensure (through zoning laws) that warehouses and distribution centers are easily accessible from manufacturing hubs and ports.
- Incentivize the set-up of better warehousing, including with high-tech functions.[1114]
- Incentivize implementation of warehouse management systems to facilitate just-in-time and just-in-sequence delivery via automatic transmission of predicted truck arrival times, automatic selection and preparation of docking slots, automatic assignment of storage space, real-time visibility of inventory, and a track-and-trace function for the entire supply chain.[1115]
- Ensure that high-tech manufacturers have access via bonded trucking to offsite airport storage to ease congestion in onsite airport storage, i.e., provide the option to transport goods to an authorized warehouse outside the port of entry without customs release, as already availa-

[1110] Interview with Ha Pham, Foreign Trade University Hanoi, Nov. 4, 2019
[1111] cf. World Bank 2010, 45
[1112] cf. World Bank 2010, 45
[1113] cf. World Bank 2010, 45
[1114] Interview with Vietnamese logistics expert, April 2019
[1115] cf. Barreto et al. 2017, 1249

ble to the two Samsung production sites in Bac Ninh and Thai Nguyen provinces.[1116]

Requirement: Tight coordination of government entities involved in fostering the logistics environment

- Enhance national management information system by connecting information between logistics-related agencies such as the Ministry of Industry and Trade, Ministry of Transport, and Ministry of Finance, to reduce competing administrative procedures and to decrease waiting times at international gateways (ports and airports) and border posts.[1117]
- Set up a national logistics council, uniting all logistics stakeholders, to ensure a feedback mechanism among private and public actors in logistics, possibly chaired by the Ministry of Industry and Trade.
- Enhance the capabilities of government employees whose work impacts on logistics performance.[1118]

Requirement: Logistics costs on par with international standards (ca. 10–17 % of GDP) or, ideally, lower[1119]

- Work towards reducing logistics costs from the 2016 level of 20.8 % of GDP by fostering healthy competition in all transport modes, lowering transaction costs of transit (customs and handling charges, and time needed for documentary compliance), and increasing reliability and predictability in the supply chain.

[1116] Interview with Hanoi (Vietnam) branch of multinational LSP, Nov. 28, 2019; need for offsite airport storage corroborated by interview with Vietnamese logistics expert from the Ministry of Industry and Trade, Dec. 2019
[1117] Interview with Vietnamese logistics expert, Hanoi (2), August 2019
[1118] Victoria University Melbourne 2014, 12
[1119] cf. Memedovic et al. 2005, 358

Cross-cutting requirement: Ensure environmental sustainability in logistics

- Select sites for warehouses to be built near roads, airports, and seaports to reduce transport time and thus reduce carbon emissions.[1120]
- Ensure the availability of waste management for unneeded products.
- Support offerings of reverse logistics so that unneeded but intact high-tech products can be reused and returns and repairs handled swiftly.

MEASURES: BUSINESS PRACTICES FOR HIGH-QUALITY LOGISTICS SERVICES

Requirement: Adoption of international standards by logistics operators, including efficient inventory management

- Initiate standard performance contracts for transport and logistics services.[1121]
- Adopt global standards for warehousing, trucking services, and freight forwarding.
- Increase the technical know-how of local LSPs, e.g., on how to manage inventory.
- Incentivize LSPs to offer auxiliary services for high-tech companies.
- Provide financial incentives to modernize the trucking fleet.[1122]
- Incentivize the use of transport management systems (e.g., using GPS systems) to consolidate shipments, control freight costs and integrate with, e.g., warehouse management systems by monitoring freight movements and vehicles.[1123]

[1120] Interview with Vietnamese LSP, Hanoi, July 2019
[1121] cf. World Bank 2010, 43; corroborated by interview with Nguyen Thi Minh Phuong, Operational Purchasing Manager, ABB Vietnam, Nov. 2019
[1122] Pham et al. 2013a, 60
[1123] cf. Barreto et al. 2017, 1249

- Incentivize the use of wearable augmented reality devices (e.g., smartglasses) to increase the efficiency and precision of loading, unloading, and handling goods and inventory.[1124]
- Support the use of temperature-sensitive packaging that prevents damage of goods in transit.

Requirement: Information flows to all supply chain partners, i.e., suppliers and customers,[1125] and supply chain partners collaborate, e.g., by sharing distribution networks, infrastructure, and vehicles

- Enable increased collaboration of supply chain partners via digital logistics platforms through strengthening the broadband internet infrastructure necessary for online coordination; possibly provide tax incentives to share equipment.

Requirement: Business practices in place to mitigate supply chain volatility

- Create incentives for supply chain partners to share stock levels to increase forecasting accuracy.[1126]
- Incentivize the use of additive manufacturing to produce spare parts to reduce lead time and cost of safety inventory.[1127]

Requirement: Use of supply chain metrics and performance measurements

- Collect detailed supply chain data and logistics statistics and compare against key performance indicators.[1128]
- Incentivize the use of predictive analytics to foresee variations in input availability and customer demand.[1129]

[1124] cf. Viswanadham 2015, 97
[1125] cf. Lee 2004, 4
[1126] cf. Nitsche 2018, 19
[1127] cf. Liu et al. 2014, 1169
[1128] Victoria University Melbourne 2014, 13, corroborated by interview with Vietnamese logistics expert, April 2019

Cross-cutting requirement: Ensure environmental sustainability in logistics

- Incentivize reduction of air freight use (towards less carbon-intensive modes) by improved business process planning.[1130]
- Pollution control: Incentivize logistics operators to limit energy consumption and the use of harmful substances, and to limit and treat wastewater, solid waste, and hazardous emissions (e.g., SO_2, NH_3, CO_2, and HC_1).[1131]
- Subsidize renewable energy sources in preference to traditional energy sources.[1132]
- Foster the reduction of CO_2 emissions from vehicles by incentivizing an increase of load factors, improvement of vehicle efficiency, utilization of lower carbon fuels,[1133] implementation of preventive maintenance,[1134] and monitoring tire pressure.[1135]
- Offer driver training to encourage fuel efficient driving.[1136]
- Reduce empty truck runs, e.g., by pooling trips via digital logistics platforms to ensure full truck- and container-loads.[1137]
- Encourage a modal shift from road transport to inland waterways or rail transport.[1138]
- Encourage a reduction of shipping weights, e.g., by packaging management.[1139]

[1129] cf. Ivanov et al. 2019, 40
[1130] cf. McKinnon 2014, 5
[1131] cf. Lee et al. 2009, 7924
[1132] cf. Wittstruck and Teuteberg 2012, 155
[1133] cf. Asian Development Bank and Gesellschaft für Internationale Zusammenarbeit 2014, 22
[1134] cf. Rushton et al. 2017, 796
[1135] cf. Clean Air Asia 2017, 27
[1136] cf. Clean Air Asia 2017, 27
[1137] Interview with Vietnamese logistics expert, Feb. 2019; corroborated by interview with Nguyen Thi Minh Phuong, Operational Purchasing Manager, ABB Vietnam, Nov. 2019
[1138] Interview with Vietnamese logistics expert, Hanoi, Dec. 2018
[1139] cf. Asian Development Bank and Gesellschaft für Internationale Zusammenarbeit 2014, 22

- Subsidize or mandate the use of recycled materials for packaging.[1140]
- Encourage the adoption of 3D printing techniques to reduce wastage of unneeded finished products.[1141]

MEASURES: CUSTOMS PRACTICES

Requirement: 24/7 or close to 24/7 opening hours of customs services and border posts

- Open ports and airports 24/7.[1142] If not warranted by border traffic, ensure that opening times are reliable.

Requirement: Availability of electronic data interchange for customs to eliminate the need for duplicate data entries, increase transaction speed, and reduce costs and error rates[1143]

- Introduce the World Customs Organization standards for classification, filing practices, and electronic data exchange.[1144]
- Introduce e-customs in all provinces, i.e., using electronic instead of paper-based procedures (eliminating opportunities for informal payments).[1145]
- Offer technical support to users encountering technical issues using the customs platform.
- Introduce blockchain technology for archiving customs documents to prevent unauthorized modifications and to expedite the flow of information and improve confidence in customs documentation.[1146]

1140 Interview with Vietnamese logistics expert from the public sector, June 2019
1141 cf. Ivanov et al. 2019, 39
1142 Interview with Executive Board Member of the Vietnam Electronics Industries Association, Dec. 2019
1143 cf. Rushton et al. 2017, 751
1144 cf. Blancas et al. 2014, 123
1145 For suggestion of e-customs: Interview with Vietnamese logistics expert, Feb. 2019; corroborated by interview with Hanoi (Vietnam) branch of multinational LSP, Nov. 28, 2019
1146 cf. Ivanov et al. 2019, 500

Requirement: Streamlined and predictable border clearance procedures

- Remove overlapping customs procedures.
- Expand the pilot scheme for automated customs management and monitoring for air cargo from Noi Bai airport to all airports.
- Expand the use of customs bonds to all exporting companies to reduce clearance times and lower customs inspection costs.
- Introduce a licensing system for customs brokers.
- Improve customs coordination with neighboring countries, i.e., set up joint border posts at the Vietnam-China border to avoid duplicate controls.[1147]
- Decrease incidence of informal payments by specifying integrity standards for customs personnel.[1148]
- Simplify the procedure for obtaining certificate of origin (enabling traceability of product inputs) and clarify the rules for its completion.[1149]

Requirement: Availability of risk management practices to minimize inspection rates[1150]

- Increase the use of the Authorized Economic Operator program.[1151]
- Adopt single-stop inspection at the border with risk-based management.[1152]
- Use an advance ruling system.[1153]

[1147] Interview with Hanoi (Vietnam) branch of multinational LSP, Nov. 28, 2019
[1148] cf. Pham et al. 2013a, 139
[1149] Interview with Hanoi (Vietnam) branch of multinational LSP, Nov. 28, 2019
[1150] cf. World Trade Organization 2014, 8
[1151] cf. World Bank 2010, 44; corroborated by interview with Hanoi (Vietnam) branch of multinational LSP, Nov. 28, 2019, and by interview with Executive Board Member of the Vietnam Electronics Industries Association, Dec. 2019
[1152] Pham et al. 2013a, 132
[1153] Pham et al. 2013a, 132

- Streamline and reduce the number of documents from the Customs Department governing inspections for import and export goods.

Requirement: High technical skills of customs personnel[1154]

- Improve the capacity of customs staff.[1155]

Requirement: Efficient inter-agency coordination in case there are multiple border protection agencies

- Increase integration of border management activities, i.e., customs, Ministry of Transport, Ministry of Science and Technology, and port authorities.[1156]
- Remove the need to obtain supporting documents from government agencies in dispersed locations by completing the National Single Window and ASEAN-wide Single Window; eliminate multiple inspections.[1157]

Cross-cutting requirement: Ensure environmental sustainability in logistics

- Allow digital signatures for certificates of origin rather than requiring original signatures and business seals, thereby eliminating the need for brokers to physically travel to companies' sites to obtain signatures and seals.[1158]

[1154] cf. World Bank 2012, 36
[1155] Interview with M1 Viettel, Vietnamese manufacturer of communications and electronic devices, August 2019
[1156] Pham et al. 2013a, 133
[1157] https://www.worldbank.org/en/news/speech/2017/12/15/world-bank-country-director-remarks-at-vietnam-logistics-forum-2017, accessed on Sep. 15, 2019
[1158] Interview with Vietnamese branch of an international manufacturer of electrical equipment, July 2019

MEASURES: REGULATORY ENVIRONMENT

Requirement: Legislation covering all aspects of logistics

- Design and pass legislation on investment in and operation of dry ports and logistics zones.[1159]
- Revise laws that touch upon SCM: commercial law, transport laws, and decrees on logistics and multimodal transport.[1160]
- Fill gaps in legislation related to export and import processes for the high-tech industry.
- Close regulatory gaps in liability and insurance to increase the attractiveness of digital logistics platforms.[1161]
- Carry out reform of the legal framework for technology application in logistics activities, covering, e.g., blockchain and transport means suitable for urban traffic.[1162]
- Set up legislation governing insurance products for LSPs.

Requirement: Absence of restrictions to entry and absence of obligatory association membership for logistics professionals to avoid collusive behavior

- Phase out price reference guides.[1163]
- Increase and eventually phase out the foreign capital limit for road transportation services.
- Remove the requirement for truck drivers to be Vietnamese citizens.

[1159] Victoria University Melbourne 2014, 23
[1160] Victoria University Melbourne 2014, 23
[1161] Interview with Vietnamese LSP, July 2019
[1162] Interview with Vietnamese logistics expert from the public sector, June 2019
[1163] cf. World Bank Group et al. 2018, xi

Requirement: Easy access to trade laws and regulations, consistency of guidelines, and absence of duplicate rules

- Review rules and regulations related to international trade included in the Vietnam Trade Information Portal; ensure consistency and remove duplication.
- Remove overlapping responsibilities among state agencies and improve cooperation and coordination among them.[1164]
- Simplify the filing of legal documents and reduce costs associated with filing legal documents.
- Improve cooperation with other governments, e.g., harmonize rules for issuing certificates of origin.[1165]

Cross-cutting requirement: Ensure environmental sustainability in logistics

- Introduce targets for reducing energy consumption overall.
- Introduce air, water, and soil pollution limits.[1166]
- Introduce a truck scrappage scheme to remove older, less fuel-efficient trucks.[1167]

MEASURES: EDUCATION, SKILLS, AND PROFESSIONAL TRAINING

Requirement: Availability of structured training to ensure an adequate supply of trained logistics specialists

- Introduce logistics courses or majors (at universities) with course content focused on the requirements of the high-tech manufacturing

[1164] Interview with Vietnamese LSP, Hanoi, Jan. 2019; corroborated by interview with Vietnamese LSP, Hanoi (2), July 2019
[1165] Interview with Vietnamese LSP, Hanoi, July 2019
[1166] cf. Straube et al. 2011, 45
[1167] cf. McKinnon 2015b, 390

supply chain and support cooperation between universities and high-tech manufacturers.[1168]

- Set up vocational training schemes with standardized curricula such as those provided by international bodies such as FIATA or at the regional level (ASEAN Freight Forwarders Association).[1169]
- Introduce Train-the-Trainer schemes (e.g., on the basis of the FIATA training curriculum or the ASEAN Freight Forwarders Association).[1170]
- Adopt certification based on international standards, e.g., CILT or FIATA, or on regional standards such as those of the ASEAN Freight Forwarders Association.[1171]
- Ensure that logistics courses in universities include coverage of the practical issues that applicants will face in daily logistics operations, e.g., how to complete a customs declaration and how to work on SAP applications.[1172]
- Introduce internship programs that align with companies' needs: Instead of full-time, offer internships in which students work at a company for 2 to 3 hours per day 2 or 3 times a week for an entire semester (in coordination with their academic schedule).[1173]
- Strengthen connections between universities, colleges and businesses to train logistics experts.[1174] Good practices already exist in the form of a network (established in 2017) of logistics professors and lecturers led by the Ministry of Industry and Trade which, for example,

[1168] Interview with Ha Pham, Foreign Trade University Hanoi, Nov. 2019
[1169] Victoria University Melbourne 2014, 19; corroborated by interview with Ha Pham, Foreign Trade University Hanoi, Nov. 2019
[1170] Interview with Vietnamese logistics expert, April 2019; corroborated by interview with Ha Pham, Foreign Trade University Hanoi, Nov. 2019
[1171] Interview with Ha Pham, Foreign Trade University Hanoi, Nov. 2019
[1172] Interview with Vietnamese LSP, July 2019
[1173] Interview with Vietnamese LSP, July 2019; corroborated by interview with Ha Pham, Foreign Trade University Hanoi, Nov. 4, 2019
[1174] Interview with Vietnamese logistics expert, Hanoi, August 2019

organizes logistics competitions for students in cooperation with LSPs; this could be expanded.[1175]

- Expand opportunities for university students to spend one or two semesters during their four-year programs at overseas universities with high-quality logistics education, e.g., in Europe or the U.S.A.; objectives will include expanding knowledge on modern SCM technologies applicable to high-tech manufacturing.[1176]
- Improve the curricula for logistics-related degrees at universities.[1177]

Requirement: High level of logistics knowledge at company level, with on-the-job training widespread and regarded by companies as value-enhancing

- Provide incentives to LSPs and manufacturing companies carrying out logistics functions to offer on-the-job training (e.g., short courses) for logistics in general and for logistics related to high-tech manufacturing in particular.[1178]
- Provide financial and content-related support to companies for training experienced logistics staff to augment their knowledge with insights on best practices, e.g., in warehousing and trucking management, ideally in the form of practical training, for instance, in an actual warehouse.[1179]
- Provide incentives to offer training on digitalization, especially for staff working on customs clearance and warehousing.[1180]
- Offer courses for import–export staff on import–export-related issues such as tax policy.[1181]

[1175] Interview with Ha Pham, Foreign Trade University Hanoi, Nov. 4, 2019
[1176] Interview with Ha Pham, Foreign Trade University Hanoi, Nov. 4, 2019
[1177] Interview with Vietnamese LSP, Hanoi, July 2019
[1178] Interview with Ha Pham, Foreign Trade University Hanoi, Nov. 4, 2019; corroborated by interview with Vietnamese logistics expert from Ministry of Industry and Trade, Dec. 2019
[1179] Interview with Vietnamese logistics professional, Nov. 1, 2019
[1180] Interview with Vietnamese logistics professional, Nov. 1, 2019

Requirement: Adequate staffing of road transport as intra-country transportation relies mostly on road transport

- Set up training programs for truck drivers and enforce standards for truck driver training.

Cross-cutting requirement: Ensure environmental sustainability in logistics

- Include course material on environmental sustainability in logistics in curricula for logistics professions.
- Incentivize companies to offer in-house training on environmental sustainability in logistics.

[1181] Interview with Vietnamese branch of an international manufacturer of electrical equipment, July 2019

10.6 Application of decision framework to automotive goods and Morocco

10.6.1 Level 1: Target set-up of logistics environment

The target set-up describes the ideal state of a well-functioning logistics environment. See section 4.3.3 for an explanation of the decision framework's levels. Owing to their importance for modern logistics for high value-added products, the target set-up focuses on the same characteristics (flexibility, reliability, and cost) for all product categories covered in the framework applications, though with partly different specifications.

Target set-up for product category automotive goods:

- High degree of flexibility in the logistics environment with short delivery times of a few weeks or days. Flexibility here refers to the capability to change based on a set of defined contingency scenarios.[1182]
- High degree of reliability; the logistics environment is resilient in the face of, e.g., port shutdowns and road congestion and still ensures on-time delivery quotas of close to 100 %. Reliability here relates to the degree of uncertainty in the lead time, where lead time refers to the time it takes for goods to arrive at the purchaser after the order has been placed.[1183]
- Low level of logistics costs, on par with international standards (ca. 10–17 % of GDP, viewed across all sectors) or, ideally, lower.[1184]

10.6.2 Level 2: Logistics concepts

This section links logistics concepts prevalent in the automotive goods product category to the target set-up of the logistics environment.[1185]

[1182] cf. OECD 2013, 50
[1183] cf. Hausman et al. 2013, 241
[1184] cf. Memedovic et al. 2005, 358
[1185] In the list below, the arrows behind each concept point to the relevant target set-up component(s).

The following concepts are business practices (i.e., they come into play at the intra-company level), but they need an enabling environment made up of components from all seven functional categories:

- trade-off between responsiveness and efficiency of the logistics environment:[1186] Responsiveness must be high to keep up with the pace of the industry, but cost pressure mandates efficiency of the supply chain (→ flexibility, reliability, and cost).
- just-in-time or even just-in-sequence production (delivery of components based on production schedule for individualized products) (→ flexibility);
- pull-oriented production and distribution (make-to-order), rather than push-oriented (make-to-stock)[1187] (→ flexibility);
- ability to handle large volumes of imported inputs, most of them by sea[1188] (→ reliability and flexibility);
- ability to handle large volumes of exported finalized products, most of them containerized and by sea[1189] (→ reliability and flexibility);
- transmission of responsibility for quality assurance shifted from manufacturer to supplier or to 3PL, with high demands on quality of products and processes[1190] (→ reliability).

10.6.3 Level 3: Trends

This section includes product-category-specific trends. It explores which trends with relevance to automotive goods may impact on logistics in the next decade (until approximately 2030).

Product-category-specific trends:

- Rising share of local rather than global sourcing for parts and components due to local content rules[1191] and high capacity utilization in

[1186] cf. Ivanov et al. 2019
[1187] cf. Göpfert and Braun 2017, 29
[1188] cf. Pham et al. 2013a, 42
[1189] cf. Pham et al. 2013a, 42
[1190] cf. Göpfert and Braun 2017, 28

existing plants, with production taking place at any plant with idle capacity → Rising need for LSPs that can handle international operations to move cars quickly to buyers in their respective locations as well as rising need for infrastructure suitable for imports/exports of components from/to international destinations.

- Rising cost pressure: Need to optimize the automotive supply chain regarding cost, e.g., by moving production to low wage locations and lowering logistics costs (transport, warehousing, inventory, and administration).[1192] Cost pressure will rise with the adoption of freight platforms that increase price transparency among transportation providers.[1193]
- Switch to low-carbon vehicles: to reduce greenhouse gas emissions by 55 % by 2030, the European Parliament and the European Commission in 2019 adopted strict emission performance standards for new passenger cars in the EU.[1194] With the European Union being a key market for automobiles, these regulations will have ramifications for automotive manufacturers worldwide and for their supply chains due to the differences of manufacturing cars with combustion engines vis-à-vis those using electricity or hydrogen as fuel.
- Higher degree of complexity in car manufacturing: higher number of parts, production lines and associated logistics requirements (and added complexity of production and logistics processes)[1195]

Non-product-category-specific trend:

- Higher demand and higher requirements for environmental sustainability in logistics:[1196] measures to address environmental sustainabil-

[1191] cf. Köhne et al. 2017, 218
[1192] cf. Göpfert et al. 2017, 12
[1193] cf. Straube (Ed.) 2019, 37
[1194] https://ec.europa.eu/clima/policies/transport/vehicles/regulation_en, accessed on Nov. 17, 2020
[1195] cf. Göpfert and Braun 2017, 33
[1196] cf. Göpfert et al. 2017, 12

ity in logistics operations are included throughout the functional categories of measures.

10.6.4 Level 4: Logistics requirements—Answer to research sub-question 1 with application to automotive goods

This section lays out the requirements of the logistics environment for the automotive product category that can be (partly) addressed by government action. Requirements are product-category-specific (not country-specific). They are grouped in two ways:

1. by functional category (infrastructure, ICT, ecosystem, business practices, customs, regulatory environment, or training);
2. by the target set-up characteristics of flexibility and reliability. Requirements related to costs (the third target set-up characteristic) are included in two ways: (1) explicitly (as an entry in the "Ecosystem" functional category), and (2) implicitly, through entries in all seven functional categories that cover how policymakers can contribute to lowering logistics costs by improving the reliability and flexibility of the logistics environment (see section 4.3.2 for details).

This section forms the answer to research sub-question 1, with application to automotive products: What are the logistics requirements of automotive goods? See section 4.3.3 for a description of the origin of the data for this level.

REQUIREMENTS: TRANSPORT- AND TRADE-RELATED INFRASTRUCTURE

Flexibility:

- facilitation of intermodal transport to handle high container volumes (for parts and components) as well as roll-on/roll-off traffic (for shipping of finished cars)

Reliability:

- large road network in good condition, at least between major production sites and export gateways
- rail network in good condition, at least between major production sites and export gateways
- availability of reliable air transport for goods with high value density
- availability of loading equipment tailored to goods that can be used across firms in the supply chain

REQUIREMENTS: INFORMATION & COMMUNICATIONS TECHNOLOGY

Flexibility:

- integration of IT tools and data formats between suppliers and customers, including for automation of cross-company information exchange, e.g., advance shipment notices[1197]
- availability of digital government services for import and export

Reliability:

- availability of data tools to support an uninterrupted supply chain across transport modes
- availability of tracking and tracing technology

REQUIREMENTS: ORGANIZATION OF THE LOGISTICS ENVIRONMENT ("ECOSYSTEM")

Flexibility:

- 24/7 or close to 24/7 opening of trade-enabling services, e.g., ports and airports

[1197] cf. Göpfert and Braun 2017, 28

- healthy competition in all transport modes and in logistics services, including competitive freight handling, trucking, shipping, and warehousing services[1198]

Reliability:

- reliable management of ports, airports, and rail transport[1199]
- tight coordination of government entities involved in fostering the logistics environment

Costs:

- logistics costs on par with international standards (ca. 10–17 % of GDP) or, ideally, lower[1200]

REQUIREMENTS: BUSINESS PRACTICES FOR HIGH-QUALITY LOGISTICS SERVICES

Flexibility:

- business practices in place to mitigate supply chain volatility, i.e., fluctuations of material flows that lead to discrepancies between supply and demand at the firm level[1201]
- adoption of international standards by logistics operators

Reliability:

- use of supply chain metrics and performance measurements

[1198] cf. World Bank 2012, 14
[1199] cf. World Bank 2010, 45
[1200] cf. Memedovic et al. 2005, 358
[1201] cf. Nitsche and Durach 2018, 868

REQUIREMENTS: CUSTOMS PRACTICES

Flexibility:

- 24/7 or close to 24/7 opening hours of customs services and border posts
- availability of electronic data interchange[1202] for customs to eliminate need for duplicate data entries, increase transaction speed, and reduce costs and error rates[1203]

Reliability:

- streamlined and predictable border clearance procedures
- adoption of risk management procedures to concentrate control efforts on high-risk shipments[1204]

REQUIREMENTS: REGULATORY ENVIRONMENT

Flexibility:

- legislation covering all aspects of logistics

Reliability:

- subsidy schemes relevant to LSPs that are designed to minimize market distortions, if introduced at all
- few or no illegal logistics providers

[1202] EDI is defined by Rushton et al. (2017, 750) as "computer-to-computer exchange of structured data for automatic processing"
[1203] cf. Rushton et al. 2017, 751
[1204] cf. World Trade Organization 2014, 8

REQUIREMENTS: EDUCATION, SKILLS, AND PROFESSIONAL TRAINING

Flexibility:

- adequate supply of trained logistics specialists to meet demand surges
- availability of structured training, with on-the-job training widespread and viewed by companies as value-enhancing

Reliability:

- adequate staffing of road transport, as intra-country transportation relies mostly on road transport
- high level of logistics knowledge at company level

10.6.5 Level 5: Gap analysis—Answer to research sub-question 2 with application to automotive goods and Morocco

The gap analysis is product-category- and country-specific: It juxtaposes the logistics requirements from section 6.4.4 with the current state of the logistics environment for automotive goods in Morocco and identifies which logistics constraints are prevalent in that country for automotive goods. All entries refer to gaps that can (partially) be addressed by government action. Exemption: entries under "Business practices" include those with limited scope for government action. Gaps are grouped by functional category (infrastructure, ICT, ecosystem, business practices, customs, regulatory environment, and training).

Data for this level originate in the following sources: (1) interviews carried out with Moroccan stakeholders, (2) official country statistics, and (3) public databases and reports. Unless otherwise noted, information in this section is based on interviews with Moroccan logistics stakeholders by the author in November and December 2015. This section forms the answer to research sub-question 2, with an application to Morocco and automotive goods: Which country-specific constraints are prevalent in Morocco in the logistics environment for automotive goods?

GAP ANALYSIS: TRANSPORT- AND TRADE-RELATED INFRASTRUCTURE

Requirement: Facilitation of intermodal transport to handle high container volumes (for parts and components) as well as roll-on/roll-off traffic (for shipping of finished cars)

- underdevelopment of intermodal transport, mainly due to the short rail network (2,109 km), with the only route connecting road to rail and maritime transport running from Casablanca port to Tangier
- lack of transshipment facilities (dry ports/inland terminals) outside Tanger-Med port
- logistics zones: too few connections of some zones to the road network, and even fewer to the rail network
- logistics zones: most zones are operated by public or parastatal entities: ONCF (public rail operator), Agence Nationale des Ports (national port agency), and SNTL (a parastatal transport and logistics operator), with limited cooperation in developing zones, limited input of private sector needs, and potentially more public resources used than necessary[1205]

Requirement: Large road network in good condition, at least between major production sites and export gateways

- road network: comparatively low road density (km of road per 100 km^2 of land area): 13.1 in Morocco in 2011 vs. 191.6 in France or 180.3 in Germany,[1206] and low importance of the transport and logistics sector regarding GDP (5.1 % of GDP[1207] vs. European average of 15 %), leading to fewer options for road transport

[1205] OECD 2015, 25

[1206] International Road Federation Geneva, World Road Statistics, accessed via World Bank, World Development Indicators (WDI) on Feb. 13, 2015 (not included in subsequent WDI updates; 2011 = latest data available)

[1207] https://maroc-diplomatique.net/le-secteur-de-la-logistique-contribue/ (accessed on Dec. 31, 2019)

- lack of road, maritime, and air freight links with other emerging markets, e.g., Nigeria and Senegal

Requirement: Rail network in good condition, at least between major production sites and export gateways

- varying density of rail network, with several regions as blind spots, e.g., around Agadir, leading to reliance on road transport for all exports from the region

Requirement: Availability of reliable air transport for goods with high value density

- air transport: low share of goods transported by air vs. other transport modes (5 % by value; 0.1 % by weight), causing difficulties for sectors relying on just-in-time production[1208]

Requirement: Availability of loading equipment tailored to goods that can be used across firms in the supply chain

- [No information for Morocco]

Relevant LPI score for Morocco: 2.43 out of 5 for the "Quality of trade- and transport-related infrastructure" component[1209]

GAP ANALYSIS: INFORMATION & COMMUNICATIONS TECHNOLOGY

Requirement: Integration of IT tools between suppliers and customers, including for automation of cross-company information exchange, e.g., advance shipment notices[1210]

- [No information for Morocco]

[1208] cf. World Bank and Ministère de l'Equipement et du Transport du Maroc 2006, 50
[1209] Arvis et al. 2018, 47
[1210] cf. Göpfert and Braun 2017, 28

Requirement: Availability of digital government services for import and export

- some availability, in particular an IT system for customs and the "PortNet" National Single Window system, a digital platform that acts as a single point of entry for regulatory information relevant to traders and enable paperless import and export processes[1211]

Requirement: Availability of data tools to support an uninterrupted supply chain across transport modes

- [No information for Morocco]

Requirement: Availability of tracking and tracing technology

- [No information for Morocco]

Relevant LPI score for Morocco: 2.51 out of 5 for the "Ability to track and trace consignments" component[1212]

GAP ANALYSIS: ORGANIZATION OF THE LOGISTICS ENVIRONMENT ("ECOSYSTEM")

Requirement: 24/7 or close to 24/7 opening of trade-enabling services, e.g., ports and airports

- maritime transport: limited operating hours at all Moroccan ports (no 24-hour operations)
- air transport: no 24-hour opening times of airports

[1211] https://portail.portnet.ma, accessed on March 23, 2019; cf. World Trade Organization 2014, 13

[1212] Arvis et al. 2018, 47

Requirement: Healthy competition in all transport modes and in logistics, including competitive freight handling, trucking, shipping, and warehousing services[1213]

- weak or no competition in several transport modes (road, rail, and air)
- competition in all logistics services from state-owned enterprises (especially from SNTL and Poste Maroc): underbidding market prices by 30–40 % owing to lower taxes and access to low-cost financing and prime real estate

Requirement: Reliable management of ports, airports, road and rail transport[1214]

- low satisfaction with rail transport service providers[1215]

Requirement: Tight coordination of government entities involved in fostering the logistics environment

- little coordination of public efforts to strengthen the logistics environment due to overlapping responsibilities of ministries

Requirement: Logistics costs on par with international standards (ca. 10–17 % of GDP) or, ideally, lower[1216]

- high level of logistics costs (20 % of GDP as of 2019),[1217] above the 10–16 % of GDP level of European countries

[1213] cf. World Bank 2012, 14
[1214] cf. World Bank 2010, 45
[1215] Arvis et al. 2016, 18
[1216] cf. Memedovic et al. 2005, 358
[1217] https://www.medias24.com/logistique-la-competitivite-a-la-traine-1427.html (accessed on Dec. 31, 2019). This number does not distinguish between economy-wide and firm-level logistics costs and no data were obtainable differentiating the two.

GAP ANALYSIS: BUSINESS PRACTICES FOR HIGH-QUALITY LOGISTICS SERVICES

Requirement: Business practices in place to mitigate supply chain volatility

- [No information for Morocco]

Requirement: Adoption of international standards by logistics operators

- low number of advanced LSPs (98 % merely offer domestic or even only regional transport or storage services)[1218]
- high degree of fragmentation among transport operators: more than 90 % own only one or two trucks[1219]

Requirement: Use of supply chain metrics and performance measurement

- [No information for Morocco]

Relevant LPI score for Morocco: 2.58 out of 5 on the "Ease of arranging competitively priced international shipments" component and 2.88 out of 5 on the "Timeliness" component (i.e., frequency with which shipments reach consignees within the scheduled/expected delivery time)[1220]

GAP ANALYSIS: CUSTOMS PRACTICES

Requirement: 24/7 or close to 24/7 opening hours of customs services and border posts

- no 24-hour opening times of border posts

[1218] CETMO 2010, 21
[1219] CETMO 2010, 20
[1220] Arvis et al. 2018, 47

Requirement: Availability of electronic data interchange for customs to eliminate the need for duplicate data entries, increase transaction speed, and reduce costs and error rates[1221]

- limited use of EDI, leading to inefficient information and document processing

Requirement: Streamlined and predictable border clearance procedures

- burdensome border administration with high clearance times and significant downside risks (a few shipments are held up for long stretches), leading to need for high buffer stocks of up to one week of finished products[1222]

Requirement: Adoption of risk management procedures to concentrate control efforts on high-risk shipments[1223]

- insufficient adoption of risk-management procedures, as evidenced by, e.g., compulsory scanning of 100 % of merchandise leaving from Tanger-Med; insufficient application of risk management techniques to identify high-risk shipments; and wait times of between two and 24 hours

Relevant LPI score for Morocco: 2.33 out of 5 on the "Efficiency of customs and border management clearance" component[1224]

GAP ANALYSIS: REGULATORY ENVIRONMENT

Requirement: Legislation covering all aspects of logistics

- lack of regulations adapted to logistics zones; current law does not distinguish between industrial and logistics zones, which puts logis-

[1221] cf. Rushton et al. 2017, 751
[1222] World Bank and Ministère de l'Equipement et du Transport du Maroc 2006, 17-18
[1223] cf. World Trade Organization 2014, 8
[1224] Arvis et al. 2018, 47

tics zones at a disadvantage as they face the same costs as industrial zones but use fewer resources and do not have a comparable tax base

Requirement: Subsidy schemes, relevant to LSPs, designed to minimize market distortions, if introduced at all

- malfunctioning truck scrappage scheme, with scrappage premiums lower than truck resale values, thus keeping high-emission and dangerous trucks on the road
- ineffective scheme to ease access to loans for small transport operators to purchase equipment as paperwork is too cumbersome

Requirement: Few or no illegal logistics providers

- high number of illegal logistics operators (i.e., without proper invoicing or registration; estimated at 30–45 % of all operators)[1225] and subsequent inability to scale up as those firms are unable to obtain credit

GAP ANALYSIS: EDUCATION, SKILLS, AND PROFESSIONAL TRAINING

Requirement: Adequate supply of trained logistics specialists to meet demand surges

- lack of logistics specialists, in particular forklift operators, truck drivers, material planners, order pickers, and team leaders

Requirement: Availability of structured training, with on-the-job training widespread and regarded by companies as value-enhancing

- few structured training programs available; none at the company level; most are in tertiary education

[1225] Ministère de l'Economie et des Finances du Maroc 2013, 11

Requirement: Adequate staffing of road transport as intra-country transportation relies mostly on road transport

- [No information for Morocco]

Requirement: High level of logistics knowledge at company level

- insufficient level of logistics knowledge at company level

Relevant LPI score for Morocco: 2.49 out of 5 on the Logistics quality and competence component[1226]

10.6.6 Level 6: Logistics measures—Answer to main research question with application to automotive goods and Morocco

Based on the preceding gap analysis, the following country- and product-category-specific measures are suggested for Morocco to meet the logistics requirements of automotive goods and foster exports in that product category. Measures were formulated by analyzing the gaps identified in Appendix 10.6.5 and selecting those that a national government (rather than the private sector) would be best placed to address. This meant excluding those that rely purely on inter-company organization and including some measures that have the characteristics of a public good for other product categories, i.e., non-excludability and non-rivalry, e.g., improving border clearance procedures. The level includes measures that a government can take with the collaboration of the private sector.

Measures related to costs are included in two ways: (1) explicitly (as an entry in the "Ecosystem" functional category), and (2) implicitly, through entries in all seven functional categories that cover how policymakers can contribute to lowering logistics costs by improving the reliability and flexibility of the logistics environment (see section 4.3.2 for details). See section 4.3.3 for a description of the origin of the data for this level. This section forms the answer to the main research question,

[1226] Arvis et al. 2018, 47

with application to automotive goods and Morocco: Which country-specific logistics measures should the government of Morocco take to foster automotive exports?

MEASURES: TRANSPORT- AND TRADE-RELATED INFRASTRUCTURE

Requirement: Facilitation of intermodal transport to handle high container volumes (for parts and components) as well as roll-on/roll-off traffic (for shipping finished cars)

- Develop logistics zones, i.e., zones providing warehouses, customs, truck centers, value added services such as packaging and labeling, and container-loading facilities.
- Develop infrastructure for line-haul transport (e.g., urban truck terminals).[1227]
- Ensure more private sector participation in the set-up of logistics zones.
- Ensure road and rail links for logistics zones.
- For locations where full-blown logistics zones are not warranted, but container loading facilities are needed, construct ICDs for transshipment, i.e., multimodal logistics platforms for the (un)loading of containers and linkage for trucks and trailers.
- Add dry port and/or storage facilities close to Tanger-Med port.[1228]

[1227] cf. World Bank 2010, 45

[1228] For guidelines how to select dry port locations, see Nguyen and Notteboom (2016, 26)

Requirement: Large road network in good condition, at least between major production sites and export gateways

- Build direct links between logistics zones and the main road network.
- Build road links (also maritime and air) to other emerging markets, e.g., Nigeria and Senegal.

Requirement: Rail network in good condition, at least between major production sites and export gateways

- Increase the number of rail links of logistics zones.

Requirement: Availability of reliable air transport for goods with high value density

- Invest in airport facilities and upgrade air cargo facilities, including warehouses at airports and pallet scanners, to facilitate the examination of air freight.[1229]
- If pure air transport is too expensive: foster sea-air-bridges, i.e., maritime transport for the first part of a trip, then transloading of products at an air hub for air transport to the final destination. Alternative: air-sea bridges.

Requirement: Availability of loading equipment tailored to goods that can be used across firms in the supply chain

- Provide tax incentives to purchase special loading equipment and a support mechanism for sharing equipment, e.g., via digital logistics platforms.

[1229] cf. Banomyong et al. 2008, 366

Cross-cutting requirement: Ensure environmental sustainability in logistics

- Support sustainable transport and sustainable fleet management: Consider the GHG emissions and fuel consumption of different transport modes.[1230]
- Incentivize increasing the carrying capacity of trucks by using longer and/or higher vehicles (bridge and tunnel height clearances permitting).[1231]
- Encourage upgrading or retrofitting of older trucks and planes to facilitate the adoption of energy-saving technology.[1232]
- Incentivize or mandate lower caps on sulfur content (SO_x) in marine (bunker) fuel (lower than those mandated by the International Maritime Organization) to decrease SO_x emissions.[1233]
- Encourage use of port equipment with cleaner technology, e.g., gantry cranes with hybrid/alternative fuels (i.e., bioenergy or electric powered).[1234]
- Offer preferential treatment to shipping companies with environmentally friendly ship designs, e.g., improved engine designs, waste heat recovery, double skin construction, or internal oil tanks.[1235]
- Enable the switch to new energy sources such as wind and biofuels.[1236]

[1230] cf. Tsolakis et al. 2015, 13
[1231] cf. McKinnon et al. 2015, 166
[1232] cf. McKinnon 2014, 7
[1233] cf. McKinnon et al. 2015, 186
[1234] cf. Roh et al. 2016, 111
[1235] cf. Roh et al. 2016, 111
[1236] cf. Vorst and Snels 2014, 8

MEASURES: INFORMATION & COMMUNICATIONS TECHNOLOGY

Requirement: Integration of IT tools between suppliers and customers, including for automation of cross-company information exchange, e.g., advance shipment notices[1237]

- Provide IT infrastructure to enable companies to offer advance shipment notices.

Requirement: Availability of digital government services for import and export

- Introduce online options for government services, including e-signatures for government approvals.[1238]

Requirement: Availability of data tools to support an uninterrupted supply chain across transport modes

- Enable increased collaboration of supply chain partners via digital logistics platforms by strengthening broadband internet infrastructure necessary for online coordination.
- Introduce predictions of estimated time of arrival for the entire transport chain, potentially using AI and machine learning, taking into account infrastructure, resources, order characteristics, and weather.[1239]

Requirement: Availability of tracking and tracing technology

- Permit new technologies relating to tracking and security;[1240] ideally, real-time tracking.[1241]

[1237] cf. Göpfert and Braun 2017, 28
[1238] cf. World Bank 2010, 44
[1239] cf. Poschmann et al. 2019, 162
[1240] cf. World Bank 2010, 43
[1241] cf. Kiwitt and Frankenberg, 2012, 160

Cross-cutting requirement: Ensure environmental sustainability in logistics

- Provide incentives or mandates for companies to integrate environmental sustainability criteria into e-procurement tools.[1242]

MEASURES: ORGANIZATION OF THE LOGISTICS ENVIRONMENT ("ECOSYSTEM")

Requirement: 24/7 or close to 24/7 opening of trade-enabling services, e.g., ports and airports

- Open ports (at least Casablanca and Tanger-Med) and airports 24/7. If this is not warranted by traffic, ensure that opening times are reliable.

Requirement: Healthy competition in all transport modes and in logistics, including competitive freight handling, trucking, shipping, and warehousing services[1243]

- Ensure that state-owned enterprises in transport and logistics enjoy no advantages vis-à-vis private operators, especially regarding taxes, access to finance, and access to real estate.

Requirement: Reliable management of ports, airports, and rail transport[1244]

- Introduce commercial management in port and airport (and potentially rail) operations.[1245]
- Raise private sector participation in building and maintaining public infrastructure.[1246]
- Improve performance of rail transport service providers.

[1242] cf. Straube et al. 2011, 46
[1243] cf. World Bank 2012, 14
[1244] cf. World Bank 2010, 45
[1245] cf. World Bank 2010, 45
[1246] cf. World Bank 2010, 45

Requirement: Tight coordination of government entities involved in fostering the logistics environment

- Improve coordination of government efforts. This includes better coordination between the relevant ministries of investment-promoting programs, especially between the Ministry of Transport, Equipment and Logistics and the Ministry of Industry, Commerce, Investment and Digital Economy.
- Improve coordination of the development of logistics zones by reducing overlap in the development of multimodal logistics zones fostered by the state. Currently, two parastatal actors develop zones at the same time (ONCF, the public rail operator, and SNTL, a parastatal logistics company); a single developer might be more economical.

Requirement: Logistics costs on par with international standards (ca. 10–17 % of GDP) or, ideally, lower[1247]

- Work towards a reduction of logistics costs from the 2019 level of 20 % of GDP by fostering healthy competition in all transport modes, lowering transaction costs of transit (customs and handling charges), and increasing reliability and predictability in the logistics environment.

Cross-cutting requirement: Ensure environmental sustainability in logistics

- Mandate reverse logistics, i.e., recycle, reduce, and reuse materials.[1248]
- Provide incentives or mandates for companies to introduce a supplier audit method with enhanced environmental sustainability criteria.[1249]

[1247] cf. Memedovic et al. 2005, 358
[1248] cf. Bourlakis and Bourlakis 2004, 226
[1249] cf. Straube et al. 2011, 46

MEASURES: BUSINESS PRACTICES FOR HIGH-QUALITY LOGISTICS SERVICES

Requirement: Business practices in place to mitigate supply chain volatility

- Create incentives for customers to share stock levels to increase forecasting accuracy; concentrate on outliers and identify reasons.[1250]
- Incentivize the use of additive manufacturing to produce spare parts to reduce lead time and cost of safety inventory.[1251]

Requirement: Adoption of international standards by logistics operators

- Initiate standard performance contracts for transport and logistics services.[1252]
- Create incentives to upgrade transport fleets to long-haul trucking fleets.[1253]
- Incentivize the implementation of warehouse management systems to enable just-in-time and just-in-sequence delivery through the automatic transmission of predicted truck arrival times, automatic selection and preparation of docking slots, automatic assignment of storage space, real-time visibility of inventory, and track-and-trace functionality for the entire supply chain.[1254]
- Incentivize the implementation of transport management systems (e.g., using GPS systems) to consolidate shipments, control freight costs, and integrate with technologies such as warehouse management systems by monitoring freight movements and vehicles.[1255]

[1250] cf. Nitsche 2018, 19
[1251] cf. Liu et al. 2014, 1169
[1252] cf. World Bank 2010, 43
[1253] cf. World Bank 2010, 43
[1254] cf. Barreto et al. 2017, 1249
[1255] cf. Barreto et al. 2017, 1249

- Incentivize the use of wearable augmented reality devices (e.g., smartglasses) to increase the efficiency and precision of loading, unloading, and handling goods and inventory.[1256]

Requirement: Use of supply chain metrics and performance measurement

- Encourage the introduction of modern SCM techniques.[1257]
- Incentivize the use of predictive analytics to foresee variations in input availability and customer demand.[1258]

Cross-cutting requirement: Ensure environmental sustainability in logistics

- Incentivize a reduction of air freight use (towards less carbon-intensive modes) by improved business process planning.[1259]
- Pollution control: Incentivize logistics operators to limit energy consumption and the use of harmful substances, and to limit and treat wastewater, solid waste, and hazardous emissions (e.g., SO_2, NH_3, CO2, and HC_1).[1260]
- Incentivize a reduction of shipping weights, e.g., by packaging management.[1261]
- Incentivize the reduction of CO_2 emissions from vehicles by increasing load factors, improving vehicle efficiency, utilizing lower carbon fuels,[1262] implementing preventive maintenance,[1263] and monitoring tire pressure.[1264]

[1256] cf. Viswanadham 2015, 97
[1257] cf. World Bank 2010, 43
[1258] cf. Ivanov et al. 2019, 40
[1259] cf. McKinnon 2014, 5
[1260] cf. Lee et al. 2009, 7924
[1261] cf. Asian Development Bank and Gesellschaft für Internationale Zusammenarbeit 2014, 22
[1262] cf. Asian Development Bank and Gesellschaft für Internationale Zusammenarbeit 2014, 22
[1263] cf. Rushton et al. 2017, 796
[1264] cf. Clean Air Asia 2017, 27

- Offer driver training to encourage fuel-efficient driving.[1265]
- Ensure that incentive application procedures are easily understandable and accessible to small companies to account for the high share of owner-operated trucking companies.
- Incentivize coordination of equipment, e.g., optimized unloading procedures and controllable machinery use, to save energy.[1266]
- Incentivize switching to machines that use less water.
- Mandate the use of environmental impact assessment tools, e.g., life cycle assessment analysis to assess the impacts of operations associated with all stages of a product's life,[1267] environmental impact assessment, environmental accounting,[1268] or carbon footprint checks at the product level.[1269]
- Encourage the adoption of 3D printing techniques to reduce waste of unneeded finished products.[1270]

MEASURES: CUSTOMS PRACTICES

Requirement: 24/7 or close to 24/7 opening hours of customs services and border posts

- Ensure 24/7 (or close to 24/7) opening times of border control entities. If that is not warranted by border traffic, ensure that opening times are reliable.

Requirement: Availability of electronic data interchange for customs to eliminate the need for duplicate data entries, increase transaction speed, and reduce costs and error rates[1271]

[1265] cf. Clean Air Asia 2017, 27
[1266] cf. Tsolakis et al. 2015, 13
[1267] cf. Vorst and Snels 2014, 10
[1268] cf. Mintcheva 2005, 719
[1269] cf. Straube et al. 2011, 45
[1270] cf. Ivanov et al. 2019, 39
[1271] cf. Rushton et al. 2017, 751

- Accept scanned copies for supporting documents and accept e-signatures.[1272]
- Introduce blockchain technology for archiving customs documents to prevent unauthorized modifications, expedite the flow of information, and improve confidence in customs documentation.[1273]

Requirement: Streamlined and predictable border clearance procedures

- Reform and automate customs procedures.[1274]
- Provide a single point of entry for information used in the clearance of cargo (complete PortNet application).[1275]
- Implement new import–export zones (customs zones). This entails the introduction of additional customs zones ("aires de dédouanement") outside the port, so that exporters and importers can complete customs and other formalities closer to their places of business. Eventually, dry ports should replace these zones.

Requirement: Adoption of risk management procedures to concentrate control efforts on high-risk shipments[1276]

- Use risk management programs to speed up clearance, including reduced inspections (to remove the need to scan 100 % of merchandise leaving Tanger-Med port) and the introduction of an Authorized Economic Operator program.

[1272] cf. World Bank 2010, 44
[1273] cf. Ivanov et al. 2019, 500
[1274] cf. World Bank 2010, 44
[1275] cf. World Bank 2010, 44
[1276] cf. World Trade Organization 2014, 8

Cross-cutting requirement: Ensure environmental sustainability in logistics

- Direct trucks into different lanes depending on risk to reduce waiting times and thus emissions.

MEASURES: REGULATORY ENVIRONMENT

Requirement: Legislation covering all aspects of logistics

- Introduce comprehensive logistics legislation, including rules on logistics zones.[1277]
- Review import/export restrictions.
- Allow mergers and acquisitions of logistics providers.[1278]
- Deregulate air freight services and introduce fifth freedom or other bilateral freedoms in air transport.[1279]
- Plan and manage multi-modal and multi-country freight corridors by coordinating planning among agencies regulating transport and border management.[1280]

Requirement: Subsidy schemes, relevant to LSPs, designed to minimize market distortions, if introduced at all

- Fix the truck scrappage scheme (raise scrappage premiums so they are higher than truck resale value or end the program).
- Fix the scheme for easing access to loans for small transport operators to purchase equipment by simplifying the paperwork.

[1277] In preparation in Morocco as of October 2018. The draft law has been submitted to parliament for adoption.

[1278] cf. World Bank 2010, 43

[1279] Fifth freedom refers to "the right or privilege, in respect of scheduled international air services, granted by one State to another State to put down and to take on, in the territory of the first State, traffic coming from or destined to a third State" (source, also for other freedoms of the air: https://www.icao.int/Pages/freedomsAir.aspx, accessed on June 19, 2020)

[1280] cf. Pham et al. 2013a, 101

Requirement: Few or no illegal logistics providers

- Reduce the number of illegal logistics operators by favoring official operators:
- Reduce fees and taxes, so as to incentivize operators to properly register.
- Increase controls on illegal activities such as unofficial warehousing in city centers.
- Lighten the administrative burden for logistics operators.
- Improve export facilitation.
- Increase accountability of, and controls on, illegal operators.

Cross-cutting requirement: Ensure environmental sustainability in logistics

- Introduce targets to reduce energy consumption overall.
- Introduce air, water, and soil pollution limits.[1281]
- Introduce a truck scrappage scheme to remove older, less fuel-efficient trucks.[1282]

MEASURES: EDUCATION, SKILLS, AND PROFESSIONAL TRAINING

Requirement: Adequate supply of trained logistics specialists to meet demand surges

- Improve vocational education and formal job training and upgrade skills in logistics professions; increase the number of, e.g., trained freight forwarders, forklift operators, truck drivers, material planners, order pickers, and team leaders.

[1281] cf. Straube et al. 2011, 45
[1282] cf. McKinnon 2015b, 390

Requirement: Availability of structured training, with on-the-job training widespread and regarded by companies as value-enhancing

- Encourage on-the-job training.
- Ensure that training is available not only at tertiary level, but also as vocational and on-the-job training, with logistics providers and shippers providing some of the training rather than just universities.[1283]

Requirement: Adequate staffing of road transport as intra-country transportation relies mostly on road transport

- Offer basic driver training (potentially as part of a scheme to reduce youth unemployment) to prevent driver shortages.

Requirement: High level of logistics knowledge at company level

- Introduce professional standards and certifications for LSPs.[1284]

Cross-cutting requirement: Ensure environmental sustainability in logistics

- Support research regarding the development of green packaging.
- Offer training on fuel-efficient truck driving practices.

[1283] cf. McKinnon et al. 2017, 61
[1284] cf. World Bank 2010, 43

10.7 Application of decision framework to perishable agricultural goods and Kyrgyzstan

10.7.1 Level 1: Target set-up of logistics environment

The target set-up describes the ideal state of a well-functioning logistics environment. See section 4.3.3 for an explanation of the framework's levels. Owing to their importance for modern logistics for high value-added products, the target set-up focuses on the same three characteristics (flexibility, reliability, and cost) for all product categories covered in the framework applications, though with partly different specifications.

Target set-up for product category perishable agricultural goods:[1285]

- High degree of flexibility in the logistics environment to balance fluctuations in supply (e.g., stemming from seasonality/weather fluctuations) and in demand (e.g., increased consumption around major holidays). Flexibility here refers to the capability to change based on a set of defined contingency scenarios.[1286]
- High degree of reliability to ensure high food quality: delays of even a few hours or days can be detrimental to perishable goods such as fruit and vegetables. Reliability here relates to the degree of uncertainty in the lead time, where lead time refers to the time it takes for goods to arrive at the purchaser after the order has been placed.[1287]
- Low level of logistics costs, on par with international standards (ca. 10–17 % of GDP, viewed across all sectors) or, ideally, lower.[1288]

10.7.2 Level 2: Logistics concepts

This section links logistics concepts prevalent in the perishable agricultural goods category to the target set-up of the logistics environment.[1289]

[1285] A previous version of this section was included as an early publication of parts of the dissertation's results in Wiederer and Straube 2019.
[1286] cf. OECD 2013, 50
[1287] cf. Hausman et al. 2013, 241
[1288] cf. Memedovic et al. 2005, 358

The following concepts are business practices (i.e., they come into play at the intra-company level), but they need an enabling environment made up of components from all seven functional categories:

- shelf-life constraints and perishability of products[1290] (need for uninterrupted cold chain) and changes in product quality along the supply chain[1291] (→ reliability);
- trade-off between responsiveness and efficiency of the logistics environment:[1292] for produce, right after picking, the supply chain must be mainly responsive (to minimize the time it takes to get produce cooled and avoid the product losing value). Post-cooling, produce's quality declines more slowly and the focus should shift to (cost) efficiency of the supply chain.[1293] (→ reliability, flexibility, and cost);
- traceability of inputs and final products (→ reliability);
- ability to handle large volumes of exported products, chiefly by road, in bulk, break-bulk or containers[1294] (→ reliability and flexibility);
- seasonality in production, long production times (growing crops), variability of quality and quantity of supply[1295] (→ flexibility);
- dynamic inventory management (to track the quality of products)[1296] (→ flexibility);
- dynamic control of goods flow to optimize market fulfillment, e.g., redirecting products to markets with lower quality requirements[1297] (→ flexibility);

[1289] In the list below, the arrows behind each concept point to the relevant target set-up component(s).
[1290] cf. Tsolakis et al. 2015, 5
[1291] cf. Vorst et al. 2007, 17
[1292] cf. Ivanov et al. 2019
[1293] cf. Blackburn and Scudder 2009, 132
[1294] cf. Pham et al. 2013a, 42
[1295] cf. Vorst et al. 2007, 17
[1296] cf. Vorst and Snels 2014, 11
[1297] cf. Vorst and Snels 2014, 11

- cross-docking to consolidate, sort, and distribute shipments in regional hub operations in agricultural production clusters (→ flexibility);
- collaboration of logistics partners: sharing of distribution networks, infrastructure, vehicles (→ flexibility and cost);
- storage buffer capacity restricted owing to shelf-life constraints[1298] (→ flexibility).

10.7.3 Level 3: Trends

This section includes product-category-specific trends. It explores which trends with relevance to perishable agricultural goods may impact logistics in the next decade (until approximately 2030).

Product-category-specific trends:

- Increased demand for transparency, traceability and complete information: Consumers demand to know the origin of produce as well as the conditions of its production, transport, storage, and processing.[1299]
- Desire to cut food waste: Roughly one third of food produced for human consumption is lost globally per year.[1300] Consumers are increasingly aware of this loss and demand decreases of food waste along the logistics chain.[1301]
- Increased demand for convenience food, e.g., pre-cut fruit and vegetables, and prepared salads[1302]

Non-product-category-specific trend:

- Higher demand and higher requirements for environmental sustainability in logistics:[1303] Measures to address environmental sustainabil-

[1298] cf. Vorst et al. 2007, 17
[1299] cf. Straube (Ed.) 2016, 14, also cf. Tsolakis et al. 2015, 14
[1300] Jedermann et al. 2014, 3
[1301] cf. Straube (Ed.) 2016, 22
[1302] cf. Straube (Ed.) 2016, 19

ity in logistics operations are included throughout the functional categories of measures.

10.7.4 Level 4: Logistics requirements—Answer to research sub-question 1 with application to higher-value perishable agricultural goods

This section lays out the requirements of the logistics environment for perishable agricultural goods that can be (partly) addressed by government action.[1304] Requirements are product-category-specific (not country-specific). They are grouped in two ways:

1. by functional category (infrastructure, ICT, ecosystem, business practices, customs, regulatory environment, or training);
2. by the target set-up characteristics flexibility and reliability. Requirements related to costs (the third target set-up characteristic) are included in two ways: (1) explicitly (as an entry in the "Ecosystem" functional category), and (2) implicitly, through entries in all seven functional categories that cover how policymakers can contribute to lowering logistics costs by improving the reliability and flexibility of the logistics environment (see section 4.3.2 for details).

See section 4.3.3 for a description of the origin of the data for this level. This section forms the answer to research sub-question 1, with application to perishable agricultural goods: What are the logistics requirements of higher-value perishable agricultural goods?

[1303] cf. Göpfert et al. 2017, 12

[1304] A previous version of this section was included as an early publication of parts of the dissertation's results in Wiederer and Straube 2019.

REQUIREMENTS: TRANSPORT- AND TRADE-RELATED INFRASTRUCTURE

Flexibility:

- availability of inland clearance facilities to allow customs clearance at regional production hubs rather than at the border
- facilitation of intermodal transport

Reliability:

- maintaining the cold chain, i.e., ensuring the availability of temperature-controlled storage and transport (e.g., in reefer containers and refrigerated trucks and railroad cars), including pre-cooling right after picking produce to maximize post-harvest life.[1305] The cold chain must also be maintained in locations beyond the shippers' and receivers' control, e.g., at customs clearance in seaports and airports.
- availability of refrigerated storage facilities, such as distribution or processing centers, close to rural production zones; facilitate cooperatives for sharing refrigerated facilities[1306]
- existence of a large road network in good condition, at least between major production sites and export gateways, and especially if production sites are not located close to processing centers
- existence of a rail network in good condition, at least between major production sites, processing centers, and export gateways
- availability of reliable air transport for goods with high value density

[1305] cf. Blackburn and Scudder 2009, 132
[1306] cf. World Bank 2012, 49

REQUIREMENTS: INFORMATION & COMMUNICATIONS TECHNOLOGY

Flexibility:

- integration of IT tools between suppliers and customers, including for automation of cross-company information exchange, e.g., advance shipment notices[1307]
- availability of digital government services for import and export

Reliability:

- availability of technology to support an uninterrupted cold chain
- availability of tracking and tracing technology

REQUIREMENTS: ORGANIZATION OF THE LOGISTICS ENVIRONMENT ("ECOSYSTEM")

Flexibility:

- 24/7 or close to 24/7 opening of trade-enabling services, e.g., airports
- collaboration of supply chain partners: sharing of distribution networks, infrastructure, and vehicles
- use of public–private partnerships to address limited provision of public goods and low private sector investment[1308]
- healthy competition on all transport modes and in logistics services, including competitive freight handling, trucking, shipping, and warehousing services[1309]

Reliability:

- reliable management of ports, airports, and rail transport[1310]

[1307] cf. Göpfert and Braun 2017, 28
[1308] cf. World Bank 2016, 10
[1309] cf. World Bank 2012, 14
[1310] cf. World Bank 2010, 45

- availability of regional logistics hubs serving agricultural production hubs
- tight coordination of government entities involved in fostering the logistics environment
- logistics costs on par with international standards (ca. 10–17 % of GDP) or, ideally, lower[1311]

REQUIREMENTS: BUSINESS PRACTICES FOR HIGH-QUALITY LOGISTICS SERVICES

Flexibility:

- business practices in place to mitigate supply chain volatility, i.e., fluctuations of material flows that lead to discrepancies between supply and demand at the firm level[1312]
- adoption of international standards by logistics operators
- adoption of practices to manage variability in the availability and quality of produce, chiefly the FEFO principle: first-expired-first-out

Reliability:

- adequate quality management systems and practices in place, including traceability of all inputs and final products as well as maintaining sanitary practices from source to shelf
- availability of specialized handling and packaging[1313]
- post-harvest treatment of produce to extend shelf life[1314]
- use of supply chain metrics and performance measurement

[1311] cf. Memedovic et al. 2005, 358
[1312] cf. Nitsche and Durach 2018, 868
[1313] cf. Jedermann et al. 2014, 2
[1314] cf. Jedermann et al. 2014, 2

REQUIREMENTS: CUSTOMS PRACTICES

Flexibility:

- 24/7 or close to 24/7 opening hours of customs services and border posts
- availability of electronic data interchange for customs to eliminate the need for duplicate data entries, increase transaction speed, and reduce costs and error rates[1315]

Reliability:

- availability of risk management practices to minimize inspection rates[1316]
- streamlined and predictable border clearance procedures
- efficient inter-agency coordination in case there are multiple border protection agencies

REQUIREMENTS: REGULATORY ENVIRONMENT

Flexibility:

- easy and automated processes for standards certification and for (phyto-)sanitary measures, characterized by (1) low laboratory costs, (2) short wait times to receive laboratory results, (3) low incidence of re-inspection of exports at port of entry, and (4) reliable laboratory results to avoid rejection of products at port of entry[1317]
- legislation covering all aspects of logistics

Reliability:

- few or no illegal logistics providers

[1315] cf. Rushton et al. 2017, 751
[1316] cf. World Trade Organization 2014, 8
[1317] cf. World Bank 2012, 13

- well-designed and consistently implemented transport regulation, including the use of truck weigh stations[1318]

REQUIREMENTS: EDUCATION, SKILLS, AND PROFESSIONAL TRAINING

Flexibility:

- adequate supply of trained logistics specialists to meet demand surges
- availability of structured training, with on-the-job training widespread and viewed by companies as value-enhancing

Reliability:

- adequate staffing of road transport, as intra-country transportation relies mostly on this mode
- high level of food logistics knowledge at company level

10.7.5 Level 5: Gap analysis—Answer to research sub-question 2 with application to perishable agricultural goods and Kyrgyzstan

The gap analysis is product category- and country-specific: It juxtaposes the logistics requirements from Appendix 10.7.4 with the current state of agri-logistics in Kyrgyzstan and identifies which logistics constraints are prevalent in the country for higher-value agricultural goods.[1319] All entries refer to gaps that can (partially) be addressed by government action. Exemption: entries under "Business practices" include those with limited scope for government action. Gaps are grouped by functional category (infrastructure, ICT, ecosystem, business practices, customs, regulatory environment, or training).

[1318] cf. World Bank 2012, 29

[1319] A previous version of this section was included as an early publication of parts of the dissertation's results in Wiederer and Straube 2019.

Data for this level originate in the following sources: (1) interviews carried out in Kyrgyzstan, (2) official country statistics, and (3) public databases and reports. Unless otherwise noted, information in this section is based on interviews with logistics stakeholders by the author in Bishkek and Osh (Kyrgyzstan) in April 2016. This section forms the answer to research sub-question 2, with application to Kyrgyzstan and perishable agricultural goods: Which country-specific constraints are prevalent in Kyrgyzstan in the logistics environment for higher-value perishable agricultural goods?

GAP ANALYSIS: TRANSPORT- AND TRADE-RELATED INFRASTRUCTURE

Requirement: Availability of inland clearance facilities and dry ports to allow customs clearance at regional production hubs rather than at the border

- no inland clearance facilities or dry ports available; all clearance is done at one of the 20 land border posts (located at the borders with Kazakhstan, China, Tajikistan, and Uzbekistan) and one at each of the airports in Bishkek and Osh.

Requirement: Facilitation of intermodal transport

- underdevelopment of intermodal transport. Road transport accounts for over half of cargo transported in Kyrgyzstan and, by some estimates, for 97 % of all cargo transported.[1320]
- The only intermodal transport taking place is from rail to truck for goods arriving from China and Korea via rail; these are transshipped via trucks from the border crossing near Urumqi (China). This is mainly due to the short rail network (420 km), with the only railway running from Kyrgyzstan to Kazakhstan.

[1320] Number referring to more than half of cargo: Asian Development Bank 2013a, 1; number referring to 97 % of all cargo: Interview with Freight Operators Association of Kyrgyzstan, Bishkek, April 11, 2016

- No direct access to maritime transport owing to being landlocked. The nearest ports are Novorossiysk, Russia (4,200 km from Bishkek; requires transit through Kazakhstan) and ports in Pakistan (about 3,200 km from Bishkek, requiring difficult passages through Uzbekistan and Afghanistan). Access exists to Aktau, Kazakhstan (2,700 km from Bishkek), but this provides access only to an inland sea (Caspian Sea).
- no navigable rivers; no canals. There are no inland waterways except for water transport on Issyk-Kul lake (low volume).
- lack of transshipment facilities (dry ports/inland terminals). There are only two transshipment points in Kyrgyzstan: one at the railroad station in Chuy valley and one in Issyk-Kul.
- lack of logistics zones; e.g., no zone at the Kyrgyz-Chinese border in Kashgar

Requirement: Maintaining the cold chain

- In 2016, the number of refrigerated trucks was estimated at 1,500 to 2,000 by the Kyrgyz Ministry of Transportation and Communications, a number that does not meet needs.
- insufficient availability of temperature-controlled storage

Requirement: Availability of refrigerated storage facilities. Either locate distribution or processing centers close to rural production zones or facilitate cooperatives for sharing refrigerated facilities.[1321]

- Too few refrigerated storage facilities or distribution and processing centers are available close to rural production zones.

[1321] cf. World Bank 2012, 49

Requirement: Large road network in good condition, at least between major production sites and export gateways, and especially if production sites are not located close to processing centers

- Comparatively low road density (km of road per 100 km^2 of land area): 17.0 in Kyrgyzstan in 2011 vs. 191.6 in France and 180.3 in Germany;[1322] volume of road freight in 2011 was 1.28 million tons.[1323]
- Transport times are longer than necessary, mostly owing to the poor condition of road the network (33 % of national and international roads are in need of repair).[1324]
- Portions of the road from Tyup (Kyrgyzstan) to Kegen (Kazakhstan) are closed for several months each winter owing to snow and poor road conditions.

Requirement: Rail network in good condition, at least between major production sites, processing centers, and export gateways

- low rail network density. Technical standards and track gauges are compatible with rail systems in the Russian Federation, Kazakhstan and Uzbekistan, but not with that in China.

Requirement: Availability of reliable air transport for goods with high value density

- Only five international carriers serve Manas airport (Bishkek): Turkish Airlines, Pegasus, Aeroflot, Air Astana, and China Southern Airlines.
- For security reasons, all Kyrgyz airlines are banned from flying within the EU.[1325]

[1322] International Road Federation Geneva, World Road Statistics, accessed via World Bank, World Development Indicators (WDI) on Feb. 13, 2015 (not included in subsequent WDI updates; 2011 data are the latest available)
[1323] World Bank 2013, 24
[1324] Asian Development Bank 2013a, 1

- low share of goods transported by air: less than 0.3 % (by weight) of cargo is shipped by air.

Relevant LPI score for Kyrgyzstan: 2.38 out of 5 for the "Quality of trade- and transport-related infrastructure" component[1326]

GAP ANALYSIS: INFORMATION & COMMUNICATIONS TECHNOLOGY

Requirement: Integration of IT tools between suppliers and customers, including for automation of cross-company information exchange, e.g., advance shipment notices[1327]

- [No information for Kyrgyzstan]

Requirement: Availability of digital government services for import and export

- limited availability of digital government services[1328]
- challenges for users of digital government services: Internet bandwidth per capita is low (21.3 Kbps in 2018 in Kyrgyzstan vs. over 100 Kbps in OECD countries); wholesale international bandwidth costs are high (US$22 per Mbps per month in Kyrgyzstan vs. US$1 per Mbps per month in Europe and the US); and fixed broadband penetration is low (9.1 % of the Kyrgyz population).[1329]

Requirement: Availability of technology to support an uninterrupted cold chain

- little technology available

[1325] https://ec.europa.eu/transport/modes/air/safety/air-ban/search_en, accessed on Feb. 26, 2021
[1326] Arvis et al. 2018, 47
[1327] cf. Göpfert and Braun 2017, 28
[1328] National Council for Sustainable Development of Kyrgyzstan 2018, 3
[1329] World Bank Group et al. 2018, 58. "Kbps" stands for "kilobits per second"; "Mbps" stands for "megabits per second".

Requirement: Availability of tracking and tracing technology

- underuse of tracking and tracing technology and modest performance: relevant LPI score for Kyrgyzstan: 2.64 out of 5 for the "Ability to track and trace consignments" component[1330]

GAP ANALYSIS: ORGANIZATION OF THE LOGISTICS ENVIRONMENT ("ECOSYSTEM")

Requirement: 24/7 or close to 24/7 opening of trade-enabling services, e.g., airports

- air transport: no 24-hour opening of Manas airport in Bishkek, the country's main airport
- no seaports available

Requirement: Collaboration of supply chain partners: sharing of distribution networks, infrastructure, and vehicles

- [No information for Kyrgyzstan]

Requirement: Use of PPPs to address limited provision of public goods and low private sector investment

- low degree of public–private cooperation in logistics. A Kyrgyz-Korean joint venture is one of the few PPPs that is planned in the country.

Requirement: Healthy competition on all transport modes and in logistics, including competitive freight handling, trucking, shipping, and warehousing services

- weak or no competition in all available transport modes (road, rail, and air) and among LSPs due to the low number of operators due to small country and market size

[1330] Arvis et al. 2018, 47

- unfair competition from Kazakh transporters: Kazakh trucks are reported to pick up goods in Kyrgyzstan and undercut Kyrgyz freight rates by loading three to five tons more than allowed, which leads to a cost advantage of US$200 to US$300 per truck (linked to the problem of unequal weighing standards enforcement, see further below).
- Unequal treatment of rail transport users: Despite Kyrgyzstan's accession to the EAEU, Russian and Kazakh railroads continue to apply foreign freight rates to Kyrgyz shippers, even though under EAEU rules they are required to bill lower, internal rates.

Requirement: Reliable management of ports, airports, and rail transport[1331]

- [No information for Kyrgyzstan]

Requirement: Availability of regional logistics hubs serving agricultural production hubs

- [No information for Kyrgyzstan]

Requirement: Tight coordination of government entities involved in fostering the logistics environment

- In August 2015, a freight strategy developed by an inter-agency task group comprising the Ministries of Agriculture, Transportation & Communications and Economic Development, as well as the Freight Operators Association, was approved but, due to a lack of funds, has not yet been implemented.[1332]

[1331] cf. World Bank 2010, 45

[1332] Email dated July 7, 2020 by Temirbek Shabdanaliev, Chairman of the Freight Operators Association of Kyrgyzstan, to the author, as a follow-up to an interview with him by the author in April 2016

Requirement: Logistics costs on par with international standards (ca. 10–17 % of GDP) or, ideally, lower[1333]

- Logistics costs in Kyrgyzstan are estimated at 20–23 % of GDP.[1334]

GAP ANALYSIS: BUSINESS PRACTICES FOR HIGH-QUALITY LOGISTICS SERVICES

Requirement: Business practices in place to mitigate supply chain volatility

- [No information for Kyrgyzstan]

Requirement: Adoption of international standards by logistics operators

- As of 2016, only two international LSP were present in Kyrgyzstan (DHL Worldwide Express and TNT Express), both of which are express carriers. Other LSPs are represented through local companies (UPS and FedEx, i.e., express carriers, and DB Schenker), and other LSPs have no presence at all.
- High degree of fragmentation among transport operators: as of 2013, only 25 companies owned more than ten trucks.[1335] Most companies in the logistics sector are mere transport operators and many are owner-operated one-truck companies. Many of the latter operate illegally, without proper registration or invoicing. Consolidation in the road freight sector is not expected, but some subcontracting occurs, which leads to greater efficiency in administration and sales.[1336]

Requirement: Adoption of practices to manage variability in availability and quality of produce, chiefly FEFO (first-expired-first-out)

- [No information for Kyrgyzstan]

[1333] cf. Memedovic et al. 2005, 358
[1334] World Bank 2013, 10-11
[1335] World Bank 2013, 24
[1336] World Bank 2013, 24

Requirement: Adequate quality management systems and practices in place, including traceability of all inputs and final products as well as maintaining sanitary practices from source to shelf

- Quality management is inadequate, mostly owing to the insufficient number of temperature-controlled storage facilities and trucks, and due to the low number of food testing laboratories (both public and licensed private ones); traceability of inputs and final products is not guaranteed; and maintaining sanitary practices is hampered by broken cold chains.

Requirement: Availability of specialized handling and packaging[1337]

- [No information for Kyrgyzstan]

Requirement: Post-harvest treatment of produce to extend shelf life[1338]

- [No information for Kyrgyzstan]

Requirement: Use of supply chain metrics and performance measurement

- [No information for Kyrgyzstan]

Relevant LPI score for Kyrgyzstan: 2.22 out of 5 on the "Ease of arranging competitively priced international shipments" component and 2.94 out of 5 on the "Timeliness" component (e.g., frequency with which shipments reach consignees within the scheduled/expected delivery time)[1339]

[1337] cf. Jedermann et al. 2014, 2
[1338] cf. Jedermann et al. 2014, 2
[1339] Arvis et al. 2018, 47

GAP ANALYSIS: CUSTOMS PRACTICES

Requirement: 24/7 or close to 24/7 opening hours of customs services and border posts

- Several customs border posts only operate for eight hours per day, and opening times are not always reliable. Sometimes border posts are open on one side of the border but not on the other, leading to hold-ups.
- Several border posts at higher altitude, including Tyup-Kegen between Kyrgyzstan and Kazakhstan, are susceptible to inclement weather and sometimes close for several months during the winter.

Requirement: Availability of electronic data interchange for customs to eliminate the need for duplicate data entries, increase transaction speed, and reduce costs and error rates[1340]

- Customs declarations must be submitted on paper.
- While progress has been made since Kyrgyzstan's accession to the EAEU, data exchange between Kyrgyzstan and Kazakhstan (one of its main trade and transit partners) still does not work well.
- No electronic declaration system is in place.

Requirement: Availability of risk management practices to minimize inspection rates[1341]

- There is no uniform application of risk management.
- The following technologies to strengthen borders while speeding up clearance are available at some of the Kyrgyz-EAEU outside borders with China, Tajikistan, and Uzbekistan, but may need upgrading: X-ray machines for scanning trucks, portable equipment for chemical identification, radiation control, power generators, satellite antennas, and IT equipment.

[1340] cf. Rushton et al. 2017, 751
[1341] cf. World Trade Organization 2014, 8

Requirement: Streamlined and predictable border clearance procedures

- Corruption at the border, tariffs and non-tariff barriers, and burdensome import procedures were named as the three most problematic factors for exporting from Kyrgyzstan.[1342]
- No single window system is in place for clearance.
- Only about 200 trucks are cleared per day at the Kyrgyz-Chinese border; trucks are often held up for a full day or more.

Requirement: Efficient inter-agency coordination in case there are multiple border protection agencies

- Cargo release times suffer from a lack of inter-agency coordination. At Manas airport (Bishkek), average release times of cargo depend on several entities: Chamber of Commerce (for the Certificate of Origin), GoStandard (government agency providing certificates) and veterinary agencies (for SPS certificates). The minimum clearance time is three to four hours, but equipment often breaks down and electricity supply is unreliable, leading to longer clearance times.

Relevant LPI score for Kyrgyzstan: 2.75 out of 5 on the "Efficiency of customs and border management clearance" component[1343]

[1342] World Economic Forum 2016, 181
[1343] Arvis et al. 2018, 47

GAP ANALYSIS: REGULATORY ENVIRONMENT

Requirement: Easy and automated processes for standards certification and for (phyto-) sanitary measures, characterized by (1) low laboratory costs, (2) short wait times to receive laboratory results, (3) low incidence of re-inspection of exports at port of entry, and (4) reliable laboratory results to avoid rejection of products at port of entry[1344]

- Certifications (e.g., SPS certificates) issued by Kyrgyz authorities do not always comply with those demanded by trading partner countries, either within or outside the EAEU. This problem of a lack of harmonization of standards applies mostly to agricultural goods.
- Export certifications (for selling agricultural goods abroad) are difficult to obtain because of the low number of licensed laboratories that can perform SPS checks. (Example: Due to the limitations in certification, only 8 out of 34 dairy processing plants in Kyrgyzstan have permits for exporting to Kazakhstan.)

Requirement: Legislation covering all aspects of logistics

- [No information for Kyrgyzstan]

Requirement: Few or no illegal logistics providers

- high share of illegal logistics providers, i.e., those operating without proper invoicing or registration

Requirement: Well-designed and consistently implemented transport regulation, including the use of truck weigh stations[1345]

- There is no uniformly enforced weight limit for trucks; trucks from different countries are not treated equally. At several cross-border weighing stations the control of axle loads is done inconsistently

[1344] cf. World Bank 2012, 13
[1345] World Bank 2012, 29

and, despite trucks conforming to the maximum weight, drivers are sometimes compelled to pay penalties for excessive truck weights.

GAP ANALYSIS: EDUCATION, SKILLS, AND PROFESSIONAL TRAINING

Requirement: Adequate supply of trained logistics specialists to meet demand surges

- There is a severe lack of qualified personnel, such that vegetable storage facilities are reported to curtail their operations as they are unable to find logistics specialists able to organize the supply chain to export markets.[1346]

Requirement: Availability of structured training, with on-the-job training widespread and regarded by companies as value-enhancing

- Public support for university training in logistics is scarce.[1347]

Requirement: Adequate staffing of road transport as intra-country transportation relies mostly on road transport

- [No information for Kyrgyzstan]

Requirement: High level of food logistics knowledge at company level

- [No information for Kyrgyzstan]

Relevant LPI score for Kyrgyzstan: 2.36 out of 5 on the Logistics quality and competence component[1348]

[1346] Email dated July 7, 2020 by Temirbek Shabdanaliev, Chairman of the Freight Operators Association of Kyrgyzstan, to the author, as a follow-up to an interview with him by the author in April 2016

[1347] Email dated July 7, 2020 by Temirbek Shabdanaliev, Chairman of the Freight Operators Association of Kyrgyzstan, to the author, as a follow-up to an interview with him by the author in April 2016

[1348] Arvis et al. 2018, 47

10.7.6 Level 6: Logistics measures—Answer to main research question with application to perishable agricultural goods and Kyrgyzstan

Based on the preceding gap analysis, the following country- and product-category-specific measures are suggested for Kyrgyzstan to meet the logistics requirements of perishable agricultural goods and to foster exports in that product category.[1349] Measures were formulated by analyzing the gaps identified in Appendix 10.7.5 and selecting those that a national government (rather than the private sector) would be best placed to address. This meant excluding measures that rely purely on inter-company organization and including some measures that have the characteristics of a public good for other product categories, i.e., non-excludability and non-rivalry, e.g., improving border clearance procedures. The level includes measures that a government can take with the collaboration of the private sector.

Measures related to costs are included in two ways: (1) explicitly (as an entry in the "Ecosystem" functional category), and (2) implicitly, through entries in all seven functional categories that cover how policymakers can contribute to lowering logistics costs by improving the reliability and flexibility of the logistics environment (see section 4.3.2 for details). See section 4.3.3 for a description of the origin of the data for this level.

This section forms the answer to the main research question, with an application to perishable agricultural goods and Kyrgyzstan: Which country-specific logistics measures should the government of Kyrgyzstan take to foster higher-value perishable agricultural exports?

[1349] A previous version of this section was included as an early publication of parts of the dissertation's results in Wiederer and Straube 2019.

MEASURES: TRANSPORT- AND TRADE-RELATED INFRASTRUCTURE

Requirement: Availability of inland clearance facilities and dry ports to allow customs clearance at regional production hubs rather than at the border

- Establish inland clearance facilities and dry ports at regional agricultural production hubs.[1350]

Requirement: Facilitation of intermodal transport

- Develop logistics zones, i.e., zones providing warehouses, customs, trucker facilities, value added services (processing, packaging, and labeling), transloading, cross-docking, and container loading facilities.
- Develop infrastructure for line-haul transport (e.g., urban truck terminals).[1351]
- Ensure private sector participation in the set-up of logistics zones.[1352]
- Ensure road links for logistics zones as well as rail links (where feasible, given the mountainous terrain).
- For locations where full-blown logistics zones are not warranted, but container loading facilities are needed, construct ICDs for transshipment, i.e., multimodal logistics platforms for the (un)loading of containers, and linkage for trucks and trailers.

[1350] cf. World Bank 2010, 45. For guidelines how to select dry port locations, see Nguyen and Notteboom (2016, 26).
[1351] cf. World Bank 2010, 45
[1352] cf. World Bank 2010, 45

Requirement: Maintaining the cold chain, including in locations beyond the shippers' and receivers' control, e.g., customs clearance in seaports and airports. The cold chain must include pre-cooling right after the picking of produce.

- Support the introduction of temperature-controlled vehicles, especially trucks.
- Ensure reliable power supply, e.g., via generators or thermal batteries.
- Ensure that pre-cooling begins right after the picking of produce (especially important for berries).
- Ensure access to credit to enable investment in modern equipment.
- Introduce Hazard Analysis Critical Control Points.[1353] These help to ensure cold chain integrity in a supply chain by identifying hazards (e.g., higher temperatures during unloading), identifying which hazards are critical, and setting up control procedures (e.g., temperature measurements by loaders, drivers, and unloaders).[1354]
- Set up chilled delivery bays at warehouses so that goods arriving on refrigerated trucks are not exposed to ambient temperatures during unloading.[1355]
- In case chilled delivery bays are too expensive/not feasible: ensure that chilled and frozen produce is not left exposed to ambient temperature for more than 20 minutes.[1356]
- Provide incentives to monitor and document temperature in transport vehicles and storage via machine-to-machine technology for tracking and tracing shipments of perishable goods on their way, thus ensuring that products with a broken cold chain are disposed of rather than transported further.[1357]

[1353] cf. Smith and Sparks 2004, 194
[1354] cf. Smith and Sparks 2004, 194
[1355] cf. Smith and Sparks 2004, 195
[1356] cf. Smith and Sparks 2004, 195
[1357] cf. Ivanov et al. 2019, 488-489

Requirement: Either make available refrigerated storage facilities, distribution or processing centers close to rural production zones or facilitate cooperatives sharing refrigerated facilities.[1358]

- Set up refrigerated storage facilities, distribution and processing centers close to agricultural production zones; ensure that distribution and processing centers offer grading, packaging, and storage of agricultural goods.
- Set up logistics zones near key agricultural production zones that offer temperature-controlled storage, trans-loading (possibly intermodal), container loading, and trucker facilities; packaging services; cross-docking (distribution with minimal handling and storage time); and processing.

Requirement: Large road network in good condition, at least between major production sites and export gateways, and especially if production sites are not located close to processing centers

- Construct new transport links and/or upgrade existing ones[1359], specifically:[1360]
- Rehabilitate five motorways that are part of international transport corridors (varying in length from 44 to 539 km and including the Bishkek–Naryn–Torugart and Karakol–Tyup–Kegen corridors).
- Preserve and improve the road network, especially restoring the road surface by adding a no-skid surface to >300 km of roads and improving a further 150 km of roads.
- Construct 170 km of detour roads to avoid the territories of neighboring countries. This is to avoid frequent border crossings into, e.g., Tajikistan.

[1358] cf. World Bank 2012, 49
[1359] cf. World Bank 2010, 45
[1360] National Council for Sustainable Development of Kyrgyzstan 2013, 99-100. These measures are planned under the CAREC framework.

- Rehabilitate the Issyk-Kul circle: refurbish the road between Issyk-Kul's two main cities, Karakol and Cholpon-Ata.
- Rehabilitate the road between Cholpon-Ata (Issyk-Kul district) and the Kazakh capital, Almaty, one of the main destinations of agricultural exports from Issyk-Kul (ca. 500 km); or build a shorter route (though through mountainous terrain) of 280 km.
- Introduce fixed and/or mobile weighing stations, e.g., at border crossings and main access points to ports and cities.

Requirement: Rail network in good condition, at least between major production sites, distribution centers, and export gateways

- Complete the feasibility studies and begin construction of the Chinese–Kyrgyz–Uzbek Trunk Railroad and a branch line connecting the north and south of Kyrgyzstan.[1361]
- Increase the number of rail links to logistics zones (once those zones are built).

Requirement: Availability of reliable air transport for goods with high value density

- Create an air transport hub (Bishkek Manas airport) and modernize the Osh, Issyk-Kul, Batken, and Isfana airports.[1362]
- Invest in airport facilities and upgrade air cargo facilities, including refrigerated warehouses at airports and pallet scanners to facilitate the examination of air freight.[1363]
- Improve flight safety and work towards the lifting of the ban on Kyrgyz airlines flying within the European Union (removal of entry on air safety list).

[1361] National Council for Sustainable Development of Kyrgyzstan 2013, 99-100. This measure is planned under the CAREC framework.

[1362] National Council for Sustainable Development of Kyrgyzstan 2013, 99-100. These measures are planned under the CAREC framework.

[1363] cf. Banomyong et al. 2008, 366

- If pure air transport is too expensive, foster air-sea bridges, i.e., air transport for the first part of the trip, then transloading of produce to maritime transport for transportation to the final destination.

Cross-cutting requirement: Ensure environmental sustainability in logistics

- Provide solar-powered mobile refrigeration units (instead of diesel-powered generators) to support an unbroken cold chain in places where the energy supply is unreliable.
- Support sustainable transport and sustainable fleet management: Consider the GHG emissions and fuel consumption of different transport modes.[1364]
- Incentivize an increase in the carrying capacity of trucks by using longer and/or higher vehicles (bridge and tunnel height clearances permitting).[1365]
- Incentivize upgrading or retrofitting older trucks and planes to encourage the adoption of energy-saving technology.[1366]
- Incentivize or mandate lower caps on sulfur content (SO_x) in marine (bunker) fuel (lower than those mandated by the International Maritime Organization) to decrease SO_x emissions.[1367]
- Enable switching to new energy sources such as wind and biofuels.[1368]

[1364] cf. Tsolakis et al. 2015, 13
[1365] cf. McKinnon et al. 2015, 166
[1366] cf. McKinnon 2014, 7
[1367] cf. McKinnon et al. 2015, 186
[1368] cf. Vorst and Snels 2014, 8

MEASURES: INFORMATION & COMMUNICATIONS TECHNOLOGY

Requirement: Integration of IT tools between suppliers and customers, including for automation of cross-company information exchange, e.g., advance shipment notices[1369]

- Support improved planning and ICT use to avoid the "bullwhip effect" (slight demand fluctuations leading to large inventory buildup due to long lead times/delays in reaction time).[1370]
- Support exchange of information on market demand with upstream supply chain parties using ICT collaboration tools.[1371]

Requirement: Availability of digital government services for import and export

- Introduce online options for government services, including e-signatures for government approvals.[1372] (This is also mentioned in the National Sustainable Development Strategy 2018–2040, which includes the country's commitment to the digitalization of government services, including an e-government system).[1373]
- Support higher broadband internet penetration.

Requirement: Availability of technology to support an uninterrupted cold chain

- Allow and incentivize the introduction of temperature control technologies:[1374] active temperature monitoring (to adjust temperature in

[1369] cf. Göpfert and Braun 2017, 28
[1370] cf. Vorst et al. 2007, 11
[1371] cf. Vorst et al. 2007, 11
[1372] cf. World Bank 2010, 44
[1373] National Council for Sustainable Development of Kyrgyzstan 2018, 3
[1374] Adapted from Logistics Bureau, Oct. 24, 2016, "7 Things That Matter Most To Fresh Supply Chain Leaders", available at https://www.logisticsbureau.com/7-things-that-matter-most-to-fresh-supply-chain-leaders/, accessed on June 23, 2018

case of fluctuations) and passive monitoring (to provide historical shipment data)

- Introduce predictions of estimated time of arrival for the entire transport chain, potentially using AI and machine learning, taking into account infrastructure, resources, order characteristics, and weather.[1375]
- Explore the potential for using blockchain technology to manage food product recalls.[1376]

Requirement: Availability of tracking and tracing technology

- Permit new technologies related to tracking and security;[1377] ideally, real-time tracking.[1378]

Cross-cutting requirement: Ensure environmental sustainability in logistics

- Provide incentives or mandates for companies to integrate environmental sustainability criteria into e-procurement tools.[1379]

MEASURES: ORGANIZATION OF THE LOGISTICS ENVIRONMENT ("ECOSYSTEM")

Requirement: 24/7 or close to 24/7 opening of trade-enabling services, e.g., airports

- Open airports 24/7. If this is not warranted by traffic, ensure that opening times are reliable.

[1375] cf. Poschmann et al. 2019, 162
[1376] cf. Verhoeven et al. 2018, 14
[1377] cf. World Bank 2010, 43
[1378] cf. Kiwitt and Frankenberg, 2012, 160
[1379] cf. Straube et al. 2011, 46

Requirement: Collaboration of supply chain partners: sharing of distribution networks, infrastructure, vehicles

- Enable increased collaboration of supply chain partners via digital logistics platforms by removing regulatory barriers to sharing infrastructure; building broadband internet infrastructure for online coordination; and possibly providing tax incentives to share equipment, e.g., reefer containers for producers whose yield is too low to fill one on their own.

Requirement: Use of PPPs to address limited provision of public goods and low private sector investment

- Use PPPs to improve the transport network, build storage and collection centers, and purchase equipment, e.g., cooling units in regional collection centers.[1380]

Requirement: Healthy competition on all transport modes and in logistics

- Ensure fair competition among road transport operators from the EAEU by enforcing weighing standards, i.e., ensuring that no transport operators undercuts others by loading more than allowed.
- Ensure fair competition among rail transport operators within the EAEU by ensuring that rail operators in all countries apply internal rather than foreign freight rates to EAEU shippers.

Requirement: Reliable management of ports, airports, and rail transport[1381]

- Introduce commercial management in port and airport (and potentially rail) operations.[1382]

[1380] cf. World Bank 2016, 10
[1381] cf. World Bank 2010, 45
[1382] cf. World Bank 2010, 45

- Raise private sector participation in building and maintaining public infrastructure.[1383]
- Improve performance of rail transport service providers.

Requirement: Availability of regional logistics hubs serving agricultural production hubs

- Ensure that the logistics zones already planned for agricultural production hubs include the main features of a logistics zone (see section on infrastructure measures above) and do not serve as mere agricultural production facilities.
- Identify which other sites would warrant logistics zones and set them up.

Requirement: Tight coordination of government entities involved in fostering the logistics environment

- Implement the freight strategy developed in August 2015 by an interagency task group comprising the Ministries of Agriculture, Transportation & Communications and Economic Development as well as the Freight Operators Association.

Requirement: Ensure logistics costs are on par with international standards (ca. 10–17 % of GDP) or, ideally, lower[1384]

- Work towards a reduction of logistics costs from the current level of 20–23 % of GDP by fostering healthy competition in all transport modes, lowering transaction costs of transit (customs and handling charges), and increasing reliability and predictability in the supply chain.

[1383] cf. World Bank 2010, 45
[1384] cf. Memedovic et al. 2005, 358

Cross-cutting requirement: Ensure environmental sustainability in logistics

- Mandate reverse logistics, i.e., recycle, reduce, and reuse materials.[1385]
- Require the reuse of waste, e.g., reuse waste from agricultural supply chains as animal feed.[1386]
- Provide incentives or mandates for companies to introduce a supplier audit method with enhanced environmental sustainability criteria.[1387]

MEASURES: BUSINESS PRACTICES FOR HIGH-QUALITY LOGISTICS SERVICES

Requirement: Business practices in place to mitigate supply chain volatility

- Create incentives for customers to share stock levels to increase forecasting accuracy.[1388]

Requirement: Adoption of international standards by logistics operators

- Introduce blockchain technology to enhance confidence in food safety by documenting the entire production process.[1389]
- Initiate standard performance contracts for transport and logistics services.[1390]
- Create incentives to upgrade transport fleets to long-haul trucking fleets.[1391]
- Support the implementation of warehouse management systems to enable just-in-time and just-in-sequence delivery.[1392]

[1385] cf. Bourlakis and Bourlakis 2004, 226
[1386] cf. Tsolakis et al. 2015, 17
[1387] cf. Straube et al. 2011, 46
[1388] cf. Nitsche 2018, 19
[1389] cf. Ivanov et al. 2019, 500
[1390] cf. World Bank 2010, 43
[1391] cf. World Bank 2010, 43

- Incentivize the implementation of transport management systems (e.g., using GPS systems) to consolidate shipments, control freight costs, and integrate with technologies such as warehouse management systems by monitoring freight movements and vehicles.[1393]

Requirement: Adoption of practices to manage variability in availability and quality of produce, chiefly the FEFO principle: first-expired-first-out

- Ensure that stock rotation takes place to match every item's remaining shelf life to the remaining transport duration.[1394]

Requirement: Adequate quality management systems and practices in place, including traceability of all inputs and final products as well as maintaining sanitary practices from source to shelf

- Create or upgrade control laboratories. Consider certification of private laboratories to perform microbiological tests.[1395]
- Create facilities for certification of origin.
- Install ICT and quality control systems at each supply chain partner; adopt RFID technology to ensure visibility at the level of a single unit (e.g., produce crate).[1396]

Requirement: Availability of specialized handling and packaging[1397]

- Mandate consistent labeling.[1398]
- Support the introduction of multi-use crates for transporting produce.[1399]

[1392] cf. Barreto et al. 2017, 1249
[1393] cf. Barreto et al. 2017, 1249
[1394] cf. Jedermann et al. 2014, 2
[1395] cf. World Bank 2012, 51
[1396] cf. Tsolakis et al. 2015, 15
[1397] cf. Jedermann et al. 2014, 2
[1398] cf. Jedermann et al. 2014, 2
[1399] cf. Jedermann et al. 2014, 2

- Ensure that pallets are positioned in a way that does not block airflow.[1400]

Requirement: Post-harvest treatment of produce to extend shelf life[1401]

- Support the introduction of facilities and practices for treating produce post-harvest.

Requirement: Use of supply chain metrics and performance measurement

- Encourage the introduction of modern SCM techniques.[1402]

Cross-cutting requirement: Ensure environmental sustainability in logistics

- Mandate sustainable inventory management considerations, e.g., limited energy use for cooling stock.[1403]
- Offer driver training to encourage fuel-efficient driving.[1404]
- Incentivize a reduction of shipping weights, e.g., by packaging management.[1405]
- Pollution control: Incentivize logistics operators to limit energy consumption and the use of harmful substances, and to limit and treat wastewater, solid waste, and hazardous emissions (e.g., SO_2, NH_3, CO_2, and HC_1).[1406]
- Encourage creation of resource-saving packaging forms.

1400 cf. Jedermann et al. 2014, 2
1401 cf. Jedermann et al. 2014, 2
1402 cf. World Bank 2010, 43
1403 cf. Vorst and Snels 2014, 10
1404 cf. Clean Air Asia 2017, 27
1405 cf. Asian Development Bank and Gesellschaft für Internationale Zusammenarbeit 2014, 22
1406 cf. Lee et al. 2009, 7924

- Incentivize the reduction of CO_2 emissions from vehicles by increasing load factors, improving vehicle efficiency, utilizing lower carbon fuels,[1407] implementing preventive maintenance,[1408] and monitoring tire pressure.[1409]
- Mandate the use of environmental impact assessment tools, e.g., life cycle assessment analysis, to assess the impacts of operations associated with all stages of a product's life;[1410] alternatively, implement environmental impact assessment, environmental accounting,[1411] or carbon footprint checks at the product level.[1412]

MEASURES: CUSTOMS PRACTICES

Requirement: 24/7 or close to 24/7 opening hours of customs services and border posts

- Ensure 24/7 (or close to 24/7) opening times of border control entities. If this is not warranted by border traffic, ensure that opening times are reliable.
- Harmonize border post opening times on both sides of the border, e.g., between Kyrgyzstan and Kazakhstan.

Requirement: Availability of electronic data interchange for customs to eliminate need for duplicate data entries, to increase transaction speed, and to reduce cost and error rates[1413]

- Accept scanned copies for supporting documents and e-signatures.[1414]

[1407] cf. Asian Development Bank and Gesellschaft für Internationale Zusammenarbeit 2014, 22
[1408] cf. Rushton et al. 2017, 796
[1409] cf. Clean Air Asia 2017, 27
[1410] cf. Vorst and Snels 2014, 10
[1411] cf. Mintcheva 2005, 719
[1412] cf. Straube et al. 2011, 45
[1413] cf. Rushton et al. 2017, 751
[1414] cf. World Bank 2010, 44

- Accept paperless customs declarations as part of a gradual move towards single window border operations.
- Introduce Blockchain technology for archiving customs documents to prevent unauthorized modifications and to expedite the flow of information and improve confidence in customs documentation.[1415]

Requirement: Availability of risk management practices to minimize inspection rates[1416]

- Use risk management to speed up clearance, including reduced inspections and an Authorized Economic Operators program.[1417]
- Check and possibly upgrade the following technologies at the Kyrgyz EAEU outside borders with China, Tajikistan, and Uzbekistan: X-ray machines for scanning trucks, portable equipment for chemical identification, radiation control, power generators, satellite antennas, and IT equipment.
- Introduce spatial planning into plans for border crossing modernization. Direct trucks into different lanes depending on risk, i.e., base border crossing layout on how trucks move in and around the border when selected for inspection.[1418]

Requirement: Streamlined and predictable border clearance procedures

- Upgrade weighing stations (weigh-in-motion) for trucks at border crossing points as well as introducing joint customs and weighing controls. (This could help with the reported problem of unequal enforcement of weight limits based on origin. Kazakhstan's move towards automated weighing stations should mitigate this, at least partially.)

[1415] cf. Ivanov et al. 2019, 500
[1416] cf. World Trade Organization 2014, 8
[1417] cf. World Bank 2010, 44
[1418] cf. World Bank 2012, 51

- Reform and automate customs procedures.[1419]
- Provide a single point of entry for information used in the clearance of cargo.[1420]
- Harmonize international customs systems and ensure seamless interaction with SPS measures.[1421]

Requirement: Efficient inter-agency coordination in case there are multiple border protection agencies, and low incidence of border delays

- Introduce standardized border monitoring and data collection to enable national customs services to make informed decisions about border management challenges.

Cross-cutting requirement: Ensure environmental sustainability in logistics

- Direct trucks into different lanes depending on risk to reduce waiting times and thus emissions.

MEASURES: REGULATORY ENVIRONMENT

Requirement: Easy and automated processes for standards certification and for (phyto-) sanitary measures, characterized by (1) low laboratory costs, (2) short wait times to receive laboratory results, (3) low incidence of re-inspection of exports at port of entry, and (4) reliable laboratory results to avoid rejection of products at port of entry[1422]

- Automate and simplify procedures for SPS measures and for standards certification, e.g., GLOBALG.A.P. or British Retail Consortium standards.[1423]

[1419] cf. World Bank 2010, 44
[1420] cf. World Bank 2010, 44
[1421] cf. World Bank 2012, 50
[1422] cf. World Bank 2012, 13
[1423] cf. Vorst and Snels 2014, 18

- Pre-clear agricultural export goods that have been tested in the country of origin and are not related to any current disease outbreaks. Retest upon entry into import country and recall only in case tests are positive.[1424]
- Set up new laboratories and upgrade old ones. The most pressing needs are in and around Bishkek and Osh.
- Set up mobile laboratory units that can reach remote areas.
- Train laboratory staff to improve compliance with regulations.

Requirement: Legislation covering all aspects of logistics

- Introduce comprehensive logistics legislation.
- Review import/export restrictions.
- Allow mergers and acquisitions of logistics providers.[1425]
- Deregulate air freight services and introduce fifth freedom or other bilateral freedoms in air transport.[1426]
- Plan and manage multi-modal and multi-country freight corridors by coordinating planning among agencies regulating transport and border management.[1427]

Requirement: Few or no illegal logistics providers

- Reduce the number of illegal logistics operators by favoring official operators:
- Reduce fees and taxes, to incentivize operators to properly register.
- Increase controls on illegal activities such as unofficial warehousing in city centers.

[1424] cf. World Bank 2012, 51
[1425] cf. World Bank 2010, 43
[1426] Fifth freedom refers to "the right or privilege, in respect of scheduled international air services, granted by one State to another State to put down and to take on, in the territory of the first State, traffic coming from or destined to a third State" (source, also for other freedoms of the air: https://www.icao.int/Pages/freedomsAir.aspx, accessed on June 19, 2020)
[1427] cf. Pham et al. 2013a, 101

- Lighten administrative burdens for logistics operators.
- Improve export facilitation.
- Increase accountability of and controls on illegal operators.

Requirement: Well-designed and consistently implemented transport regulation, including the use of truck weigh stations[1428]

- Introduce automated weighing stations (weigh-in-motion) for trucks at border crossings.
- Introduce joint customs and weighing controls (i.e., controls operated by border officials from both sides of the border).

Cross-cutting requirement: Ensure environmental sustainability in logistics

- Introduce targets to reduce energy consumption overall.
- Introduce air, water, and soil pollution limits.[1429]
- Introduce a truck scrappage scheme to remove older, less fuel-efficient trucks.[1430]

MEASURES: EDUCATION, SKILLS, AND PROFESSIONAL TRAINING

Requirement: Adequate supply of trained logistics specialists

- Improve vocational education, formal jobs training, and skills upgrading in logistics professions, thereby increasing the number of, e.g., trained freight forwarders.
- To ensure good availability of well-trained logistics managers able to organize supply chain for agricultural exports across borders, aca-

[1428] cf. World Bank 2012, 29
[1429] cf. Straube et al. 2011, 45
[1430] cf. McKinnon 2015b, 390

demic training (e.g., at the master's level) should be available and publicly supported.[1431]

Requirement: Availability of structured training, with on-the-job training widespread and regarded by companies as value-enhancing

- Encourage on-the-job training.
- Ensure that new training is available not only at tertiary level, but also as vocational and on-the-job training, with logistics providers and shippers providing some of the training rather than just universities.[1432]

Requirement: Adequate staffing of road transport, as intra-country transportation relies mostly on road transport

- Offer basic driver training (potentially as part of a scheme to reduce youth unemployment) to prevent driver shortages.

Requirement: High level of food logistics knowledge at company level

- Develop the knowledge and capacity of operators to apply good handling practices to produce.[1433]
- Train packers in how to select produce.[1434]
- Introduce professional standards and certifications for LSPs.[1435]

Cross-cutting requirement: Ensure sustainability in logistics

- Support research for the development of green packaging and its adoption.

[1431] Email dated July 7, 2020 by Temirbek Shabdanaliev, Chairman of the Freight Operators Association of Kyrgyzstan, to the author, as a follow-up to an interview with him by the author in April 2016
[1432] cf. McKinnon et al. 2017, 61
[1433] cf. Vorst and Snels 2014, 19
[1434] cf. Vorst and Snels 2014, 19
[1435] cf. World Bank 2010, 43

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Overcoming logistics-related barriers to higher-value exports – a decision framework to identify policy measures

Logistics is key to a country's trading opportunities. This is acutely relevant for developing countries, where a frail logistics environment can decrease export competitiveness. While logistics services are mostly provided by private actors, governments play a key role in ensuring a well-functioning logistics environment, for example, by providing trade-related infrastructure, customs procedures, or vocational training. This dissertation develops a decision framework to identify logistics interventions for a country wishing to facilitate higher-value exports. The results include logistics requirements and policy recommendations for three product categories. The framework can also be applied to other product categories. It allows to identify recommended policy measures even with a narrow empirical base of logistics-related data and interviews with logistics stakeholders.

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