The Integration of Laos into the International Economy: Global Production Sharing, Landlockedness, and Trade Costs

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Declaration

I declare that this is my own original work except where otherwise indicated or acknowledged in the thesis.

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Abstract

Laos is a developing country well-endowed with natural resources that faces development challenges due to high trade costs from being landlocked. This thesis examines the integration of Laos into the international economy, focusing on the role played by global production sharing and trade costs associated with landlockedness. Laos has opened up to the regional and global economy in order to overcome its locational disadvantage and to graduate from its status as a least developed country. As the world is increasingly characterised by the geographical dispersion of production, this offers opportunities for Laos to tap into certain segments of production sharing that are commensurate with its comparative advantage. A framework is developed, which is based on a gravity model, to analyse the factors affecting countries' participation in global production sharing (or 'networked trade'), with emphasis on the implications for landlocked countries. Controlling for economic size and geographical factors, landlocked status reduces networked trade (both for trade in parts and components, and final goods). However, reducing services links costs, in particular improved logistics performance and joining regional trade agreements, contributes to the expansion of networked trade. This highlights the importance for landlocked countries to improve services links that coordinate geographically dispersed production processes.

In examining the role of firm-specific characteristics in influencing export performance, the findings suggest firm size, foreign ownership, and input imports have positive effects on firms' export intensity. Larger firms have more resources to exploit economies of scale to enable them to export more. Having foreign equity and using imported inputs also help raise firms' productivity through foreign expertise and networks. Case studies further reveal that although the Lao garment industry is relatively small compared to regional comparators, the electronics industry shows promising prospects given its recent strong growth. The absence of supporting industries in these sectors highlights the challenge that Laos faces in competing with neighbouring countries given the cost and time penalty associated with being landlocked. The current study makes a strong case for Laos to focus efforts on upgrading trade-related logistics, deepening regional economic integration, and improving the overall business environment. Such measures suggest Laos can overcome its natural disadvantage of being landlocked, which would help the country further integrate into the international economy and facilitate a smooth transition after Laos graduates from least developed country status.

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List of Abbreviations

AEC	ASEAN Economic Community
AFAS	ASEAN Framework Agreement on Services
AFC	Asian Financial Crisis
AFTA	ASEAN Free Trade Area
APTA	Asia-Pacific Trade Agreement
ASEAN	Association of Southeast Asian Nations
ASYCUDA	Automated System for Customs Data
ATC	Agreement on Textiles and Clothing
BEC	Broader Economic Category
CES	Constant Elasticity of Substitution
CIF	Cost Insurance and Freight
CMT	Cut, Make and Trim
Comtrade	Commodity Trade Statistics Database
EI	Export Intensity
EP	Export Propensity
EU	European Union
FDI	Foreign Direct Investment
FE	Fixed Effect
FOB	Free on Board
GDP	Gross Domestic Product
GNI	Gross National Income
GPS	Global Production Sharing
GSP	Generalised System of Preference
HDD	Hard Disk Drive
HS	Harmonised System
ICT	Information and Communication Technology
IPT	Inward-Processing Trade
ISIC	International Standard Industrial Classification
ISO	International Standard Organization
ITC	International Trade Centre
LDC	Least Developed Country
LGIA	Lao Garment Industry Association
LLAC	Landlocked Advanced Country
LLDC	Landlocked Developing Country
LPI	Logistics Performance Index
LR	Likelihood-ratio
MFA	Multi-Fibre Agreement

MFN	Most-Favoured-Nation
MNE	Multinational Enterprise
MRA	Mutual Recognition Arrangement
NEM	New Economic Mechanism
NIE	Newly Industrialising Economy
NTB	Non-Tariff Barrier
NTM	Non-Tariff Measure
OECD	Organisation for Economic Co-operation and Development
OLS	Ordinary Least Squares
OPT	Outward-Processing Trade
P&C	Part and Component
PPML	Pseudo-Poisson Maximum Likelihood
RCEP	Regional Comprehensive Economic Partnership
RE	Random Effect
RTA	Regional Trade Agreement
SEZ	Special Economic Zone
SITC	Standard International Trade Classification
SME	Small and Medium Enterprise
SOE	State-Owned Enterprise
SPS	Sanitary and Phytosanitary
TBT	Technical Barriers to Trade
TFP	Total Factor Productivity
TRAINS	Trade Analysis Information System
UK	United Kingdom
UN	United Nations
UNCTAD	United Nations Conference on Trade and Development
US	United States
WDI	World Development Indicator
WITS	World Integration Trade Solution
WTO	World Trade Organization

1 Laos' Trade and Development Challenges

The lack of direct access to the sea presents profound challenges to the development dynamics of landlocked nations. One of the conditions of development is the degree of economic integration — through trade and investment to specialise in comparative advantage — with the rest of the world; or the extent to which an economy is able to trade internationally (UN-OHRLLS 2013). Many landlocked developing countries (LLDCs) find themselves structurally disadvantaged as landlockedness raises trade and transport costs, thereby lowering their trade engagement and economic growth potential (World Bank and UN-OHRLLS 2014). Landlocked developing countries trade 30 per cent on average less than comparable coastal countries (Limao and Venables 2001). In addition, being landlocked is found to cut around half a percentage point off the economic growth rate (MacKellar *et al.* 2000).

Against this stylised background, it is important to have a quantitative assessment of the impacts that landlocked status has on the development prospects of a particular country. Laos is an important case study in this context. Since introducing economic reforms in the mid-1980s, Laos has achieved impressive economic growth in recent years (Pholsena and Vilavong 2015). On average, the Lao economy has grown by 7.5 per cent per year and trade has expanded by 17 per cent per year since 2000, reflecting the importance of trade as a key driver of the country's growth. In 2011, Laos was upgraded from a lower- to lower-middle-income economy under the World Bank's country classification.[1] The catch-up of Laos to the middle-income group is a promising trajectory, but landlocked status appears to put Laos at a disadvantage.

Despite its impressive economic performance, Laos is still mainly reliant on the production and exports of natural resources, with minerals and electricity accounting for 30 per cent of gross domestic product (GDP) and 60 per cent of total exports (Record *et al.* 2014). At the same time, the share of traditional exports, such as timber, garments, and agricultural produce, has steadily declined.

There is concern about the 'Dutch disease', whereby economic growth that is driven predominantly by natural resource exploitation makes non-resource exports less

[1] Lower-middle-income economies are those with average gross national income (GNI) per capita of US$1,006 to US$3,975. The GNI per capita of Laos was US$1,010 in 2011.

competitive by raising factor input costs and causing the real exchange rate to appreciate (MOIC 2012). Although the poverty level of Laos was halved to 23.2 per cent between 1997 and 2012, it is still relatively high by regional standards.[2] Laos even trailed behind Cambodia and Vietnam, whose poverty headcount ratios in 2012 were 17.7 per cent and 17.2 per cent, respectively. In addition, the income gap between people living in urban and rural areas as well as across ethnic groups in Laos has been widening over time (Warr *et al.* 2015).

More importantly, Laos still remains a least developed country (LDC) classified by the United Nations.[3] The goal to graduate from LDC status by 2020 presents a pressing need to explore how the country can sustain the current growth path and ensure that development outcomes are equitable and inclusive.

1.1 Export diversification and global production sharing

As Laos is contemplating its future development strategy it may make sense to consider how the country can further integrate into the regional and global economy. One of the key challenges is to maintain a high export growth rate in the years to come. Because most current export earnings are derived from limited mineral and hydropower reserves, it is important for Laos to ensure its export-led growth development is sustainable. That may be achieved through diversifying into non-resource activities. First, export diversification may be expected to help Laos cushion itself from potential negative shocks associated with dependency on resource exploitation, such as in commodity price fluctuations. Second, it can also contribute to lessening economic vulnerability, which is one of the three criteria for graduation of least developed country status.[4]

This highlights a need for Laos to identify economic activities that are less sensitive to distance and transportation. Promoting stronger regional trade expansion can be a development strategy that would help Laos to mitigate the adverse impact of its geographical disadvantage and associated trade costs.

One way forward could be to tap into global production sharing (GPS). This would link

[2] According to the World Bank's World Development Indicators, as measure by a poverty headcount ratio at a national poverty line.

[3] Laos was designated to be a least developed country by the United Nations in 1971.

[4] A country is eligible for LDC graduation if it meets the thresholds for two of three criteria, which relate to income per capita, human development assets (such as health and education), and economic vulnerability (MOIC 2012).

Laos with regional and global opportunities as the world is increasingly characterised by the dispersion of production processes across different economies where goods can be most efficiently produced (Arndt and Kierzkowski 2001). Evidence shows that the development contribution of global production sharing can be significant. Nowhere is this more evident than in China and Southeast Asia, where the networks of production are at the heart of the export-led growth model that has contributed to the economic growth and poverty reduction success story of these economies in recent decades (Athukorala 2011, Taglioni and Winkler 2016). Participating in global production sharing can also act as an avenue for developing countries to build productive capacity, which opens opportunities for industrial upgrading and long-term development (Lall *et al.* 2004, Sturgeon and Memedevic 2010).

Global production sharing offers Laos an opportunity to participate in certain segments of production that are commensurate with its endowments and productive capacity. This may be done without the need to build a complete array of productive capacities at home. However, participation in global production sharing is not automatically warranted. While many developing countries have successfully integrated into and benefited from global production sharing, many landlocked developing countries still remain left out (UNCTAD 2015). The challenges associated with the state of landlockedness deserve further consideration.

1.2 The costs of being landlocked

Trade is more difficult and costly in landlocked developing countries than in other countries. Landlocked countries are subject to higher costs of international trade compared to coastal countries, which is estimated on average to add 70 per cent in ad-valorem to the cost of traded goods (World Bank and UN-OHRLLS 2014). In addition, it takes around 43 days on average to deliver exports from LLDCs, which is more than twice the time needed to export from coastal developing countries (UN-OHRLLS 2013). Exporters in landlocked countries obviously face higher trade and transport costs. But high costs are not only a function of geographical features; insufficient infrastructure and many policy-induced factors also play an important part (World Bank and UN-OHRLLS 2014). Transit trade and other infrastructural deficiencies add to documentation requirements and mean that it takes longer to clear imports and exports through customs compared to transit neighbours.

Being landlocked is associated with increased prices of imports and reduced export

revenues, and has adverse impacts on the terms of trade and real incomes from trade for landlocked economies (MacKellar *et al.* 2000). As goods cross a border, they are subject to transaction costs associated with customs and handling procedures. In addition, if there is a switch in the mode of transport, there are also offloading and onloading charges along with warehousing expenses. Landlocked developing countries are also dependent on the quality of the infrastructure and administrative procedures of transit neighbours to transport their goods to port (World Bank and UN-OHRLLS 2014). In this study, the costs of international trade (or 'trade costs') are understood to cover all the relevant components of costs for goods to be internationally traded.[5]

Landlockedness and its associated costs may partly explain why landlocked developing countries account for only 1.1 per cent of world exports, whereas coastal developing countries' exports represent 24 per cent of the export share (World Bank and UN-OHRLLS 2014). Apart from that, the export structure of LLDCs is commonly narrow and less diversified. These countries rely on exporting primary commodities more heavily than their coastal counterparts. Most of them are commodity-dependent, with primary products accounting for over half of the total exports of 27 out of 32 landlocked developing countries (UNCTAD 2015). Only a handful of these countries have low dependence on commodity exports, such as Macedonia and Moldova in Eastern Europe, Bhutan and Nepal in Asia, and Lesotho in Africa.

In addition, landlocked developing countries are on average 20 per cent less developed than they would have been, if these economies were not landlocked (UN-OHRLLS 2013). Yet growth performance seems to differ among individual nations. Evidence at the country level reveals that inter-country differences among LLDCs can be explained by good governance and trade openness to a certain extent (Paudel 2014). Heterogeneity in the economic performance of landlocked countries motivates interest in the study of a particular country such as Laos.

As for Laos, exporting a standard (20-foot) container from Vientiane to Los Angeles adds as much as 45 per cent to total shipping costs compared to from Bangkok to the same destination (World Bank 2010a). In addition, it takes 78.5 days on average to ship a standard container from Vientiane to Los Angeles, which is almost double the time

[5] Trade costs are defined as the price equivalent of the reduction of international trade as compared with the potential implied by domestic production and consumption in the origin and destination economies (World Bank and UN-OHRLLS 2014).

taken to ship from Bangkok. This excessively high time penalty is well above the LLDC average of 32 per cent, although Laos' cost penalty is slightly better than the LLDC average of 53 per cent (World Bank 2010a). This is an obvious disadvantage for Laos in integrating into the international economy, especially through participation in global production sharing.

When manufacturing is geographically organised in production networks, trade costs at each stage of the supply chain are incorporated into production costs and passed on to the next stage. Trade costs propagate through international supply chains, cascading from upstream to downstream to final consumers (World Bank *et al.* 2017). Even small additional costs arising from barriers to trade can have a detrimental impact on the competitiveness and ability of countries to compete in export markets (Yi 2003). Given that production networks involve multi-border crossings of intermediate inputs and the need to coordinate production facilities across geographical space, the need to reduce trade costs is even more important than in the case of horizontal trade (Kimura *et al.* 2008, Saslavsky and Shepherd 2014).

The costs associated with the quality of logistics and supply chain reliability play an even more important role in explaining trade costs than distance, or traditional trade policies that focus on tariffs (Arvis *et al.* 2010). Unlike landlockedness and other geographical factors, which are impossible to change, connectivity and logistics performance problems can be addressed through different policies in LLDCs and transit countries. It is important to know which components of international trade costs in Laos are high, and whether they can be reduced, including through trade and other policies.

1.3 Research questions

The purpose of this thesis is to examine the integration of Laos into the international economy, and the way in which landlockedness affects trade costs and the integration of economies and firms into international trade around the proliferation of global production sharing. These are the key themes running through the analysis in this research.

Specifically, the thesis tries to answer the following questions. How does the landlocked nature of Laos affect its ability to integrate into the regional and global economy, and what related policies might be important for the country's future trade and development? What is the relative importance of trade costs associated with geographical and other factors in influencing the participation of countries in global

production sharing? What factors determine the export performance of firms in engaging in international trade?

The findings from this research are expected to contribute to an improved understanding of the interaction between economic development, the internationalisation of an economy, the microeconomics of firms, and related policy choices for a landlocked country.

1.4 Structure and overview

The thesis consists of seven chapters. What follows is a preview of each chapter. Chapter 2 reviews the relevant theoretical and empirical literature to develop a framework to understand the concept and drivers of global production sharing, and how it is mapped. It sets the stage to help understand the process of economic integration within the context of Laos. The chapter establishes a qualitative research framework to analyse the economic integration experience of Laos (Chapter 3) and sectoral case studies (Chapter 6) as well as develops quantitative modelling for macroeconomic and microeconomic analyses based on international fragmentation and firm heterogeneity theories (Chapters 4 and 5).

Chapter 3 reviews progress on the economic integration of Laos since the introduction of the 'New Economic Mechanism' in the mid-1980s. Trade liberalisation has been largely shaped by the membership of Laos in the Association of Southeast Asian Nations (ASEAN) and the World Trade Organization (WTO). As a result, Laos has been one of the fastest growing economies in Southeast Asia. With economic growth of over 7 per cent in recent decades, Laos is now a lower-middle-income country. While its economic progress has been impressive, the resource sector remains the principal driver of the Lao economy. Agriculture is also the main absorber of the labour force and the country's manufacturing base is narrow. Exports are also less diversified in terms of both product compositions and markets.

This chapter also discusses some challenges and how Laos can move forward. One of the key challenges for Laos is to manage its resource wealth in a way that ensures broad-based growth across a diversity of sectors and creates jobs for a larger proportion of the population. A related question is how Laos can further integrate into the regional and global economy and ensure a smooth transition after its graduation from least developed country status.

Chapter 4 examines recent trends in global production sharing, which reveal that

although developing countries have increasingly engaged in international supply chains in many industries, LLDCs are still left out. This chapter seeks to provide a better understanding of the relative importance of geographical and policy factors in influencing countries' participation in global production sharing. An analytical framework is developed based on fragmentation theory. A gravity model is used to account for factors explaining countries' participation in global production sharing or 'networked trade' (measured by trade in parts and components, and final goods). The model estimation covers 191 economies between the years 2000 to 2014.

The econometric results show that after controlling for economic size, and geographical factors (such as distance, sharing common borders), landlocked status reduces countries' exports by a large extent. However, reducing services links, in particular through improved logistics performance and regional economic integration, is found to contribute to the expansion of networked trade. This highlights the importance of landlocked economies overcoming their locational disadvantage by reducing the costs of services links associated with these factors.

Chapter 5 investigates economic integration from a firm-level perspective. The theory of firm heterogeneity provides a framework within which to explain how firms get involved in international trade. This chapter examines the importance of firm characteristics on export performance, taking Laos as a case study. Following an examination of the manufacturing sector in Laos, the chapter develops a framework based on firm heterogeneity theory.

This chapter then undertakes an empirical analysis using the enterprise surveys on Laos conducted by the World Bank in 2009, 2012, and 2016. Firm size, foreign ownership, and the import of inputs are found to have positive effects on firms' export intensity (the proportion of total sales that is exported directly. Larger firms have more resources to exploit the cost advantages that they obtain due to large scale of operations to enable them to export more. Additionally, having foreign equity and using imported inputs also help raise firms' productivity through foreign expertise and networks.

To supplement the cross-country and firm-level analyses, Chapter 6 conducts case studies on the textile and garment sector, and the electronics sector. Although the textile and garment industry in Laos is relatively small by international standards, the electronics industry shows promising prospects given its strong growth after 2013. Both industries have been significant contributors to the Lao economy in terms of employment and export earnings.

The absence of supporting industries in the textile and garment, and electronics sectors highlights the challenges that Laos faces in competing with neighbouring countries given the cost and time penalty associated with being landlocked. Therefore, improving trade-related logistics, which will reduce trade costs and lead time, would be an avenue to improve the position of Laos in global production sharing.

Finally, Chapter 7 provides a summary of key findings of the thesis and discusses policy implications. The chapter ends with a discussion on research limitations and suggestions for further research. The findings from the thesis make a strong case for improving trade-related logistics, deepening economic integration with the region, and improving the overall business environment to overcome trade costs associated with being landlocked so that Laos can successfully integrate into the international economy.

2 Understanding Global Production Sharing

2.1 Introduction

International trade and production are increasingly fragmented with production processes for goods being divided vertically and value being added at each stage of production in different locations. The structure of this global production sharing means a country is able to participate in certain segments of production without developing the full range of productive capabilities. While developing countries have responded positively to these opportunities, many landlocked developing countries including Laos, are still missing out. These countries are at a disadvantage compared to coastal countries in reaping gains from international exchange because of a higher trade cost, which is a key determinant of the location decision of multinational enterprises within the entrenched networks of international supply chains (UNCTAD 2015).

There are 32 landlocked developing countries (LLDCs) in the world, half of which are located in sub-Saharan Africa, and ten of which are in Asia (UNCTAD 2014).[6] Laos is the only landlocked country in Southeast Asia, and it appears to share some of the characteristics of other landlocked economies. The country is structurally disadvantaged given high international trade costs, and the concentration of export markets and product compositions. As such, efforts to understand the economic integration of Laos need to be framed in the context of it being a small landlocked economy.

The purpose of this chapter is to develop a framework for understanding how a landlocked economy like Laos integrates into the international economy, focusing on the role played by global production sharing and trade costs associated with being landlocked. As a point of departure, the next section explores the concept and drivers of global production sharing while Section 2.3 describes how networks of production sharing can be mapped at both the country and firm levels. Section 2.4 elaborates research methodologies, paving the ground for empirical analyses to be conducted in subsequent chapters. Section 2.5 presents concluding remarks.

[6] See a complete list of landlocked developing countries in Table 2.1.

2.2 Global production sharing

Global production sharing has increasingly become a prominent feature of international trade, and now is common in many sectors. The process of production fragmentation has evolved from being largely confined within developed countries to being increasingly integrated into developing countries.

The concept of global production sharing

The term 'global production sharing' (GPS) originates from international fragmentation theory.[7] Previously integrated production processes are dispersed into segments located in different countries to take advantage of cost differentials and can be coordinated by services links. Global production sharing has seen the internationalisation of manufacturing processes, in which numerous countries participate in various stages of production. The process is of considerable economic importance because it permits production stages to be located where they can be performed most efficiently (Yeats 1999). Larger scale output can result in a finer international division of labour with services links that connect increasingly fragmented segments or blocks of production. Breaking down the integrated process of production into separate stages opens up new opportunities for a greater degree of international specialisation, with gains from increasing returns to scale and a greater degree of production fragmentation (Jones and Kierzkowski 1990, Arndt 2001).

In the current study, global production sharing is defined as the fragmentation of production processes into stages with each being located in different economies to achieve locational advantages and being coordinated by services links. This definition closely follows that adopted by Jones and Kierzkowski (1990, 2000). This is to capture the notion of trade linkages among economies involved in international supply chains, from importing parts and components to processing them into final goods.

Hummels *et al.* (2001) define global production sharing as production arrangements in which firms manufacture final goods via multiple stages of production located in various countries, as an important aspect of overall trade in intermediate inputs. Henderson *et al.* (2002) characterise it as a nexus of interrelated functions through

[7] Global production sharing have also been referred to as 'slicing up the value chain' (Krugman *et al.* 1995), 'global value chains' (Gereffi 1999), 'international fragmentation' (Deardorff 2001), 'vertical specialisation' (Hummels *et al*. 2001), 'the second unbundling' (Baldwin 2006), and 'global production networks' (Nishimura *et al.* 2016).

which goods are processed, distributed, and consumed. Therefore, the concept of global production sharing covers a full range of interconnected activities that pull together inputs from various economies and assemble them into final goods.

The drivers of global production sharing

The traditional approach to trade flow analysis, which assumes that countries trade in goods produced within national boundaries, is becoming increasingly irrelevant because of the ongoing process of international production fragmentation (Jones and Kierzkowski 1990, 2000). This suggests two new trade theories organised around production fragmentation and firm heterogeneity.[8] The analysis of Laos' integration into the international economy, in particular global production sharing, needs to be grounded in these two streams of trade theory.

International fragmentation theory

The theory of fragmentation of international production stipulates that production processes can be dispersed into various segments with each located in different economies and connected by service links (Jones and Kierzkowski 1990, 2000). The international location of each stage is influenced by international relative factor prices and productivities, which determine the extent to which entire processes can be fragmented geographically (Jones and Kierzkowski 1990). The increasing interconnectedness of production processes in international supply chains that stretch across different economies allows each country or economy to specialise in a particular stage of production (Hummels *et al.* 2001, Yi 2003).

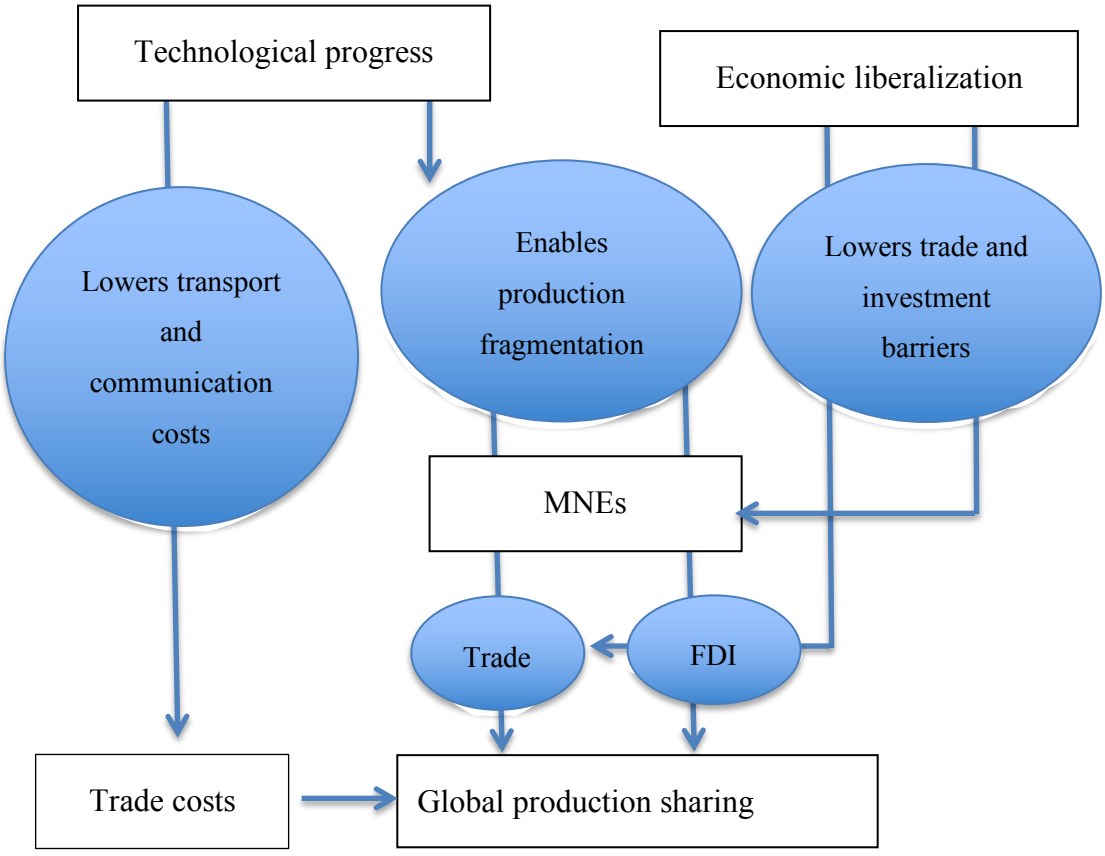
Fragmentation theory essentially extends traditional trade theory by incorporating two mutually reinforcing forces: comparative advantage and return to scale. Fragmentation allows production processes to be subject to comparative advantage in a stage of production for each participating economy. This is because each economy has workers with different skills that are required for each fragmented production process so that production dispersion can lower marginal costs as in the case of the Ricardian model. On the contrary, a production segment may be different from others due to the required factor proportion, which enables firms to relocate their labour-intensive fragments to

[8] A review of the contributions to fragmentation theory using Ricardian and Heckscher-Ohlin models can be found in the works of Arndt and Kierzkowski (2001) and Antràs and Rossi-Hansberg (2009). Spencer (2005) and Helpman (2006) review the theoretical literature on fragmentation, focusing on the organisational choices of firms, their boundaries, and incomplete contracts.

locations with lower labour costs as in the Heckscher-Ohlin model (Deardorff 2001). The implication is that rather than the average factor of the final product, it is the factor intensity of each component that determines locational choice in production. Therefore, the international division of labour tends to match factor intensities of components with the factor abundance of locations (Arndt and Kierzkowski 2001).

The emergence and proliferation of global production sharing is attributed to three factors: first, advances in production technology; second, reductions in transport and communication costs, and third, lowering trade and investment barriers (Jones and Kierzkowski 1990, 2000, Hummels *et al.* 2001, Athukorala *et al.* 2017). Figure 2.1 illustrates how each of these factors drive the process of international production sharing.

Figure 2.1 Illustration of the drivers of global production sharing



Source: Adapted from Amador and Cabral (2014).

Improved production technology

Previously, goods could be produced from a standard, integrated production system that involved design, production, delivery, and installation, all of which required coordination technologies. Thanks to improved production technology, it is now possible to assemble final goods by performing each of the exogenously specified segments separated in space and time (Jones and Kierzkowski 1990, Hummels *et al.* 2001). For example, in the electronics industry, an important reason for the high value-chain character of this industry is the high modularity of its products. Standardisation, codification, and computerisation enable interoperability of parts and components, which in turn enables the international fragmentation of production processes (Sturgeon and Memedevic 2010).

Production activities are often executed by different firms in international supply chains. Production sharing in the electronics industry, for instance, is increasingly becoming global in ways that such high modularity allows these activities to be undertaken across a large distance if transportation costs are small. Most electronics products are characterised by a high value-to-weight ratio, resulting in the rapid and inexpensive shipment of intermediate and final goods across geographical space. The coordination across different cross-country production stages is largely carried out online, hence permitting a smooth flow of information (De Backer and Miroudot 2014).

The intensity of international fragmentation varies by industry, and is determined by four characteristics of production processes: technical divisibility, factor intensity, technological complexity, and value-to-weight ratio (Lall *et al.* 2004, Soejachmoen 2012). First, not all production processes can be separated into different stages. Some industries have discrete stages with diverse scale, skill, and technology requirements so that the processes can be dispersed geographically. This is generally characterised by the electronics and automotive industries. On the contrary, the chemical industry, for example, has a continuous process that is not economically separable.

Second, the factor intensity of production dictates whether a production stage can be moved to a low-wage location or not. This will be economical only if the production process is labour-intensive and the costs saved from wages are greater than transportation and other trade costs arising from coordinating different segments of production.

Third, the complexity of technology signifies that production relocation toward a low-wage location is feasible when the technology accompanying each is simple and

sufficiently stable. In other words, not all labour-intensive processes (such as design and product development) can be moved to cheaper-wage locations with low skills or technological capabilities.

Fourth, the distance of production relocation depends on the value-to-weight ratio of products. If parts and components are light and of high value, then relocating to a farther location to exploit cost differences is economical. However, if parts and components are heavy and low value, then they tend to be kept in close geographical proximity.

Lowering transport and communication costs

The spatial dispersion of production processes is made possible due to coordination through services links. Services links (such as transport and communication) have the function of connecting separated production blocks that are located in several countries (Jones and Kierzkowski 1990). Participation in production networks is possible when the costs of services links needed to coordinate the dispersed production activities do not offset gains from lower wages and other relative costs (Kimura and Ando 2005). The international dispersion of production processes produces gains from international trade to the extent that a finer degree of disaggregation and specialisation according to comparative advantage results in greater efficiency in resource allocation (Jones and Kierzkowski 1990).

While geography is important for trade integration, the ability of firms and countries to participate in global production networks is greatly affected by the quality of infrastructure. Transport infrastructure (including roads, ports and airports) determines the cost and speed with which parts and components can be brought to manufacturing firms for processing and shipped out for further value addition (Bamber *et al.* 2014, Kowalski *et al.* 2015). Thanks to improvements in transport infrastructure, the costs of organising complex production activities over a distance have been lowered. Improved transport infrastructure has not only shrunk the physical distance, but also facilitated services links that combine separated fragments in a timely and cost-effective manner (Athukorala and Menon 2010).

Improvements in the quality of transportation services, such as greater speed and reliability, allow the reorganisation of international networks of production (Hummels 2007). Progress has been made along international supply chains, ensuring the smooth flows of goods and services in a coordinated and inexpensive manner (De Backer and

Miroudot 2014). In a world where just-in-time supply chains are currently the norm, and in which transit shipment is rapid, time literally means money. For products ranging from fruits and vegetables (perishable by nature) to apparel (depending on the whims of fashion) and to electronics (obsolete relatively fast), a delay by one day in delivery is equivalent to a tariff of one per cent or even more (Kowalski *et al.* 2015).

In addition, cheap and reliable communication technologies (such as e-mail and video-conferencing) along with a sharp reduction in information transmission costs have made it easier for firms to coordinate production facilities in diverse locations (Hummels *et al.* 2001). Information and communication infrastructure facilitates the transmission of codified design specifications, which has come to play an unprecedented role in shaping the ability of firms to participate in international supply chains across various technology spectrum (Bamber *et al.* 2014). This has transformed the organisation of international production and trade across a spatial environment. Production processes that were previously performed in close proximity can now be dispersed without impacting efficiency or timeliness of a supply chain (De Backer and Miroudot 2014).

Lowering trade and investment barriers

Improvements in production technology and services links are not the only sources of locational advantages. The third factor is attributed to lowering trade and investment barriers resulting from economic liberalisation, including under the World Trade Organization (WTO) and regional trade arrangements. Tariffs have been lowered through successive rounds of multilateral trade negotiations. The proliferation of regional trade agreements also has implications for the development of global production sharing, and contributes to the consolidation of production networks (Orefice and Rocha 2014).

The emergence of global production sharing has occurred with the expansion of international trade and foreign direct investment (Amador and Cabral 2014). Economic liberalisation and reforms have contributed to strong growth in foreign direct investment (FDI) since the 1990s. Productivity differences play a crucial role in the decisions of multinational enterprises (MNEs) to offshore parts of their production operations. Production networks coordinated by multinational enterprises are estimated to account for some 80 per cent of global trade (UNCTAD 2013a).

Many factors determine choices of country locations by MNEs. These include economic characteristics (for example, market size, and infrastructure), policy framework (for

example, investment laws and trade agreements), and policies facilitating businesses (such as the costs of doing business and investment incentives). Therefore, enabling the participation of firms in developing countries in global production sharing indicates the need to create a conducive environment for investment and trade while putting in place the necessary infrastructure (UNCTAD 2013a).

In summary, advances in information, communication and transport technology along with economic liberalisation, which lower trade and services links costs, have facilitated international fragmentation of production and have allowed wider participation of developing countries. The lowering costs of services links facilitate the coordination of production activities across geographical spaces while falling international trade costs make it cheaper and easier to move goods, including parts and components, across borders. These two issues comprise the core subject matter relevant to analysing the integration of LLDCs into global production sharing by overcoming the tyranny of distance.

Implications for landlocked developing countries

Being landlocked has a profound impact on the trade and development trajectory of countries without direct access to the sea. Many landlocked developing countries are at the bottom end of international rankings with respect to national incomes and social development indicators (Collier 2007). In fact, 17 landlocked developing countries are classified as least developed countries (LDCs). Laos is among the LDC grouping given its low human development assets and economic vulnerability index.

Landlocked developing countries find themselves structurally disadvantaged given the high costs of international trade that they face. The costs of international trade are not only influenced by geographical attributes. Trade costs include the range of costs incurred from the factory where the goods are designed, produced and delivered to final consumers (OECD 2013). These costs encompass not only those incurred because of tariffs and non-tariff measures but also transport and port expenses, freight and insurance costs, and mark-ups by importers, wholesalers and retailers.

The impact of trade costs is reflected in the trade compositions of LLDCs. Most of them are commodity-dependent, with primary and resource-based manufactured products accounting for over half of the total exports of 27 out of 32 landlocked developing countries (see Table 2.1). The share of commodities in exports ranges from 68 per cent in Swaziland to as high as 99 per cent in Chad. Only a handful of LLDCs are less

dependent on commodity exports, including Lesotho in Africa, Bhutan and Nepal in Asia, and the former Yugoslav Republic of Macedonia and Moldova in Eastern Europe.

Table 2.1 Export compositions of LLDCs, 2014–2015 average

	Primary products	Manufactured products			
		Resource-based	Low-technology	Medium-technology	High-technology
Afghanistan	83.5	10.5	3.5	1.5	1.0
Armenia	28.5	52.5	9.0	9.5	1.0
Azerbaijan	94.0	4.5	0.5	0.3	-
Bhutan	15.5	7.0	2.5	61.0	13.5
Bolivia	44.0	50.5	3.5	2.0	-
Botswana	3.5	91.5	1.5	3.0	1.0
Burkina Faso	19.5	78.0	0.5	0.5	1.0
Burundi	50.5	43.5	3.0	1.5	1.5
Central African Republic	14.0	82.5	1.0	1.5	1.0
Chad	95.0	4.0	0.5	-	0.5
Ethiopia	70.0	16.5	10.0	3.0	1.0
Kazakhstan	80.0	11.5	2.5	5.0	1.5
Kyrgyzstan	20.0	66.0	10.0	2.5	1.0
Laos	45.0	37.5	6.0	4.0	7.5
Lesotho	4.0	45.5	42.5	6.5	1.5
Macedonia, former Yugoslav Republic	12.0	9.5	25.0	51.5	2.0
Malawi	87.0	8.5	3.0	1.0	-
Mali	20.5	75.5	1.5	2.0	0.5
Moldova	32.0	14.0	36.0	15.5	3.0
Mongolia	47.0	47.0	3.5	1.0	1.0
Nepal	16.0	14.5	62.5	6.5	1.0
Niger	44.0	46.0	3.0	5.0	2.0
Paraguay	83.0	7.0	6.5	3.0	-
Rwanda	36.5	61.0	1.0	0.5	1.0
South Sudan	-	-	-	-	-
Swaziland	4.0	64.0	11.5	19.0	1.5
Tajikistan	53.5	41.0	3.5	1.5	0.5
Turkmenistan	38.5	43.0	16.0	1.5	1.5
Uganda	77.0	12.5	7.0	2.5	0.5
Uzbekistan	33.0	38.5	18.5	8.5	1.0
Zambia	88.0	8.0	1.0	3.0	-
Zimbabwe	63.5	21.0	3.0	12.5	-

Note: Product classification follows the World Bank (2013). Calculated in a two-year average using mirrored statistics in HS2002 nomenclature. Manufactured products are HS 28 to 97.

Source: Author's calculations from UN Comtrade.

This is also consistent with the finding in UNCTAD (2014) that resource-based activities dominate in most LLDCs, with the average share of these goods in their export baskets being around 66 per cent, ranging from 33.0 per cent to 95.6 per cent during the 2010–2012 period. World Bank and UN-OHRLLS (2014) reveal that five products are found to contribute at least 90 per cent of exports in a third of LLDCs. The share of fuel exports in Azerbaijan, Kazakhstan, and Bolivia in particular has increased significantly. Landlocked developing countries exhibit little diversification not only in terms of export compositions but also in terms of export markets (World Bank and UN-OHRLLS 2014).

However, some landlocked countries do not necessarily suffer because of their landlocked status. Out of 44 landlocked countries, nine are categorised as high-income economies. [9] Landlocked countries may focus on economic activities, the competitiveness of which is less sensitive to distance and transportation, as well as promote stronger regional trade links in order to mitigate the adverse impact of their geographical remoteness (UNCTAD 2014). Reducing international trade costs is of great importance from a policy perspective since they are an important determinant of a country's ability to lift output potential through taking part in global production sharing. International production sharing opens up opportunities for LLDCs to tap into production networks that are proliferating globally and specialising in supplying high-value-to-weight parts and components for which air freight is the major mode of transport (Hummels 2009, Athukorala *et al.* 2017).

Distance had often been assumed to be among the main determinants of the costs of international trade and also of countries' participation in production sharing. However, recent empirical studies suggest that it is not distance itself that is a direct impediment to trade, but rather transport connectivity and hosts of other policies (Faye *et al.* 2004, Nicita *et al.* 2013, Kowalski *et al.* 2015). Trade costs related to geographical factors matter, but their importance can be reduced through improving services links associated with policies.

While infrastructure development is an important element in enabling landlocked economies to participate in global production sharing, building infrastructure alone

[9] Landlocked developed countries are those with per capita incomes in 2015 over US$12,475, according to the World Bank's classification using the Atlas method. These are Andorra, Austria, Czech Republic, Hungary, Liechtenstein, Luxembourg, San Marino, Slovak Republic, and Switzerland.

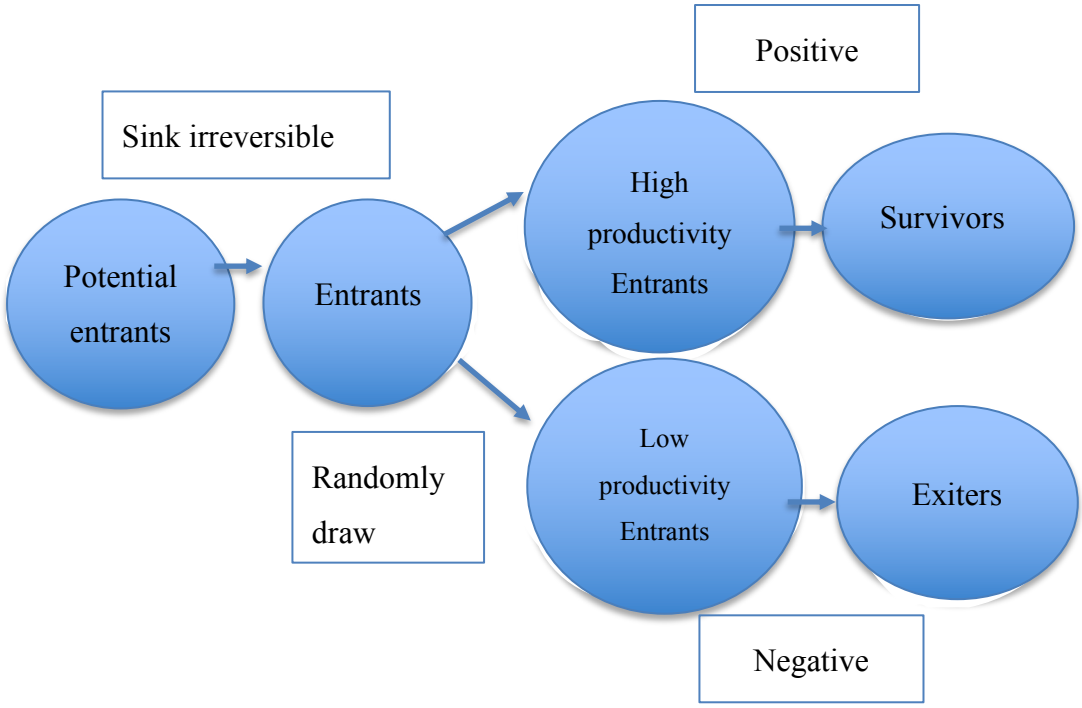
without changes in policies to improve administrative efficiency will not necessarily lead to lower transport costs (Kowalski *et al.* 2015). Logistics services are more important for limiting the costs of being landlocked than investing massively in infrastructure that neglects the functioning of logistics services (Arvis *et al.* 2010).

In addition, GPS-oriented policies need to consider the role of imports as well as exports. They also need to consider the impact of border delays since participation in geographically fragmented supply chains requires speedy and cheap movement of goods over international borders (Bamber *et al.* 2014). International production sharing is, in particular, affected by trade barriers. Because goods along with parts and components cross borders multiple times, as both imports and exports, trade costs can be compounded (World Bank *et al.* 2017).

Firm heterogeneity theory

The Jones-Kierzkowski framework of 1990 for analysing production fragmentation represents a major improvement in the understanding of global production sharing. It is still, however, based on the notion of inter-country trade, leaving little scope for understanding how players at the industry level influence international trade. Another stream of theory relevant to this research is one that incorporates firms' heterogenous characteristics (Melitz 2003, Bernard and Jensen 2004). The firm heterogeneity model suggests that firms can export by paying a fixed entry cost that is irreversible once invested. Each firm has to make a productivity draw from an exogenous distribution specifying which types of firms should export or not export (see Figure 2.2).

Figure 2.2 Firms' export behaviours and productivity



Source: Greenaway and Kneller (2007).

The existence of fixed costs (such as information searching or compliance with exporting markets) implies that firms drawing a productivity level below the cut-off of zero-profit productivity would make negative profits and therefore exit. Fixed and variable costs of exporting guarantee that only firms that draw productivity above a higher productivity cut-off find it profitable to engage in export activities (Bernard et al. 2011). Entry into foreign markets incurs a fixed cost and only firms that are highly productive can exploit economies of scale (the cost advantage experienced by firms when they increase output level) necessary to self-select into foreign markets (Melitz 2003).

It follows that exporters are generally more productive as reflected in their larger size and other firm characteristics than are non-exporting firms (Bernard *et al.* 2011). The implication is that firms that are purely local will not be able to produce and sell within global production sharing. These firms need a link with multinational enterprises, either through trade or investment ventures, at least at a formative stage to be able to engage in global production sharing.

Gains from trade arise from expansion in market size, and reduction in fixed or variable costs. The market expansion effect is due to the enlargement of trading blocs while the

cost reduction effect results from actual cost reduction or lowering trade barriers. The key implication of this model is that trade liberalisation will induce resource reallocation from less productive firms to more productive firms. This, in turn, improves the overall efficiency of the industry and helps realise comparative advantage, which contributes to welfare gains from trade (Melitz and Redding 2014).

Subsequent research has explored a number of dimensions of the theory of firm heterogeneity and international trade. This includes studies that develop a theoretical framework about the links between comparative advantage and firms' heterogeneous characteristics (Bernard *et al.* 2007), variable mark-ups and market size (Melitz and Ottaviano 2008), multi-product plants (Bernard *et al.* 2011, Mayer *et al.* 2011), organisation of firms and international trade (Antràs and Helpman 2006), and frictions in the labour market (Egger and Kreickemeier 2009, Helpman and Itskhoki 2010).

Empirical literature on firm heterogeneity has flourished since the late 1990s, which is fuelled by two complementary developments. First, a major theoretical breakthrough led by Melitz (2003) and others provided a novel way of thinking about firms' heterogeneous characteristics and their participation in international trade. Second, the growing availability of datasets has facilitated detailed analysis of firm behaviours in global and regional trade (Bernard *et al.* 2011).

An early study by Bernard and Jensen (1999) finds that productive firms in the United States become exporters, and that exporting is linked to plant size expansion. However, a lack of productivity gains appears to suggest that a firm's entry into the export market is not likely to raise its productivity, even if it tends to export continuously. Clerides *et al.* (1998) found no evidence of differences in productivity growth between exporters and non-exporters in Mexico, Colombia and Morocco. Later studies included those undertaken by Renard (2002) in China, Kasahara and Rodrigue (2008) in Chile, and Nguyen and Nishijima (2009) on Vietnam. These findings tend to suggest self-selection; that is, exporters are more productive (a condition which does not necessarily result from exporting itself) because only the most productive firms can overcome the fixed costs associated with entering export markets.

Studies of the determinants of firms' exports in Laos include those conducted by Kongmanila and Takahashi (2009), Kyophilavong (2011), and Nolintha and Jajri (2015). Nolintha and Jajri (2015) find that manufacturing firms in Laos have achieved considerable technological upgrading, and that firm performance is determined by export activities. Using a field survey of an industrial cluster among Lao garment

factories, Kongmanila and Takahashi (2009) discover that product and process innovations are important factors in determining firms' export performance and profitability. Kyophilavong (2011) finds that access to finance is another important determinant that affects firms' export performance since credits to support working capital and investment are deemed necessary.

2.3 Mapping global production sharing

The high complexity of international supply chains makes it difficult to measure and map global production sharing in a single, simple way. However, a few methodologies have been used in the empirical literature to quantify the magnitude and the pattern of global production sharing at both the country and firm levels.

Measurements at the country level

For the country-level analysis, there are three methodological approaches: processing-trade-based, trade-based, and trade based on value-added measures. These approaches are discussed in turn below.

Processing-trade-based approach

The first approach relies on outward-processing trade (OPT) by drawing on data from the Organisation for Economic Co-operation and Development (OECD). This characterises a scenario in which the stages of production of an MNE's manufacturing activities are shifted overseas so that products are initially exported for processing, and then re-imported.[10] The statistics include information on trade associated with customs arrangements in which tariff preferences are granted corresponding to the domestic-input content of imports. This approach was applied by Feenstra (1998), Egger and Egger (2005), and Hanson *et al.* (2005). Hanson *et al.* (2005) find that the growth of global trade has been driven largely by the rapid growth of trade in intermediate inputs, much of which involves multinational enterprises locating input processing in their foreign affiliates. In analysing bilateral processing trade flows of the EU 12 countries over the period 1988–1999, Egger and Egger (2005) find that infrastructure, relative factor endowments, and other cost variables are important determinants for the EU's outward-processing trade.

[10] A related concept is inward-processing trade (IPT).

Although this approach can map production sharing through the linkage between international trade and MNEs, one notable drawback is the focus is mainly on the European Union and the United States (Amador and Cabral 2014). This may underestimate the true extent of international production fragmentation, which is increasingly participated in by many developing countries. In addition, not all products are covered under outward-processing trade and product coverage appears to vary over time (Wignaraja *et al.* 2013).

Trade-based approach

The trade-based approach separates trade in parts and components from trade in final goods in sectors that are dominated by international production sharing. The logic behind this approach is that in fragmented production processes, parts and components or partially manufactured sub-assemblies cross international borders before final goods are produced and then shipped to final markets. The list of parts and components was identified at a detailed level using the United Nations Broader Economic Categories (BEC) classification or its modification. The trade-based approach was adopted in Yeats (1999), Ng and Yeats (2003a), Sturgeon and Memedevic (2010), and Athukorala and Kohpaiboon (2013).

Using this approach, Yeats (1999) finds that trade in parts and components has grown much faster than trade in final goods in OECD economies, with parts and components being estimated to account for 30 per cent of the world's trade in manufactured goods in 1995. Sturgeon and Memedevic (2010) also find that the electronics industry drives intermediate goods trade the most compared to the motor vehicle and apparel industries. Athukorala and Kohpaiboon (2013) suggest that the significance of trade in parts and components has loomed larger for East Asian developing economies, in particular for China and the Association of Southeast Asian Nations (ASEAN). Trade in parts and components and final assembly dominated by global production sharing constitute almost two-thirds of the exports of Singapore, Malaysia, Thailand, and the Philippines. Vietnam has witnessed a rapid growth in global supply chains, although from a small base, while Cambodia began as late as 2012 to participate in regional production sharing on a modest scale (Athukorala and Kohpaiboon 2013).

The chief advantage of the trade-based measure of production network is the high coverage of countries, which is very useful for research that focuses on developing countries. It is also less difficult to obtain trade data for mapping the pattern of global production networks in various sectors at a highly disaggregated level. Another

advantage is that this approach allows for a relationship among specific trading partners to be identified and compared over a long period of time.

One of the drawbacks of this measurement may be its low accuracy as it relies heavily on the product classification available from international trade statistics (Amador and Cabral 2014). In addition, trade data does not show the different stages of manufacturing of a given product across borders, while fragmentation often involves the same product undergoing different processes in several economies (Lall *et al.* 2004).

Value-added-based approach

Another measurement is by mapping value-added in a supply chain within vertical specialisation. The basic concept is that domestic value-added combines with foreign inputs to produce exports. National accounts are consolidated with data on bilateral trade into a consistent framework, allowing value adding in exports to be decomposed into domestic and foreign components. The domestic value-added in exports corresponds to the accumulation of the value-added component incorporated in each of the domestic sectors that contribute to the supply chain. The foreign content of exports, also known as import content, provides an estimate of trade between countries involved in international supply chains.

Value-added trade can be captured through applying a vertical specialisation formula based on international input-output tables, including those implemented by Hummels *et al.* (2001), Yi (2003), Johnson and Noguera (2012), UNCTAD (2013), and Koopman *et al.* (2014). The share of value-added trade by developing countries is increasing rapidly. It grew from around 20 per cent of the world's value-added trade in 1990 to over 40 per cent in 2010 (UNCTAD 2013a). This growth in the share of value-added trade is driven primarily by the growth attributed to downstream use in production sharing of natural resources and raw materials. The variations in the relative size of different components of exports across countries provide a way to gauge the differences in the role that these countries play in global production networks. For example, most of the exports of the United States reflect its own domestic value-added while the domestic value-added of China and Mexico accounts for less than half the value of their processed exports (Koopman *et al.* 2014).

A key advantage of this approach is that it helps overcome the weaknesses of the trade-based measurement, which tends to overstate the domestic (value-added) content of exports (Johnson and Noguera 2012, UNCTAD 2013a). Conventional statistics on gross

trade may double count the net value-added of exports as production sharing involved in multiple-border crossings of parts and components. However, it is not possible to use this methodology in this thesis since the development of value-added measurement is still ongoing in most developing countries (Wignaraja *et al.* 2013).

This research adopts a trade-based approach, which is the only possible way to undertake a comprehensive analysis of trade patterns at the country level. Value-added trade data are basically relevant only for analysing bilateral trade imbalances. In reality, trade policy can focus only on trade in gross terms. Value-added is the outcome of firms' operation in manufacturing. In addition, per unit value-added (value-added as a percentage of gross output, which is the focus of OECD value-added trade data) is diminishing because of international fragmentation of production (Athukorala *et al.* 2017).

This method follows Athukorala and Talgaswatta (2016) in delineating trade in parts and components (P&Cs) and final products. The list of P&Cs is identified by mapping the intermediate products subcategory of the BEC at the five-digit level of the Standard International Trade Classification (SITC) in eight product categories: office machines and automatic data processing machines (SITC 75), telecommunication and sound recording equipment (SITC 76), electrical machinery (SITC 77), road vehicles (SITC 78), other transport equipment (SITC 79), professional and scientific equipment (SITC 87), photographic apparatus (SITC 88), and textiles and garments (SITC 65+724+84). See the list of parts and components that correspond to these product categories in Appendix 2.A. Final products are calculated from deducting P&Cs from the aggregate trade statistics reported in the United Nations Comtrade database. The data are tabulated using partner-reported statistics, which is considered to be more suitable for analysing trade involving a large group of developing countries. This method is less susceptible to recording errors and can capture the origins and compositions of trade more accurately than the data reported by exporters (Feenstra *et al.* 2005).

Measurements at the firm level

For firm-level analysis, available empirical studies do not adopt a common methodology. Qualitative survey data related to the international relocation of production activities have also been deployed while other studies rely on international trade data to quantify the relevance of offshoring operations. Some studies examine the international transfer of production activities within multinational enterprises, focusing only on this specific group of firms. Other studies use the relative importance of

interactions between affiliates as a measure of offshoring (Amador and Cabral 2014).

Although firm-level data is available for Laos (including enterprise surveys conducted by the World Bank and German Development Co-operation Agency or GIZ), the collected information does not permit us to identify which firms are involved in global production sharing. Ideally, information on firms' participation in global production sharing should reflect how firms engage in international supply chains. To get this information, comprehensive data collection needs to be done, and this is not only costly but also time-consuming. Therefore, this thesis examines the behaviour of firms in engaging in international trade instead, and this is supplemented by case studies for some sectors. As shown in Chapter 6, most firms in the garments and electronics industries are involved in global production sharing. The study of firms' engagement in international trade can give some indications about their involvement in production sharing as earlier discussed.

2.4 Research methodologies

The key questions in the thesis are: how do geographical circumstances affect Laos' ability to integrate in the international economy? And, what policies are important for the country's future trade and development? What is the relative importance of trade costs associated with geographical and other factors in influencing the participation of countries in global production sharing? What factors determine the export performance of firms in engaging in international trade?

To answer these questions, there is a need to disentangle the different dimensions of economic integration, including at international, national, industry, and firm levels. Chapter 3 looks into the integration experience of the small landlocked economy of Laos, providing the context for analyses in the ensuring chapters. Chapters 4 and 5 apply quantitative modelling to examine the factors that influence economic integration at cross-country and firm levels. The framework for the macroeconomic and microeconomic analyses conducted in these two chapters is based on international fragmentation and firm heterogeneity theories. Chapter 6 takes an industry perspective to analyse the textile and garment sector as well as the electronics sector.

Analysing global production sharing and landlocked developing countries

Fragmentation theory provides a theoretical foundation for understanding the emergence of global production sharing while a gravity model of trade helps explain

determinants of bilateral trade between countries. Gravity modelling has been widely used to examine trade relations, explaining the role of policy-related factors and other characteristics of trade (Armstrong 2009b). Services links have been found to be critical to enhancing networked trade. Maritime transport and logistics connectivity serve as the key determinants of bilateral trade costs, whereby their combined effect is comparable to those arising from geographical distance (Arvis *et al.* 2013). Trade in parts and components is particularly sensitive to transportation speed as each day that goods are in transit is equivalent to an ad-valorem tariff of 0.6 per cent to 2.3 per cent (Hummels and Schaur 2012). This suggests a linkage between a reduction in the cost of rapid transportation and expansion in international production sharing. Landlockedness and weak transport infrastructure raise trade costs and hence impose substantial binding constraints on trade, in particular for landlocked developing countries.

The gravity model originated from the law of gravitation pioneered by Tinbergen (1962), which explains that countries are expected to trade more on average the larger they are, and trade less the further they are apart. An early use of the gravity model was criticised for a lack of theoretical underpinnings as it was implemented to simply fit the observed features of bilateral trade. However, the situation has changed with rigorous derivations of gravity equations led by Anderson (1979), Bergstrand (1985), and Anderson and Van Wincoop (2003), among others. Modern gravity modelling application now relies on structural equations supported by theoretically consistent derivations of a gravity equation.

Structural gravity models can be derived by either demand- or supply-side techniques (Head and Mayer 2014). In the former, an exogenous wage along with a constant mark-up assumption neutralises the supply side of a gravity equation. Examples of demand-side gravity derivations include the Anderson-Armington model based on a differentiated production assumption (Anderson 1979). As for the supply-side gravity model formulation, the derivations assume either Fréchet or Pareto distribution of productivity, which eliminates demand-side terms from the final equation. The models of Eaton and Kortum (2002) and Helpman *et al.* (2008), the key assumptions of which are based on heterogeneity in industries and firms, exemplify supply-side gravity model derivations. The current study bases its theoretical framework on an approach adopted by Baldwin and Taglioni (2011), which is in fact based on Anderson and Van Wincoop (2003), in deriving the demand-side gravity equation for explaining networked trade.

A gravity model is employed to delineate the impacts of geographical factors and trade-

induced factors on countries' participation in global production sharing in Chapter 4. A gravity model is adapted to explain trade in parts and components, and final products dominated by global production sharing (or networked trade), using panel data that covers 191 economies between the years 2000 to 2014. The analysis only covers trade in goods as data on services-related production networks is not readily available for the majority of developing countries.

Analysing the determinants of firms' export performance

The process of economic integration ultimately depends upon the behaviour and actions of the private sector. Understanding the characteristics and behaviour of firms that are connected to the international market is important to formulating policy strategies that seek to maximise the advantages of international engagement and its capacity to promote economic growth and welfare.

In this light, Chapter 5 investigates international integration from a firm-level perspective. The theory of firm heterogeneity provides a framework within which to explain how firms get involved in international trade. These firms need foreign affiliation with multinational corporations, either through trade or investment, at least at an initial stage, to engage in global production sharing. Entry into foreign markets incurs a fixed cost and only firms that are highly productive can exploit economies of scale and self-select into exporting (Melitz 2003). The literature suggests that exporters are generally more productive, as reflected in their larger size and other firm characteristics, than are non-exporting firms (Bernard *et al.* 2011). This chapter therefore examines the importance of firm characteristics on export performance, taking Laos as a case study.

A key dataset used in this study is the enterprise surveys conducted by the World Bank, which are available for Laos in 2009, 2012, and 2016. The dataset provides information on enterprises' status, ownership, access to infrastructure and services, sale and supplies, degree of competition, access to technology, capacity, finance, government support, business environment, performance, and labour, among others. Sample design is based on stratified random sampling to obtain unbiased estimates for different subdivisions of the population and to ensure that the final total sample includes establishments from diverse sectors (Vilavong *et al.* 2016).

Undertaking sectoral case studies

Chapter 6 presents case studies in order to better understand the dynamics and

development contributions of the textile and garment sector, and the electronics sector. Global production sharing can be categorised as being either buyer-driven or producer-driven. The buyer-driven type is generally found in consumer goods industries such as garments, footwear, travel goods toys, and handicrafts (Athukorala 2017). In this type of production sharing, lead firms in supply chains are international buyers, including large retailers (such as Walmart, and Marks & Spencer). Production sharing takes place principally through an arm's length relationship with intermediaries playing a key role in linking producers in developing countries with lead firms (Gereffi 1999).

Producer-driven production sharing is common in vertically integrated industries such as electronics and automobiles as well as scientific and medical devices (Athukorala 2017). In this type of global production sharing, lead firms are multinational corporations (for example, Intel, Apple and Samsung), and the bulk of production sharing in these industries tends to take place through intra-firm linkages rather than in an arm's-length relationship (Kawakami and Sturgeon 2011). Although the electronics industry as a whole is considered to be high-technology manufacturing, some of the tasks in the production process are quite labour-intensive, and can be performed in a low-wage country like Laos.

In this light, the main characteristics of global production sharing in the textiles and garments, and electronics sectors are reviewed. Recent developments in these industries are also mapped. This is to establish how Laos fares compared to its regional competitors. Fieldwork surveys are conducted in Laos to supplement information gathered from desk research.

2.5 Concluding remarks

This chapter has reviewed the relevant theoretical and empirical literature to develop a framework for explaining the trade and development challenges of the small landlocked economy of Laos. The dispersion of production processes, made possible by falling trade costs and improved services links, is now common in many sectors and involves an increasing number of countries. This opens up opportunities for a landlocked developing country to tap into certain stages of production that are commensurate with its endowments and productive capacity.

This chapter lays out multiple approaches to understand the process of economic integration within the context of Laos. Apart from qualitative research used to analyse the integration experience of Laos (Chapter 3) and sectoral case studies (Chapter 6),

macroeconomic and microeconomic analyses using quantitative modelling are also undertaken (Chapters 4 and 5). At the country level, the theory of fragmentation attributes the drivers of global production networks to three factors: progress in production technology, lowering transport and communication costs, and lowering trade and investment barriers. This theory provides a basis for applying a gravity model for the empirical testing to be conducted in Chapter 4 on the determinants of countries' participation in global produciton sharing, focusing on natural and policy-related factors that are relevant to LLDCs. At the firm level, firm heterogeneity theory suggests that firm-specific factors affect firms' productivity and varying degrees of export performance. This paves the ground for an empirical exercise to be conducted in Chapter 5, using Laos as a case study.

3 Laos' Integration into the International Economy

3.1 Introduction

To overcome the disadvantages that come from being landlocked, Laos has embraced a process of opening up to the international economy. Economic liberalisation that started in 1986 and the accompanying domestic reforms have paid off with a remarkable turnaround in its economic performance. Laos is among the fastest growing economies in Southeast Asia, with economic growth averaging 7.8 per cent over the decade to 2016. The growth has also resulted in gradual structural change with growing contributions to national output from the industrial and services sectors. Laos has also become a lower middle-income economy and has achieved success in poverty reduction. However, recent growth is still driven from a narrow economic base dominated by low-productivity agriculture and natural resources. A major challenge for Laos is to continue to sustain development by opening up more of the economy to international competition while managing the process of structural change and managing the volatility that an open economy brings, especially in the natural resource sector. Doing so will help sustain growth across a diversity of sectors and creates jobs for a larger population. More importantly, Laos still remains one of the least developed countries (LDCs) classified by the United Nations. The goal to graduate from LDC status by 2020 presents a pressing need to explore how the country can sustain its current growth path and ensure that development outcomes are sustainable and inclusive.

This chapter evaluates the integration of Laos into the international economy, following its trade and investment reforms and increased economic openness. The chapter proceeds as follows. Section 3.2 provides historical context for a series of economic reforms that Laos has undertaken while Section 3.3 tracks the country's economic performance. Economic reforms led not only to economic growth but also to structural change and a rising role of the natural resource sector in the production and export base. Section 3.4 discusses some challenges and how Laos can move forward. The final section concludes.

3.2 Trade liberalisation and domestic reforms

The overall development strategy of Laos is laid out in the national socioeconomic development plan, which is updated every five years. The current plan, covering the

period 2016–2020, sets goals for Laos to graduate from least developed country status by 2020 through maintaining robust economic growth, ensuring macroeconomic stability, and continuing economic liberalisation. Liberalisation is expected to help enhance the potential of a landlocked country like Laos to better integrate into the regional and global economy through trade and investment linkages.

This section reviews the evolution of the economic liberalisation and domestic policy reforms undertaken by Laos. The developments can be divided into two important phases: a period in which the economy was closed and a period of transition toward a market-oriented economy.

Closed economy (1975 to 1985)

The legacy of colonial neglect and civil conflict left Laos as one of the world's poorest nations in the 1970s. It had been bombed extensively during the Indo-China War, and is estimated to have the highest amount of unexploded ordnance per capita in the world (Bird and Hill 2010). Laos was classified as a least developed country by the United Nations in 1971.

After independence in 1975, the country adopted an inward-looking development strategy and a centrally planned economic model. Most large factories were nationalised. Laos also attempted to introduce agricultural collectivisation, even though the scale of collectivisation was not as large as in Vietnam and other former communist countries. Foreign trade with the West had virtually ceased and Laos was in effect trading formally with Soviet-bloc countries only (Otani and Pham 1996).

In the second half of the 1970s, national output began to decline and this was followed by financial instability, and the lowering of overall living standards (Otani and Pham 1996). This was largely the result of foreign capital flight and the emigration of the country's intellectuals. Poor economic performance in the late 1970s forced the first steps toward economic reforms (Douangboupha 2010).

Economy in transition (1986 to present)

The 'New Economic Mechanism' (NEM) was launched in 1986. It aimed to transform Laos from subsistence farming to a commercialised economy. The economic reforms fell into two phases. In the first period between 1986 and 1999, small trading establishments were consolidated and their trading operations were no longer interfered with by the government (Otani and Pham 1996, Douangboupha 2010). Restrictions in domestic and foreign trade were also eased. Price controls (with the exception of

utilities and some strategic sectors, such as cement and fuels) were liberalised. The reform and restructuring of state-owned enterprises (SOEs) commenced. The number of SOEs fell from around 800 in the 1990s to 37 enterprises in 2002. Most SOEs that were privatised in the 1990s were in services sectors such as telecoms, transport, insurance, real estate, and tourism (World Trade Organization 2012).

The tariff structure was simplified, and tariff rates were reduced following a major reform in 1995. Previously, there were 12 tariff bands, ranging from 5 per cent to 100 per cent. The top rate was lowered to 40 per cent and the number of bands reduced to six: 5 per cent, 10 per cent, 15 per cent, 20 per cent, 30 per cent, and 40 per cent. Higher import tariffs were generally applied to agricultural products than to industrial products. Low tariffs (10 per cent or lower) were set on imported raw materials and agricultural inputs. The highest rate (40 per cent) applied to luxury goods, including alcohol and perfumes, as well as manufactured products (World Bank 2006).

Domestic reforms were temporarily stalled by the interrelated events that resulted in serious macroeconomic problems in Laos at the time of the 1997 Asian Financial Crisis (AFC). There was a short-term loss of macroeconomic control with a brief period of hyperinflation and substantial depreciation in the nominal exchange rate. The exchange rate collapsed and economic contraction in other Asian economies put the reform momentum of Laos on hold in the late 1990s.

The second phase of reforms resumed after Laos was able to restore macroeconomic stability in 2000. These reforms included further trade liberalisation, foreign exchange deregulation, and liberalising the investment regime. This has resulted in the gradual transformation of the Lao economy from a centrally planned system to a more open, market-driven one (Pholsena and Vilavong 2015). The short period of central planning has mitigated the transition to a market economy. The smooth transition is attributed to geographical location, where the success of nearby Vietnam had a positive demonstration effect for Laos (Bird and Hill 2010). Apart from that, Laos was able to take advantage of the superior transport infrastructure of neighbouring countries.

In the area of trade liberalisation, the priority was on integration into the regional and global economy. The economic liberalisation of Laos is, to a large extent, shaped by Laos' membership in the Association of Southeast Asian Nations (ASEAN) and its accession to the World Trade Organization (WTO).

Regional economic integration

Laos joined ASEAN in July 1997. Under the ASEAN Free Trade Area (AFTA), the country committed to eliminate import duties on 96.3 per cent of its products by 2018. Some products (such as fuels, automobiles, and alcoholic beverages), which had significant revenue effects, were phased in between 2015 and 2018. Laos maintains 87 tariff lines (such as arms, ammunition, and drugs) under the general exception list, which is not subject to any tariff reductions. As of January 2017, 89.3 per cent of Laos' products were zero, 7 per cent were less than 5 per cent, and the remainder (2.8 per cent) were at 5 per cent, according to the Department of Foreign Trade Policy of Laos.

As the remaining tariff reductions are phased in, Laos is expected to lose considerable customs revenue. The government has therefore tried to shift its revenue base from import tariffs, in particular from vehicles and other luxury imports, to value-added and excise taxes. At the same time, lowering import duties is expected to help improve the efficiency of firms utilising imported inputs as well as benefit consumers through lower prices and allowing more choices.

In parallel to its tariff commitments in ASEAN, Laos is also obligated to eliminate non-tariff barriers (NTBs). These NTBs include import quotas, unreasonable standards, import licences and other restrictions at the border. Laos has engaged in various regional initiatives to strengthen its institutional capacity related to standards and technical regulations. The country joined the ASEAN consultative committee on standards and quality in 1998. Laos is also implementing a mutual recognition arrangement (MRA) on ASEAN conformity assessment and is a member of the ASEAN MRA for electrical and electronics equipment.

Apart from trade in goods, Laos is also a member of the ASEAN Framework Agreement on Services (AFAS). The AFAS sets out specific targets for lifting substantially all restrictions on trade in services: by 2010 for four priority sectors (air transport, computer and telecoms, healthcare, and tourism services), by 2013 for logistics services, and by 2015 for all other services sectors. By the end of 2015, nine AFAS packages were concluded. Laos liberalised 92 services subsectors out of a total of around 160 subsectors. By comparison, Cambodia made commitments in 94 sectors and Vietnam in 99 sectors (ASEAN Secretariat 2015). Laos put forward the 10th package of AFAS in mid-2017, raising sectoral coverage to 110 services subsectors.

Laos has also engaged in regional trade negotiations with the dialogue partners of ASEAN. These include Australia, China, Japan, India, New Zealand, and South Korea

(see a summary in Table 3.1). Negotiations have been ongoing to consolidate these agreements into the Regional Comprehensive Economic Partnership (RCEP) arrangement. Laos is also a party to the Asia-Pacific Trade Agreement (APTA), previously known as the Bangkok Agreement. The members of APTA are Bangladesh, China, India, South Korea, Laos, and Sri Lanka.

Table 3.1 Key trade liberalisation timeline

Timeline	Trade liberalisation	Remarks
1997	Joined the Association of Southeast Asian Nations	Under the AFTA, import duties were to be lowered to 0–5 per cent for most products, with phase-in implementation by 2018 for new members. The ASEAN Framework Agreement on Services and the Agreement on ASEAN Investment Area were also concluded.
1997	Applied for membership of the WTO	Became an observer in 1998.
2007	ASEAN-China Free Trade Agreement concluded	This agreement entered into force in 2005 (trade in goods) and 2007 (trade in services), with phase-in implementation by 2020.
2008	ASEAN-Korea Free Trade Agreement concluded	This agreement covers trade in goods and in services, entering into force in 2010, with phase-in implementation by 2024.
2008	ASEAN-Japan Free Trade Agreement concluded	This agreement covers trade in goods and in services, entering into force in 2008, with phase-in implementation by 2026.
2009	ASEAN and Australia-New Zealand Free Trade Agreement concluded	This agreement covers trade in goods and in services, entering into force in 2010, with phase-in implementation by 2025.
2013	Became a full member of the WTO	Tariffs binding at a maximum rate of 18.8 per cent on average. Services liberalisation covers 79 out of 160 sub-sectors.
2014	ASEAN-India Free Trade Agreement concluded	This agreement entered into force in 2010 (trade in goods) and 2015 (trade in services), with phase-in implementation by 2024.
2016	ASEAN Economic Community (AEC) commenced	The AEC Blueprint 2025 sets out a vision for ASEAN to become highly intra-regional, integrated, competitive, and dynamic.

Source: Author’s compilations from the WTO's regional trade agreements.

WTO membership negotiations and post-accession implementation

Laos applied to join the World Trade Organization in 1997, the same year that it was admitted into ASEAN. Laos took 15 years to complete the WTO accession negotiations and became the 158th member of the WTO on 2 February 2013. The accession process was a long one as it involved building national consensus and aligning domestic policies with international practices. Around 90 laws and regulations governing economic activities had been enacted or revised during the years leading up to the WTO membership (Pholsena and Vilavong 2015). For example, the Decree on Import Licensing of 2007 abolished trade balancing requirements while the 2011 Tax Law addressed excise tax rates that were imposed differently between imported and domestically produced goods.

In joining the World Trade Organization, Laos has undertaken commitments on trade in goods and in services. Tariffs were bound at a maximum rate of 18.8 per cent on average: 19.3 per cent for agricultural products, and 18.7 per cent for industrial products.[11] As for services, Laos committed to liberalise 79 subsectors, including those in business services, telecoms, construction, distribution, education, environment, banking, tourism, and air transport services. Some commitments are allowed for phase-in implementation between 3 and 7 years after accession.

The commitments that Laos undertakes are also in the form of legislative reforms to ensure compliance with WTO general principles (such as non-discrimination and transparency), and some specific agreements. These include trading rights, import licensing procedures, standards, and technical regulations. The majority of these commitments were to be implemented on the date of WTO membership while others were subject to phase-in periods of up to 3 years after accession.

In terms of post-accession implementation, an official gazette has been established as part of a transparency requirement. The gazette provides an avenue for businesses to comment on and have ready access to legislation. In addition, a trade portal has been created, acting as an online platform providing publicly accessible laws and regulations, but it is more trade-related. The platform also provides a comprehensive and searchable

[11] Import tariffs under the WTO are of two types: bound and applied rates. Bound rates are the ceiling rates as listed in WTO members' schedules or lists of commitments. Applied rates are the rates that a particular member currently charges on imports from other members, which can be lower than the bound rates.

database for businesses to use to look for tariff rates and regulations. The trade portal is not only meant to implement the WTO Trade Facilitation agreement that Laos ratified in September 2015, but also fulfils Laos' obligations in establishing an ASEAN trade repository.

Two enquiry points have been set up on sanitary and phytosanitary (SPS) measures managed by the Ministry of Agriculture and Forestry and on technical barriers to trade (TBT) managed by the Ministry of Science and Technology. In addition, a notification point with a combined function on SPS and TBT has been established by the Ministry of Industry and Commerce. In the area of trade in services, an enquiry point has been located in the Ministry of Industry and Commerce.

Market access appears not to be a key concern for Laos in joining the WTO as it already has preferential access to a large number of markets. As a least developed country, Laos benefits from duty-free access to most developed country markets (such as Australia, Canada, the European Union, and Japan) along with some developing countries (such as China, India, and Russia). Laos' expectations of WTO membership have therefore to do with access to the rules-based trading system of non-discrimination and predictability as well as locking-in the country's internal reforms (MOIC 2012).

Thus, tangible benefits are expected to be derived from further and deeper integration into the regional economy given the intensity of trade and foreign investment that Laos has with its neighbouring countries. ASEAN countries are expected to move closer together economically following fuller integration under the AEC. Deeper regional integration, especially within ASEAN and with ASEAN dialogue partners should provide more opportunities for Laos to further grow and diversify its economic base. Some sectors in which the country may gain stronger comparative advantage include agro-processing (particularly from tea and coffee), hydropower generation, mining, and assembly of machinery and electronics components (MPI and UNDP 2017).

In short, Laos has opened up to the international economy. Economic liberalisation and domestic reforms are mainly shaped by the country's membership in ASEAN and the WTO. The following section provides some evaluation of developments that are associated with or that have accompanied the recent liberalisation efforts.

Lowering tariffs amid widespread non-tariff measures

Laos has been exposed to growing regional competition with the gradual opening of the domestic market following trade liberalisation made under ASEAN. The country's

average tariff applied on a most-favoured-nation (MFN) basis was 9.7 per cent in 2010. This is comparable with the average of 10.2 per cent applied by countries in East Asia and the Pacific (Record and Nghardsaysone 2010). The average trade-weighted tariff, which reflects the actual rate applied to imports, is somewhat higher (14.9 per cent). When preferential tariffs are taken into account, the average trade-weighted rate dropped from 12.7 per cent in the early 2000s to 8.3 per cent in 2010 (Record and Nghardsaysone 2010). This primarily reflects the government's efforts to meet its AFTA tariff commitments.

The WTO accession process brought the landscape of non-tariff measures (NTMs) in Laos closer to the regional practice. The reduction of the incidence of NTMs is explained chiefly by a remarkable reduction in the prevalence of behind-the-border measures, in particular quantity controls (World Bank 2016a). Nevertheless, Laos still relies on many types of regulation in a higher frequency than other ASEAN member countries.

An assessment by ASEAN Secretariat (2015) found that within ASEAN, the largest areas of concentration of NTMs in nominal terms are technical barriers to trade (1,188 measures, of which only 62 are in force), and sanitary and phytosanitary measures (735 measures, of which 249 in force). Quantitative restrictions (120 measures) are also considered quite prevalent. There are considerable variations in the measures listed across different member countries, which ranges from 1 for Myanmar to 869 for Thailand (ASEAN Secretariat 2015).[12]

Providing a level playing field for investors

During the WTO accession process, regulations governing the investment regime in Laos have significantly improved, providing a level playing field for the private sector regardless of their origins. A key milestone was the revision of the Investment Promotion Law in 2009 to unify rules governing domestic and foreign investment. Previously, foreign investors had to obtain an investment licence from investment authorities before getting enterprise registration. Under the new regime, only those (whether foreign or domestic investors) wishing to get investment concessions are required to get an investment licence. The rest can obtain enterprise registration from the industry and commerce authorities directly.

[12] This is based on data on non-tariff measures notified to the WTO's Integrated Trade Intelligence Portal.

Another improvement was the removal of discretionary rules for investors' obtaining investment incentives. Under the former laws on domestic and foreign investment, investors had to meet at least three out of six criteria to get investment incentives. These included hiring at least 90 per cent local staff, using model technology, preserving the environment, being in promoted activities that complement other domestic production, using more than 50 per cent of local materials, and exporting at least 80 per cent of total output. These requirements were abolished after the promulgation of the revised investment law. Although investment incentives remain, the new eligibility criteria are that either the investment is in promoted sectors (such as education), or is located in rural remote areas.

Regional connectivity to overcome landlocked status

Laos has leveraged its geopolitical situation to transform the country's position from being 'landlocked' to 'land-linked'. The construction of the Lao-Chinese railway began in December 2016. The cost of this mega-project is expected to reach US$6 billion, with 70 per cent to be funded by China and the remainder by Laos. This 427-kilometre railway link is expected to be finished by 2021 and will form part of the Kunming-Singapore rail route. Laos is also working with Vietnam to prioritise the construction of a 600-kilometre rail link between its capital Vientiane and Vietnam's seaport Vung Ang. This project aims to improve Laos' access to the sea. The two countries also plan to construct a six-lane highway to connect their two capitals. This is another mega-project that will cost US$4.5 billion (The Economist Intelligence Unit 2017).

These projects add to the regional connectedness efforts that Laos has already made with Thailand and Myanmar. The first Lao-Thai Friendship Bridge, which was partially financed by the Australian Government, began operating in 1994. Four international bridges over the Mekong now connect Vientiane and other economically important cities of Laos to Thailand. Laos also opened its first friendship bridge with Myanmar in May 2015.

Better connectivity is expected to accelerate the integration of Laos into Southeast Asia and beyond. This facilitates the country's access to the market of 600 million people in ASEAN, and still larger markets when the regional trade agreements between ASEAN and dialogue partners are fully implemented. For example, the ASEAN-China free trade agreement is one of the world's largest regional trade agreements, with over 2 billion people, and the third largest as measured by total trade volume. It is estimated that trade between ASEAN and China would be increased by almost 30 percent by 2011 and

would expand by another 20 percent by 2016 (Lord 2013).

3.3 Economic performance

As discussed in the previous section, Laos has made tremendous efforts to integrate into the external economy while beginning to reap the benefits of economic growth and increased openness. Despite impressive economic progress, Laos remains dependent on a narrow range of export products and destinations. Key economic performance indicators are reviewed below.

Growth and structural change

The adoption of the NEM marked a crucial milestone in the development of Laos. It resulted in moderate growth of gross domestic product (GDP) by 6.3 per cent on average during the 1990s. The successes of market reforms were evident with an average growth rate of 7.5 per cent since 2000 following the commencement of the second phase of economic reforms. This has also been supported by two resource booms. The economic growth was initially powered by a mining boom in the early to mid-2000s. Since the late 2000s, strong expansion in hydropower development and associated construction activities has driven output growth (World Bank 2017a). The twin booms were estimated to contribute around three percentage points of GDP growth, and roughly 15 per cent of total government revenue (Bird and Hill 2010).

At the same time, gross national income (GNI) per capita rose substantially from US$190 in 1990 to US$1,000 in 2010. In 2011, Laos was upgraded from a lower-income economy to a lower-middle-income economy under the World Bank's country classification. The GNI per capita further soared to US$2,000 in 2015 (see Table 3.2). Laos has also successfully reduced poverty level (the poverty headcount ratio at the national poverty line) from 39.1 per cent of population in 1997 to 33.5 in 2002, and further down to 23.2 per cent in 2012.[13]

[13] According to the World Bank's World Development Indicators.

Table 3.2 Laos' growth profile and output compositions, 1990–2015

	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Real GDP growth (%)	6.7	5.8	5.8	5.9	6.1	6.4	7.1	8.6	7.6	7.8	7.5	8.5	8.0	8.0	8.5	7.5	7.4
Share in GDP (%)																	
- Agriculture	61.2	45.2	44.0	42.7	41.0	39.0	36.2	35.3	36.1	34.9	35.0	31.4	29.6	28.1	26.4	27.6	27.4
- Industry	14.5	16.6	17.1	19.5	21.3	20.5	24.6	27.7	26.9	28.6	26.7	32.3	34.6	36.0	33.2	31.3	30.9
- Services	24.3	38.2	38.9	37.8	37.7	40.5	39.2	37.0	37.0	36.6	38.3	36.3	35.8	35.9	40.4	41.0	41.7
GNI per capita, Atlas method (US$)	190	280	310	320	340	390	460	510	620	750	890	1,000	1,120	1,350	1,590	1,840	2,000

Source: Author's calculations from the World Development Indicators of the World Bank (2018a).

In 2017, the Lao economy expanded at 6.9 per cent and it is expected to pick up to around 7 per cent in 2018 and 2019 (World Bank 2017a). Recent growth was underpinned by the strong increase in the contribution of hydropower development as well as from manufacturing. But it was partly offset by slight moderation in construction, flat output in the mining sector, and decreasing public spending.

Looking forward, economic prospects for are projected to remain favourable over the years to come. This is because of the vigorous pipeline of hydropower development projects and expanding opportunities for the non-resource sector likely to result from further AEC integration and the government's efforts to improve the investment climate. Around 20 hydropower dams are at different stages of construction with around 600 megawatts of electricity capacity estimated to be in operation by 2020. This is expected to both stimulate the Lao economy and raise electricity exports to neighbouring Thailand (Asian Development Bank 2017, World Bank 2017a).

Overall growth has been accompanied by structural change that has gradually shifted the economy away from agriculture. As shown in Table 3.2, the share of industrial value-added in GDP increased from 14.5 per cent in 1990 to 30.9 per cent in 2015, mainly in manufacturing. Over the same period, the share of agricultural output declined from 61.2 per cent to 27.4 per cent. On the other hand, the services share expanded from 24.3 per cent to almost 42 per cent, thanks to strong growth in tourism along with foreign investment inflows into the financial and distribution sectors.

Despite its growing share, manufacturing still has weak backward linkages, especially with the services sector. Inadequate supply of financial and telecoms services (representing only 3 per cent of total services inputs to manufacturing) may be an important constraint on the diversification and upgrading of manufacturing firms, inhibiting them from moving up the value chain (MPI and UNDP 2017). Region-wise, domestic value-added (49 per cent) in manufacturing exports from Laos is below the levels in other countries such as Cambodia (76 per cent), Thailand (80 per cent) and Vietnam (64 per cent), according to Varela *et al.* (2016).

The growing importance of resource-based exports

Trade has acted as the primary driver of growth in the small landlocked economy of Laos. Merchandise trade has expanded 20 per cent annually on average over the past decade. However, overall trade openness remains quite limited compared to other countries in East Asia and the Pacific. Laos' exports averaged 33 per cent of GDP for the period 1999–2012 but its trade share in GDP remains relatively low compared with

other countries in the region (Record *et al.* 2014).

Laos' trade is increasingly dominated by commodity exports, with primary and resource-based manufacturing products constituting 45 per cent and 38 per cent of total exports, respectively. This is not unique to Laos as 27 out of 32 landlocked developing countries are also commodity-dependent, as discussed in Chapter 2. Agricultural products used to be the main export items before being overtaken by minerals and hydropower (See Table 3.3). The agricultural share has fallen from 65 per cent of total exports in 1990 to 20 per cent in 2016. The export share of agriculture appears to have been negatively impacted during the 1997 Asian Financial Crisis and also the 2008 Global Economic Crisis. In 2016, ores and metals (mainly copper) and electricity accounted for 22 per cent and 24 per cent of total exports, respectively. The average share of manufacturing exports was 47.9 per cent during 1990–2005, before falling to 18.8 per cent over the past decade.

A further breakdown of manufacturing exports shown in Table 3.4 reveals a reduction in the importance of traditional items such as textiles and garments.[14] Their average share of manufacturing exports was around 75 per cent during the 1990s and 2000s before a sharp decline in 2014. At the same time, the contribution of non-traditional exports was rising (though from a small base). The emergence of chemicals and electronics may indicate some level of Laos' participation in global production sharing, which is explored later in this chapter.

[14] This is based on the Standard International Trade Classification (SITC) revision 3. A breakdown of product compositions based on the Harmonised System (HS) classification is provided in Appendix 3.A.

Table 3.3 Compositions of exports from Laos, 1990–2016

	1990	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Total exports (US$ million)	59.1	364.8	610.3	1,085.7	1,165.9	1,410.4	1,423.7	2,072.4	3,023.3	3,237.7	3,928.0	4,667.7	4,277.7	4,099.5
Share in total exports (%)														
- Agriculture	65.2	39.2	34.6	23.9	24.4	25.9	25.5	24.4	29.8	29.8	35.1	47.2	34.4	19.8
- Fuels	0.0	0.4	11.0	15.0	7.1	8.5	7.3	13.8	15.5	16.0	19.5	12.5	14.2	24.7
- Manufacturing	18.3	57.1	36.8	22.7	22.4	23.1	20.9	17.6	14.0	14.9	13.4	14.6	21.0	22.3
- Ores & metals	15.4	1.4	14.6	35.7	45.1	42.1	46.2	44.1	40.6	37.4	30.7	25.7	24.0	21.6
- Others	1.1	2.0	3.1	2.7	1.0	0.5	0.1	0.1	0.0	1.9	1.3	0.1	6.4	11.7
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Note: Agriculture (SITC 0+1+2–27–28+4), fuels including electricity (SITC 3), manufacturing (SITC 5+6–68+7+8+9), and minerals (SITC 27+28+68).

Source: Author's calculations from UN Comtrade, using partner-reported data.

Table 3.4 Breakdown of manufacturing exports, 1990–2016

	1990	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Manufacturing exports (US$ million)	10.8	208.2	24.7	246.5	261.4	325.2	297.7	364.9	422.6	483.1	525.8	679.5	898.8	913.1
Share in manufacturing exports (%)														
- Chemicals	1.2	0.3	0.9	2.9	3.3	4.5	8.1	7.0	12.1	22.6	21.6	18.2	22.3	11.5
- Electronics	0.7	0.4	2.9	3.1	5.1	5.6	5.7	6.5	4.2	4.6	5.9	24.4	35.6	44.2
- Automobiles & other transport equipment	1.5	30.0	0.4	0.6	2.4	5.1	2.5	2.3	2.1	1.9	2.8	0.8	1.0	1.7
- Textiles and garments	57.4	64.5	81.2	80.5	76.8	73.2	71.4	68.8	69.7	57.4	52.8	41.9	27.7	27.0
- Footwear	0.2	2.1	3.1	3.1	3.2	2.1	3.9	3.6	3.9	4.3	4.1	3.8	3.3	4.1
- Scientific & photographic equipment	1.0	0.0	0.2	0.1	0.1	0.8	0.6	0.5	0.4	0.6	0.6	1.0	1.1	1.1
- Misc. manufacturing	2.9	0.1	2.1	2.2	1.4	0.9	1.4	3.7	2.5	2.7	2.4	2.5	2.2	4.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Note: Chemicals (SITC 5), electronics (SITC 75+76+77), automobiles and other transport equipment (SITC 78+79), textiles and garments (SITC 65+724+84), footwear (SITC 85), scientific and photographic equipment (SITC 87+88), and miscellaneous manufacturing (SITC 89).

Source: Author's calculations from UN Comtrade, using partner-reported data.

As for imports, manufacturing products accounted for around two-thirds of the total, followed by agricultural products (18 per cent), and fuels (12 per cent) in 2016.[15] Within manufacturing, automobiles and electronics respectively made up 16 per cent and 12 per cent of total imports. The recent growth in the importance of transport equipment, fuels, and machinery reflects the development of hydropower dams and road infrastructure.

Given the growing role of natural resources in exports, concerns have begun to be raised over the possibility of Laos being afflicted by the 'Dutch disease', where resource-driven growth causes non-resource exports to be less competitive (World Bank 2010b, MOIC 2012). The possible effects of this phenomenon can be examined via two channels (MOIC 2012). First, there is a 'spending effect' when an increase in demand leads to inflation and real exchange rate appreciation. Higher prices for inputs raise production costs, which could lead to stagnation or even contraction in other tradable sectors. Another mechanism is through a 'resource-movement effect', which occurs when the booming resource sector induces factor inputs to move away from other economic activities. The greater the volume of the inputs used by the resource sector, the greater the drawdown of those factors on the non-resource sector, whether it is in traded or non-traded activities (World Bank 2010b).

There appears to be some sign of a spending effect in Laos since the beginning of the export booms in mining and hydropower. Between 2005 and 2011, the real effective exchange rate appreciated by almost a third following major investments in these two sectors. In the same period, copper prices surged by 200 per cent (MOIC 2012). This underlines the need for Laos to manage these vulnerabilities while trying to diversify its economy away from natural resource dependency.

There is less evidence for the resource-movement effect because the contributions of both manufacturing and non-tradable sectors have remained relatively stable (World Bank 2010). The share of these sectors in national output might be caused by factors other than those linked with resource booms. Manufacturing growth has been largely driven by the food-processing and assembly industries while the expansion in the construction sector was due to government spending. In addition, the growth of tourism was partly associated with an overall surge in international tourism travel to the

[15] According to UN Comtrade, using partner-reported data. All statistics from UN Comtrade is retrieved though the World Integrated Trade Solution (WITS) of the World Bank (2018b).

Southeast Asian region (World Bank 2010b).

Concentration of trade on very few trading partners

Laos' international trade is concentrated in a very few trading partners within the region. Thailand, China, and Vietnam account for 82.3 per cent of Laos' total exports. In 2016, Thailand was the largest destination, with an export share of 40.1 per cent, followed by China (28.5 per cent) and Vietnam (13.7 per cent), as reported in Appendix 3.B. Other important export markets included Germany, Japan, India, Russia, Switzerland, the United Kingdom (UK), and the United States (US).

In general, emerging and developing economies dominated the trade pattern of Laos, of which Asia accounted for 87 per cent of total exports in 2016. Around 55 per cent of export share was destined to ASEAN while 6 per cent went to the European Union (EU). Trade with Africa, the Middle East and other parts of the world was minimal.

There has been a significant shift in the export pattern of Laos since 2000 when the largest markets were Vietnam and Thailand, accounting for 29.8 per cent and 23.1 per cent, respectively. In the same year, 46 per cent of exports went to advanced economies with the EU making up a 36 per cent share. Japan and the US accounted for 3.4 per cent and 2.7 per cent shares, respectively.

Most of Laos' merchandise imports were sourced from emerging and developing economies, with an import share increasing from 81 per cent in 2000 to 92 per cent in 2016 (see Appendix 3.C). Around 79 per cent was imported from ASEAN while less than 7 per cent was from the EU in the same year. Almost 62 per cent of imports were sourced from Thailand in 2000 while imports from Vietnam accounted for around 11 per cent and China 6 per cent.

Thailand was still the dominant source of imports, accounting for 65 per cent of the country's total imports, followed by China and Vietnam with shares of 16 per cent and 9 per cent, respectively. Other key import sources included Germany, France, India, Japan, South Korea, and Singapore.

Direction of investment towards the resource sector

Since Laos is surrounded by some of the fastest growing economies in the world, it has benefited considerably from external demand and foreign investment. Around 4,500 foreign direct investment (FDI) projects were approved from 1989 to 2014, with the total amount valued at US$23.5 billion, according to the Department of Investment of

Laos. Similar to its role in international trade, the importance of China in foreign investment has also risen to the point where it has become the biggest investor in Laos. China took up 33.1 per cent of total FDI stock, followed by Thailand and Vietnam with shares of 27.4 per cent and 20.8 per cent, respectively. Other foreign investors include South Korea, France, Japan, the Netherlands, Malaysia, and the United Kingdom.

The growing importance of the resource sector is not only seen in external trade but also in foreign direct investment. Most investment inflows have been into mining development, totalling US$6.5 billion, equivalent to 30 per cent of FDI stock in the 2000–2013 period. The hydropower sector came second, valued at US$6.3 billion (29 per cent), followed by agriculture (12 per cent), and services (10 per cent). This underscores the challenge of how Laos can attract investment into the non-resource sector to assist in both export and general economic diversification.

Laos participating in labour-intensive production sharing

As discussed in Chapter 2, the processes of manufacturing are geographically dispersed to take advantage of cost differentials. This has resulted in the internationalisation of production sharing, in which countries participate in different stages of international production (Jones and Kierzkowski 1990). China and ASEAN countries are among the economies that have emerged as dominant centres in global production sharing.

In general, production sharing in Southeast Asia can be mapped in a three-tier framework based on countries' participation at different levels of incomes and industrialisation (Nishimura *et al.* 2016). First, Tier 3 is characterised by a situation wherein the point of production and the point of consumption are separated, known as 'the first unbundling'.[16] At this stage, countries hook up to a regional supply chain that can operate with slow but reliable transport connectivity. This suits countries that are still pre-industrialised and under-developed economies such as Cambodia, Laos, and Myanmar. The sectors that feature this stage of global production sharing include products that are resources-based and unskilled labour-intensive such as agro-processing, mining, garments, and other simple assembly line activities (see Table 3.5).

[16] See discussion of the concept of different types of unbundling by Baldwin (2006).

Table 3.5 The position of ASEAN members in global production sharing

	Economic characteristics	Connectivity	Innovation	ASEAN countries
Tier 3	Under-developed economy or pre-industrialisation	Medium grade		Cambodia, Laos, and Myanmar
	Hooking up with global supply chains (the first unbundling) in labour-intensive and resource-based industries			
Tier 2	Participation in production networks (the second unbundling) or jumpstart industrialisation	High grade		
Tier 1a	Forming industrial agglomeration with accelerating technology transfer and spillovers	Turnpike connectivity	Process	Indonesia, Philippines, and Vietnam
Tier 1b	Innovation hub with urbanisation and nurturing human capital		Product	Malaysia, Singapore, and Thailand

Source: Nishimura *et al.* (2016).

Second, Tier 2 is nested in a more advanced stage of development, called 'the second unbundling' or global production networks, when production has been spliced into separate segments that are spread around the world to take advantage of falling costs of services links and effective coordination across segments. This stage needs high-grade connectivity that is fast, precise, and synchronised. In this tier, countries begin to jumpstart industrialisation. Laos has recently been involved in the simple assembly of electronics components, which is considered to be the initiation of participation in Tier 2 production sharing.

Third, a higher international division of labour occurs in Tier 1. At this stage of development, industrial agglomeration and urban amenities are central to the stimulation of innovation and industrial upgrading, when a country has reached a middle-income level. This stage can be further split into Tier 1a and Tier 1b. In the former, participating countries are involved in process innovation and industrial agglomeration. The members of ASEAN that feature this tier are Indonesia, the

Philippines, and Vietnam, which benefit from technological transfer and spillover. As for the latter, in the top-end of this framework of development are Malaysia, Singapore, and Thailand. To reach this stage, countries need to establish an innovation hub along with urban amenities to attract and nurture human resources and realise a creative economy underpinned by active product innovation (ERIA 2015, Nishimura *et al.* 2016).

Parts and components and final assembly dominated by global production sharing account for almost two-thirds of the exports of Singapore, Malaysia, Thailand, and the Philippines. While Thailand's engagement in international production sharing is relatively diversified compared to the other ASEAN members, Singapore has remained an attractive destination for high-value, more sophisticated tasks within global production sharing given its emphasis on infrastructure development, building human capital, and maintaining an excellent business-enabling environment. Although from a small base, Vietnam has witnessed a rapid growth in its trade in global production sharing. Cambodia has also begun to get involved in regional production sharing, although on a more modest scale (Athukorala and Kohpaiboon 2013).

The participation of Laos in global production sharing had a humble start in garment manufacturing since the mid-1980s when Laos began to open up to the external economy. Over the years, this sector has contributed considerably to the Lao economy in terms of export earnings and manufacturing employment (Nolintha and Jajri 2015). By 2004, there were 57 export-oriented garment factories and 43 subcontractors, and the number of all firms exceeded 100 in 2012 (Kongmanila and Takahashi 2009), before falling to 92 in 2017 (see further detail in Chapter 6).

Later on, Laos started to attract foreign investment into non-garment manufacturing. This includes companies assembling electronics components (such as Dai-ichi Denshi, Mitsubishi Materials, and Kitani), automotive wire harnesses (Daiwa and Toyota), camera parts (Nikon), and lens polishing (Essilor). Most of them started to invest in Laos after 2010 and concentrated investment in special economic zones in Vientiane, Savannakhet, and Champasack. This has resulted in rapid growth in parts and component assembly and exports in other labour-intensive manufacturing, overtaking the garment sector.

Table 3.6 shows that GPS-dominated products accounted for 15.8 per cent of total

exports in 2015/16, compared to 21.5 per cent in 1990/91.[17] The share of textiles and garments reduced while the importance of electronics was increasing. The share expressed in manufacturing exports was relatively higher; that is 40 per cent for electronics and 27 per cent for textiles and garments in 2015/16, reflecting the dominance of resources in export compositions (see Appendix 3.E). All textile and garment exports were final products while parts and components (P&Cs) dominated electronics exports in 2015/16.

Table 3.6 Share of GPS-dominated products in total exports, 1990/91 and 2015/16

	1990/91			2015/16		
	P&Cs	Final	Total	P&Cs	Final	Total
Electronics	0.0	0.1	0.1	6.7	2.0	8.7
Automobiles	0.0	0.1	0.2	0.2	0.1	0.3
Other transport	0.0	0.0	0.0	0.0	0.0	0.0
Textiles and garments	0.0	20.1	20.1	0.0	5.9	5.9
Scientific equipment	0.0	0.1	0.1	0.0	0.0	0.1
Photographic equipment	-	0.0	0.0	0.0	0.2	0.2
Misc. manufacturing	-	0.9	0.9	0.0	0.7	0.7
Share in total exports (%)	0.1	21.4	21.5	7.0	8.8	15.8

Note: Electronics (SITC 75+76+77), automobiles (SITC 78), other transport equipment (SITC 79), textiles and garments (SITC 65+724+84), scientific equipment (SITC 87), photographic equipment (SITC 88), and miscellaneous manufacturing (SITC 89). The calculation is a two-year average to avoid annual data fluctuations. "-" data is not available.

Source: Author's calculations from UN Comtrade, using partner-reported data.

On the import side, GPS-dominated products constituted 32.8 per cent of total imports in 2015/16. As shown in Table 3.7, automobiles made up 14.8 per cent of the total share, followed by electronics (11.5 per cent), and textiles and garments (2.1 per cent).

[17] A methodology to measure global production sharing participation using a trade-based approach is explained in Chapter 2.

Table 3.7 Share of GPS-dominated products in total imports, 1990/91 and 2015/16

	1990/91			2015/16		
	P&Cs	Final	Total	P&Cs	Final	Total
Electronics	5.0	3.7	8.7	7.1	4.3	11.5
Automobiles	0.9	12.6	13.4	0.8	14.0	14.8
Other transport	0.0	0.1	0.2	0.1	1.5	1.6
Textiles and garments	0.4	7.8	8.2	0.1	1.9	2.1
Scientific equipment	0.1	0.8	0.9	0.0	0.6	0.7
Photographic equipment	0.0	0.1	0.1	0.1	0.1	0.2
Misc. manufacturing	0.3	1.4	1.7	0.1	1.7	1.9
Share in total imports (%)	6.7	26.5	33.3	8.5	24.3	32.8

Note: Electronics (SITC 75+76+77), automobiles (SITC 78), other transport equipment (SITC 79), textiles and garments (SITC 65+724+84), scientific equipment (SITC 87), photographic equipment (SITC 88), and miscellaneous manufacturing (SITC 89). The calculation is a two-year average to avoid annual data fluctuations. "-" data is not available.

Source: Author's calculations from UN Comtrade, using partner-reported data.

In short, the integration of Laos into international production sharing remains concentrated in labour-intensive segments of manufacturing. A related question is what undermine Laos' participation in global production sharing and what can be done to improve its position? This will be examined further in Chapter 4 while some aspects of challenges warrant discussions below.

3.4 Some challenges and the way forward

Laos has taken major steps toward outward-looking policy orientation since the mid-1980s. This has also been intended to enhance economic interaction with the international economy, which in turn helps support high levels of trade and economic growth. Despite impressive progress, Laos remains dependent on a narrow range of export products and destinations. This section examines some challenges associated with the integration of Laos into the international economy and discusses possible ways forward.

Transforming resource wealth for sustainable development

One of the chief challenges for Laos is to transform natural resources into productive

capital so that once such resource wealth is exhausted, there are other income-generating assets to take their place. More than half of Laos' wealth is in the form of natural assets (water, agricultural land, forests, and minerals). Overall, total wealth in Laos has been estimated to be around US$10,000 per capita. This is higher than in Mongolia or Vietnam, measured on a per capita basis. Nevertheless, physical capital accounts for only 9 per cent of the country's wealth, which is somewhat below the 17 per cent average for low-income countries (World Bank 2010b). Therefore, to transform some of these natural resources into productive investments would benefit growth and long-term development prospects for Laos.

To achieve this objective, the revenues generated from resource exploitation need to be effectively managed. Development experience has shown that different sustainability strategies yield different outcomes in many countries. Vietnam, for instance, has been able to maintain a high savings rate while utilising a large amount of resources to maintain a high growth rate. On the contrary, the savings rate of Zimbabwe became negative whereas the depletion of its resource wealth failed to generate growth (World Bank 2010b). For Laos, the government may consider diverting export revenues from natural resources into growth-enhancing investments. Such interventions should be in the form of delivery of public goods such as core infrastructure, research and development as well as productivity and skills training (World Bank 2010b, Lord 2011).

Supporting the non-resource sector for broad-based growth

Economic growth in Laos in recent decades has been driven largely by natural resources. The contribution of mining and hydropower is expected to reach one quarter of GDP by 2020, implying that the non-resource sector contributes the remaining 75 per cent (Lord 2011). The fast-growing development of mining and hydropower projects employs only one per cent of the total workforce. This suggests that the recent growth has not been broad based. Although the share of agriculture in national output has declined considerably, its importance in terms of employment remains significant as labour in the agricultural sector only lowered from 71.3 per cent to 65.2 per cent over the same period. The employment shares of the respective manufacturing and services sectors were 11.4 per cent and 23.4 per cent in 2015 (MPI 2016).

Therefore, the non-resource sector remains a vital contributor to employment and inclusive development. Expansion in agricultural production and exports is important given the significant share of this sector in employment. Manufacturing expansion is

also expected to create job opportunities, especially for labour-intensive activities. Laos has already been engaged in regional production sharing in food processing and garments. It has also begun to tap into other elements of labour-intensive assembly such as electronics components, lens polishing, and automotive wire harnesses, as discussed above.

Boosting growth outside the resource sector will require a vibrant private sector. Despite ongoing domestic reforms, Laos is still ranked poorly in terms of doing business. It was ranked 139th out of 190 economies in the 2017 Doing Business survey, reflecting weak and inconsistent law enforcement along with burdensome procedures. Cambodia and Myanmar were ranked at 131th and 170th, respectively. In starting a business, for example, it takes entrepreneurs 67 days to complete enterprise registration in Laos, compared with 24 days on average in East Asia and the Pacific. In the same vein, the time spent on complying with export requirements in Laos is as high as 216 hours whereas only 73 hours is needed on the regional average. Such delays may be partly attributed to Laos being a landlocked country, but policy barriers also play a substantial role.

In addition, enterprise surveys conducted by the World Bank found that firms in Laos complained much more about tax rates in 2016 than in 2012. The Lao firms interviewed were more frequently visited by tax officials and the visits lasted longer compared to East Asia and Pacific averages (World Bank 2017a). This may be partly prompted by strengthened enforcement of tax collection against the backdrop of a shortfall in government collection. Laos needs to continue reform efforts with a greater focus on improving the business environment. The Lao government has recently committed to supporting the private sector (MPI and UNDP 2017). Efforts in this direction could help unlock opportunities for further economic integration of Laos and support long-term economic growth.

Improving hard and soft infrastructure

Exporting a standard container from Vientiane to Los Angeles adds as much as 45 per cent to total shipping costs compared to exporting from Bangkok to the same final destination (World Bank 2010a). Putting landlocked status aside, the high shipping cost is also attributed to the unreliable national transport system. Road transport is the dominant mode of transport in Laos, which accounts for 70 per cent of freight transport and 90 per cent of passenger transport. Currently, Laos has no rail or water transport. In

addition, transport is also hampered by mountainous terrain making up three-quarters of the country's area (MOIC 2012).

Similarly, there is anecdotal evidence from company surveys to show that Laos has the highest logistics costs in the region. It costs US$2,500 to ship a 40-foot container from Vientiane to Yokohama compared with around US$1,200 from Phnom Penh or US$1,000 from Hanoi. The cost of transit from Vientiane to Bangkok is found to be as high as US$1,700, of which 40 per cent is attributed to clearing customs and transport-related procedures at the Lao-Thai border checkpoint (JETRO 2016).

While there has been investment in numerous infrastructure projects with a bid to link Laos to the region as earlier discussed, Laos remains among the world's bottom 10 in a recent survey on logistics performance. The country's overall logistics performance index (LPI) was 2.07 in 2016, which was down from 2.39 in 2014 (World Bank 2017b).[18] Laos was behind all other ASEAN members in almost all aspects including efficiency in border clearance, trade and transport infrastructure and logistics competence. The only areas where Laos did not score last were timeliness and international shipments, in which Laos scored comparably to Myanmar.

This highlights the critical importance of improving not only hard infrastructure but also soft infrastructure in order to better connect Laos to the region. Hence, customs modernisation efforts are underway particularly in the organisation of clearance procedures. A prime example is the introduction of the United Nations Automated System for Customs Data (ASYCUDA) in order to reduce the time for customs clearance. It is essential that the current efforts continue in order to boost customs enforcement and to ensure effective regulation, as trade volumes are expected to increase when the AEC operates in full swing.

3.5 Concluding remarks

Laos has made impressive economic progress since adopting the NEM in the mid-1980s, shifting the economy from a centrally planned regime to the one that is more market-driven. Laos is a full member of the WTO and increasingly integrated into the AEC and other regional groupings. With economic growth of over 7 per cent over the

[18] The logistics performance index is on a scale from 1 (very low) to 5 (very high). See detail in: https://lpi.worldbank.org/international/scorecard/radar/128/C/LAO/2016#chartarea

past few decades, the country is now a lower-middle-income country, which shows positive momentum toward its target of LDC graduation. While Laos' economic progress has been impressive, the resource sector (mining and hydropower) remains the main driver of the economy. Agriculture is still the main absorber of the labour force and the country's manufacturing base is narrow. Exports are also less diversified in terms of both product compositions and markets.

One of the key challenges for Laos is to manage its natural resource wealth in a manner that can ensure broad-based growth across a diversity of sectors and create jobs for a larger proportion of population. This highlights the importance of utilising revenues from current resource exports in growth-enhancing investments in the longer term, including in basic infrastructure, education, and productivity enhancement. In addition, the non-resource sector remains a vital contributor to employment and inclusive development for Laos, which needs to be promoted through facilitating private sector development. Apart from investments in upgrading transport infrastructure, particular focus should be on further reforms to improve the poor business environment and logistics performance. These efforts are expected to help Laos reap benefits from its integration into the regional and global economy and to ensure a smooth transition after its graduation from LDC status.

4 Global Production Sharing and Landlocked Developing Countries

4.1 Introduction

The purpose of this chapter is to examine the patterns and determinants of global production sharing with an emphasis on implications for landlocked developing countries. The emergence of global production sharing has been a remarkable feature of the world's economy. With advances in information and communication, and transport technology, production processes are fragmented into segments and relocated in economies where goods can be most efficiently produced (Jones and Kierzkowski 1990, Arndt and Kierzkowski 2001). This allows countries to integrate into global production sharing in line with their relative cost advantage (Athukorala *et al.* 2017). East Asia, in particular the Association of Southeast Asian Nations (ASEAN), has taken advantage of the opportunities provided by this international organisation of production, as discussed in Chapter 2. The expansion of trade and investment in these economies has directly contributed to substantial developmental gains as witnessed in marked poverty reduction and improved welfare (ESCAP 2015). However, landlocked developing countries (LLDCs) are still left out. These countries account for a fairly small share of global trade within production networks. This raises some questions that need to be answered. What are the recent trends in global production sharing and the level of participation by landlocked developing countries? What are the factors fundamental to these countries' participation (or lack of it) in global production sharing? And what policy implications can be drawn for Laos and other landlocked developing countries?

This chapter is organised as follows. Section 4.2 tracks recent trends in trade within global production sharing ('networked trade'), with emphasis on the role of landlocked developing countries. Section 4.3 develops a theoretical framework and methodology based on a gravity model for analysing the determinants of networked trade. Section 4.4 presents econometric results, showing that although LLDCs are disadvantaged by their geographical nature, they can better integrate into networked trade by improving services links. Section 4.5 provides concluding remarks.

4.2 Trends in global production sharing

There is no universally accepted methodology for assessing the extent of trade through global production sharing (see more discussions in Chapter 2). This research uses a trade-based measure of global production sharing or 'networked trade' by delineating trade in parts and components (P&Cs) from trade in final products. The list of P&Cs is identified by mapping the intermediate products of the Broad Economic Categories (BEC) classification at the five-digit level of the Standard International Trade Classification (SITC), following Athukorala and Talgaswatta (2016). The current study defines networked trade to cover eight product categories: office machines and automatic data processing machines (SITC 75), telecommunication and sound recording equipment (SITC 76), electrical machinery (SITC 77), road vehicles (SITC 78), other transport equipment (SITC 79), professional and scientific equipment (SITC 87), photographic apparatus (SITC 88), and textiles and garments (SITC 65+724+84).[19] Final products are calculated from deducting P&Cs from the aggregate trade statistics reported in the United Nations Commodity Trade Statistics Database (UN Comtrade). The data are tabulated using partner-reported statistics, which is considered to be more suitable for analysing trade involving a large group of developing countries. This method is less susceptible to recording errors and can capture the origins and compositions of trade more accurately than data reported by exporters (Feenstra *et al.* 2005).

Global production sharing (GPS) has emerged to be a prominent feature of the world's economy. Exports of products dominated by global production sharing or networked trade (trade in parts and components, and final products) increased from US$2,510.6 billion in 2000/01 to US$5,682.2 billion in 2014/15 (see Table 4.1). Initially limited to only a few sectors such as apparel and electronics, they have now deepened and spread to other sectors such as automobiles, televisions and radio receivers, machine tools, cameras, watches, solar panels, and medical devices, among others, over the past four decades, as discussed in Chapter 2.

[19] See the list of parts and components in Appendix 2.A.

Table 4.1 GPS-dominated exports by country groups

	2000/01			2014/15		
	P&C	Final	Total	P&C	Final	Total
World (US$ billion)	998.8	1,511.8	2,510.6	1,904.4	3,777.7	5,682.2
Developed countries	720.0 (72.1)	1,035.2 (68.5)	1,755.2 (69.9)	889.8 (46.7)	1,908.3 (50.5)	2,798.2 (49.2)
Developing countries	209.8 (21.0)	382.7 (25.3)	592.4 (23.6)	836.4 (43.9)	1,531.3 (40.5)	2,367.7 (41.7)
- LLDCs	0.3 (0.0)	2.5 (0.2)	2.8 (0.1)	1.6 (0.1)	2.5 (0.1)	7.3 (0.1)
- Non-LLDCs	209.5 (21.0)	380.2 (25.1)	589.7 (23.5)	834.8 (43.8)	380.2 (10.1)	2,360.4 (41.5)

Note: Developed countries are high-income economies under the World Bank's classification while developing countries are those with low- and middle-incomes. Landlocked countries are defined following UN-OHRLLS (2013), whereas the rest are other developing countries. Data is recorded by partner countries, using a two-year average to avoid annual data fluctuations. Numbers in (…) are percentages of the world's exports in respective columns.

Source: Author's calculations from UN Comtrade.

Developing countries have emerged as key players in global production sharing. Between 2000/01 and 2014/15, GPS-dominated exports by developing countries skyrocketed by 300 per cent. As a result, their share in world exports of GPS-dominated products rose from 23.6 per cent in 2000/01 to 41.7 per cent in 2014/15. Over the same period, the share of developed countries in the word's exports dominated by production sharing reduced from 69.9 per cent to 49.2 per cent.

Nevertheless, landlocked developing countries still play a minimal role in networked trade. Their GPS-dominated exports increased from US$2.8 billion in 2000/01 to US$7.3 billion in 2014/15. The export share of landlocked developing countries remained at 0.1 per cent of the world's exports of GPS-dominated products (see Table 4.1).

Similar patterns can also be observed on the importing side, as shown in Table 4.2. The imports of GPS-dominated products by developing countries jumped from US$399.9 billion in 2000/01 to US$1,451.4 billion in 2014/15. Again, landlocked developing countries accounted for only 0.9 per cent of the world's imports of GPS-dominated products in 2014/15.

Table 4.2 GPS-dominated imports by country groups

	2000/01			2014/15		
	P&C	Final	Total	P&C	Final	Total
World (US$ billion)	932.3	434.88	2,367.2	1,718.1	3,617.0	5,335.1
Developed countries	706.7 (75.8)	1,134.47 (79.1)	1,841.2 (77.8)	1,119.2 (65.1)	2,415.7 (66.8)	3,534.9 (66.3)
Developing countries	173.2 (18.6)	226.6 (15.8)	399.9 (16.9)	470.8 (27.4)	980.6 (27.1)	1,451.4 (27.2)
- LLDCs	2.4 (0.3)	5.18 (0.4)	7.5 (0.3)	11.4 (0.7)	38.3 (1.1)	49.7 (0.9)
- Non-LLDCs	170.8 (18.3)	221.6 (15.4)	392.4 (16.6)	459.4 (26.7)	942.4 (26.1)	1,401.8 (26.3)

Note: Developed countries are high-income economies under the World Bank's classification while developing countries are those with low- and middle-incomes. Landlocked countries are defined following UN-OHRLLS (2013), whereas the rest are other developing countries. Data is recorded by partner countries, using a two-year average to avoid annual data fluctuations. Numbers in (…) are percentages of the world's imports in respective columns.

Source: Author's calculations from UN Comtrade.

Table 4.3 shows the composition of GPS-dominated products exported by LLDCs. In general, their exports of these products are concentrated in textiles and garments. Textile and garment exports amounted to US$2,153.9 billion in 2000/01 and increased to US$4,194.2 billion in 2014/15. The export share of textiles and garments fell from 77.6 per cent of all GPS products in 2000/01 to 57.4 per cent in 2014/15. This was compensated by a growing share of electronics exports while the contributions of automobiles as well as scientific and photographic equipment were slightly increasing.

Table 4.3 Exports from LLDCs by product compositions

	2000/01			2014/15		
	P&C	Final	Total	P&C	Final	Total
Electronics (SITC 75+76+77)	213.6 (71.4)	74.6 (3.0)	288.2 (10.4)	1,384.6 (87.1)	561.9 (9.8)	1,946.6 (26.6)
Automobiles (SITC 78+79)	40.2 (13.4)	254.2 (10.3)	294.3 (10.6)	117.2 (7.4)	724.9 (12.7)	842.2 (11.5)
Scientific and photographic equipment (SITC 87+88)	5.3 (1.8)	33.2 (1.3)	38.5 (1.4)	25.8 (1.6)	298.6 (5.2)	324.4 (4.4)
Textiles and garments (SITC 65+724+84)	40.1 (13.4)	2,113.8 (85.4)	2,153.9 (77.6)	61.8 (3.9)	4,132.3 (72.3)	4,194.2 (57.4)
All (US$ billion)	299.2	2,475.8	2,775.0	1,589.5	5,717.8	7,307.3

Note: Landlocked countries are defined following UN-OHRLLS (2013). Data is recorded by partner countries, using a two-year average to avoid annual data fluctuations. Numbers in (…) are the share in the world's exports in respective columns.

Source: Author's calculations from UN Comtrade.

The fact that landlocked developing countries are less integrated into networked trade compared to coastal developing countries prompts this research to probe what could possibly determine the trade performance of these countries. As fragmentation theory suggests, multinational enterprises spread their operations across various countries with cheaper wages or other costs in order to attain cost-efficiency (Jones and Kierzkowski 1990, Yeats 1999). These vertically fragmented production locations must be coordinated so that the entire production chain runs smoothly. Each location may offer lower production costs, but the coordination of these facilities should not be counterweighed by the costs of services links. The term 'services links' refers to an arrangement for coordinating activities into a smooth sequence in producing a final good. Services links costs relate to transportation, communication, and other related tasks involved in connecting the activity in a given country within global production sharing (Jones and Kierzkowski 2000).

When manufacturing is geographically organised, trade costs at each stage of the supply chain are incorporated into production costs and passed on to the next stage. Trade costs propagate through supply chains, cascading from upstream to downstream to final consumers (World Bank *et al.* 2017). Therefore, even small additional costs arising from barriers to imports generally hurt the competitiveness and ability of countries to

compete in export markets (Yi 2003). Given that production fragmentation involves multi-border crossings of intermediate inputs and the need to coordinate production facilities across geographical spaces, the role of services links is even more important than in the case of horizontal trade (Kimura *et al.* 2008, Saslavsky and Shepherd 2014).

Landlocked developing countries perform worse than coastal countries in trading across borders. As shown in Table 4.4, it cost US$3,142 on average to export a 20-foot container in LLDCs in 2014 as opposed to only US$1,422 average in coastal countries, which is 121 per cent higher. This is because exporters in landlocked developing countries need to provide more documentation, and it takes them longer to clear exports compared to transit neighbours. As for importing, the average time to import for LLDCs was 47 days in 2014, which is very high compared to 25 days for comparable transit countries. Firms in landlocked developing countries paid US$3,732 per container on average to import, compared to US$1,742 in their transit counterparts.

Table 4.4 Indicators on trading across borders, 2007 and 2014

	Exporting						Importing					
	Number of documents		Days		Cost per container[#]		Number of documents		Days		Cost per container[#]	
	2007	2014	2007	2014	2007	2014	2007	2014	2007	2014	2007	2014
Developed countries												
OECD	4	4	11	10	921	1014	4	4	11	9	997	1045
Non-OECD	5	5	17	14	737	1079	7	6	19	15	1160	1258
Developing countries												
Upper middle income	6	6	26	19	1291	1276	8	7	30	24	1465	1589
Lower middle income	8	7	29	25	1019	1542	9	8	35	29	1323	1858
Low income	9	8	45	36	1886	2591	11	10	57	41	2205	3128
LLDCs	9	9	51	41	2301	3142	11	10	59	47	2693	3732
Transit countries	8	6	32	22	1295	1422	10	7	37	25	1525	1742

Note: [#] A 20-foot container in US$. All fees associated with completing the procedures for exporting (or importing) are covered, including for documents, administrative fees for customs clearance and technical control, customs broker fees, terminal handling charges, and inland transport. Only official costs are recorded. However, the costs exclude tariffs and trade taxes.

Source: Author's compilations from the World Bank and UN-OHRLLS (2014).

This reaffirms findings in other studies. Landlocked developing countries are subject to higher trade costs compared to coastal countries, which is estimated on average to add 70 per cent in ad-valorem to the cost of traded goods (World Bank and UN-OHRLLS 2014). In addition, it takes around 43 days on average to export from LLDCs, which is more than twice the time needed to export from coastal developing countries (UN-OHRLLS 2013). Businesses in landlocked developing countries obviously face higher trade costs. But high costs are not only a function of geographical features; insufficient infrastructure and many policy-induced factors also play an important part (World Bank and UN-OHRLLS 2014). Transit trade and other infrastructural deficiencies add to documentation requirements and mean that it takes longer to clear imports and exports through customs compared to transit neighbours. As goods cross borders, they are subject to transaction costs associated with customs and handling procedures. In addition, if there is a switch in the mode of transport, there are also offloading and onloading charges along with warehousing expenses (MacKellar *et al.* 2000).

Additionally, landlocked developing countries are also found to have inferior logistics connectivity. Their logistics performance index (LPI) averaged 2.49 in 2014, compared to 2.84 in transit countries (see Table 4.5).[20] Logistics performance also appears to correlate with income levels, with the lowest scores in low-income countries, whereas countries in the Organisation for Economic Co-operation and Development (OECD) maintain the highest index. Infrastructure is considered a key determinant of transport costs, especially for landlocked countries. Trade is choked-off by distance, borders, or a range of political and cultural obstacles (Behar and Venables 2011). The costs of international trade are important determinants of a country's ability to integrate into the international economy. Nevertheless, Limao and Venables (2001) suggest that landlocked developing countries can overcome this disadvantage substantially through improvements in their own and their transit countries' transport infrastructure.

[20] The World Bank's LPI is the composite logistics performance indicator of six components: efficiency and border clearance, quality of trade and transport infrastructure, ease of arranging competitively priced shipments, competence and quality of logistics services, ability to track and trace consignments, and frequency with which shipments reach consignees within scheduled or expected delivery time. Each of the six indices is on a scale from 1 (very low) to 5 (very high).

Table 4.5 Logistics performance index by country groups, 2007–2014

	2007	2010	2012	2014	2007–2014, change (%)
World	2.74	2.87	2.87	2.89	5.5
Developed countries					
OECD	3.64	3.66	3.63	3.70	1.6
Non-OECD	3.13	3.19	3.21	3.18	1.6
Developing countries					
Upper middle income	2.64	2.74	2.78	2.82	6.8
Lower middle income	2.40	2.58	2.58	2.59	7.9
Low income	2.22	2.38	2.37	2.41	8.6
LLDCs	2.18	2.46	2.40	2.49	14.2
Transit developing	2.66	2.78	2.85	2.84	6.8

Source: Author's compilations from the World Bank and UN-OHRLLS (2014).

While cross-country analysis was conducted on trade costs, causal links have not been established to explain why landlocked developing countries are less integrated into global production sharing. We next develop a framework to look into this.

4.3 Theoretical framework and methodology

The theory of international fragmentation attributes the drivers of global production sharing to three factors (Jones and Kierzkowski 1990, Arndt and Kierzkowski 2001), as discussed in Chapter 2. First, fragmentability in production technology has enabled production operations that were previously performed in close proximity to be spread out across countries in order to take advantage of each location's cost competitiveness. Second, economic liberalisation has lowered trade and investment barriers in both home and host countries. Third, improved communication and transport infrastructure have contributed to declining costs of services links, which enhance the expansion of networked trade without impacting on the efficiency or timeliness of international production sharing. The quality of logistics is a crucial part of the globalised economy. Better logistics performance allows companies to move goods across borders not only quickly but also cheaply and reliably (Arvis *et al.* 2013). This helps reduce costs by lowering inventory levels, making it possible for businesses to adopt just-in-time logistics. Networked trade in consumer electronics, for instance, relies particularly heavily on logistics to coordinate the production and distribution of parts and

components as well as their assembled products among firms and to final consumers.

A gravity model

The current study analyses the determinants of countries' participation in global production sharing. The econometric analysis is based on a gravity model, which has been widely used to analyse the factors influencing bilateral trade. This includes examining the determinants of trade in global production sharing (Saslavsky and Shepherd 2014, Athukorala *et al.* 2017), in intermediate goods (Baldwin and Taglioni 2011), and at the sectoral level (Eaton and Kortum 2002, Martínez-Zarzoso *et al.* 2011). On global production sharing, Saslavsky and Shepherd (2014) found that the quality of logistics is particularly important for networked trade among Asian-Pacific economies, which is where the emergence and proliferation of international production sharing have been most pronounced.

A gravity model is no longer just an intuitive way of summarising the relationship among trade, economic mass, and distance. The estimation of a gravity model should take careful consideration of theoretical underpinning as it has become clear that a naive approach leads to biased estimations and often misinterpretation (Head and Mayer 2014). A variety of theory-consistent gravity models now exist, which make a crucial difference to the way the dataset is set up, the way in which the gravity model is estimated, and more importantly, the results and interpretation that are drawn from the estimation (Shepherd 2012). As a rule of thumb, all gravity model research should now include appropriate dimensions of fixed effects, or otherwise account for multilateral resistance introduced by Anderson and Van Wincoop (2003). This chapter also discusses the gravity derivations by Baldwin and Taglioni (2011), which is a follow-up from Anderson and Van Wincoop (2003) to explain how economic mass should be properly measured in analysing bilateral trade given the increasing importance of trade in parts and components.

In deriving a reduced form of gravity equations, Anderson and Van Wincoop (2003) employ a monopolistic competition framework based on the Armington assumption that each country produces differentiated goods. Trade is driven by consumers' love of variety, whereby goods are assumed to be differentiated by countries of origin such that each country specialises in producing only a good which is fixed in supply. The love-of-variety preference suggests that their utility increases either from consuming more of a given product variety or from consuming a wide range of varieties without consuming more of any one (Yotov *et al.* 2016).

The current research extends gravity modelling to explain the determinants of networked trade, focusing on factors that are most relevant to a landlocked developing country like Laos. First, the gravity model is adapted by augmenting economic mass to reflect total demand for and total supply of trading partners given the significance of trade in parts and components in international trade (Baldwin and Taglioni 2011). Second, it examines the relative importance of geographical and policy factors in determining trade costs with special attention paid to implications for landlocked nations. Third, the study takes advantage of the availability of panel data to address potential estimation problems such as endogeneity in some policy variables such as tariffs.

As a starting point, the theoretical gravity model of Anderson and Van Wincoop (2003) can be expressed in a reduced form as

$$X_{ijt} = \frac{Y_{it}\,E_{jt}}{Y^W} \cdot \left(\frac{\tau_{ijt}}{\Pi_{it}\,P_{jt}}\right)^{(1-\sigma)} + \varepsilon_{ijt} \qquad (4.1)$$

where X_{ijt} is export flows from exporting country i to importing country j, Y_{it} is production in country i, E_{jt} is expenditure in country j, Y^W is the world's total production, σ is the intra-sectoral elasticity of substitution between varieties within a sector, τ_{ijt} is bilateral trade costs, Π_{it} and P_{jt} denote the outward and inward multilateral resistance terms, respectively, and ε_{ijt} is a normally distributed error.

A prominent feature of the Anderson and Van Wincoop (2003) model is the inclusion of the multilateral resistance terms, Π_{it} and P_{jt}. Any model specification failing to take these resistance terms into account can result in a biased estimate, known as the 'gold medal mistake' (Baldwin and Taglioni 2006).

Given the multiplicity of a gravity equation, after taking logarithm (denoted *ln*) the expression becomes

$$lnX_{ijt} = lnY_{it} + lnE_{jt} - lnY^W + (1-\sigma)(ln\tau_{ijt} - ln\Pi_{it} - lnP_{jt}) + \varepsilon_{ijt} \quad (4.2)$$

where lnY^W becomes a constant term.

Equation (4.2) is a theory-consistent gravity equation, which is used in this study for analysing trade determinants in two separate regressions: the exports of parts and components, and the exports of final (assembled) goods.

In essence, the determinants of bilateral trade are composed of three components: economic mass, bilateral trade costs, and multilateral resistance. Each of these is

discussed in turn below.

Economic mass

In a traditional gravity model, gross domestic product (GDP) is usually used as a proxy for economic mass of exporting and importing countries (Y_{it} and E_{jt}). Appendix 4.A shows how a gravity equation is derived for analysing networked trade based on the Dixit-Stiglitz-Krugman monopolistic competition framework (Baldwin and Taglioni 2011).[21] The derivations suggest the importance of using an appropriate proxy for economic mass in modelling trade in parts and components that is different from that in final goods.

As shown in Equation (A.3) of Appendix 4.A, economic mass can be measured by GDP in a gravity equation for the exports of final goods. However, for gravity equations for part and component exports, the standard mass variable fails to perform well when trade in parts and components are important (Baldwin and Taglioni 2011). For this reason, in measuring an importing country's economic mass, GDP should be added with the purchases of parts and components from all sources, except for from the corresponding bilateral pair, as shown in Equation (A.10) of Appendix 4.A. This is to avoid including the same trade flows on both sides of the equation. Similarly, the origin or exporting country's economic mass is constructed by exploiting a direct definition of total production costs, comprised of the costs of primary and intermediate inputs. As shown in Equation (A.11), the proxy for an exporting country's mass variable should be manufacturing output (value-added) plus the sum of the imports of parts and components from all sources, except for from itself due to a lack of data.

Trade costs

Turning to the trade cost variable (τ_{ijt}), geographical distance alone cannot sufficiently explain why nations are trading less. Geographical distance is the easiest to measure and is usually used as a proxy for transport costs. The costs of international trade are affected by factors that are natural trade barriers, such as distance, landlocked status, contiguity, and common language, as well as policy-induced barriers, such as trade and

[21] The assumptions of this type of monopolistic competition include the products are differentiated, the number of firms is so large that each firm ignores its strategic interactions with other firms, and market entry is unrestricted and possible until the profits of existing firms are driven down to zero.

investment protection (Drysdale and Garnaut 1982, Baldwin and Taglioni 2006, Armstrong 2007).

Policy variables can be further broken down into those that are inhibiting and promoting trade. Trade-inhibiting factors include tariffs and other measures that are imposed at or behind the border. Measures that promote trade (through reducing the costs of services links) include the quality of trade-related logistics and the formation of regional trade agreements.

The current research uses tariffs (Tariff), logistics performance index (LPI), and regional trade agreements (RTA) as policy factors that reduce the costs of services links. As discussed in Chapter 2 that landlocked status affects developed (advanced) countries and developing countries differently, dummy variables for landlocked status LLAC and LLDC are used separately. Other control variables for trade costs are geographical distance (Distance), a dummy variable for a shared border (Contiguity), and a dummy variable for a common language (Language). By this, the trade cost term is expressed as

$$ln\tau_{ijt} = a_1 Tariff_{jt} + a_2 lnLPI_{it} + a_3 lnLPI_{jt} + a_4 RTA_{ijt} + a_5 LLAC_{ijt} + a_6 LLDC_{ijt} + a_7 lnDistance_{ijt} + a_8 Contiguity_{ijt} + a_9 Language_{ijt} \quad (4.3)$$

Other policy factors potentially influencing integration into global production sharing can be added, including infrastructure (such as roads, ports and telecoms), business environment and institutions, among others (Nunn and Trefler 2013, Kowalski *et al.* 2015). To ensure that the regression analysis is manageable, the choices of variables are framed by relevance to the research questions, which focus on the participation of landlocked developing countries in global production sharing. In addition, the use of panel data estimation should take care of other policy factors that are not included in the regression.

Multilateral trade resistance

Bilateral trade is not only determined by factors specific to the two trading partners. There is also a third-party effect, such as the size of neighbouring countries or the proximity of third countries, that can influence trade between a given pair of countries (Armstrong 2009a). This is called multilateral resistance by Anderson and van Wincoop (2003) or gravitational un-constant by Baldwin and Taglioni (2006). As shown in Equation (4.2), outward multilateral resistance (Π_{it}) captures the notion that exports from country *i* to country *j* depend on trade costs across all feasible export markets. In

addition, inward multilateral resistance (P_{jt}) represents the dependence of imports into country j from country i on trade costs across all feasible suppliers.

In general, it is difficult to observe multilateral resistance, but it can be captured in regression analysis. One approach is to use an iterative method to obtain estimates of the price-raising effects of trade barriers to multilateral resistance (Anderson and van Wincoop 2004). This approach is, however, not frequently adopted because a non-linear least square procedure is required to calculate multilateral resistance. A much simpler approach is to use fixed-effects or random-effects models or any estimation that controls for multilateral resistance (Head and Mayer 2014). More details are discussed in the section on estimation methods.

In addition, it is also imperative to control for time-specific effects (or fixed-time dummies) to capture the effects of shocks from global financial crises, macroeconomic conditions associated with business cycles, or general technological change (Egger and Egger 2005).

Model specification

Substituting the trade cost function in Equation (4.3) into Equation (4.2), a model specification becomes Equation (4.4). This is the gravity equation that is used for estimation separately for the exports of parts and components and the exports of final goods.

$$lnX_{ijt} = b_0 + b_1 lnS_{it} + b_2 lnM_{jt} + b_3 Tariff_{jt} + b_4 lnLPI_{it} + b_5 lnLPI_{jt} + b_6 RTA_{ijt} + b_7 LLAC_{ijt} + b_8 LLDC_{ijt} + b_9 lnDistance_{ijt} + b_{10} Contiguity_{ijt} + b_{11} Language_{ijt} + b_{12} t_{ijt} + \varepsilon_{ijt} \quad (4.4)$$

where X_{ijt} is the exports from exporting country i to importing country j, using reporter-recorded data.[22] S_{it} and M_{jt} denote economic mass of countries i and j, which are measured differently for part and component exports and final goods exports. $Tariff_{jt}$ is importing country j's simple average applied rate. LPI_{it} and LPI_{jt} are the logistics performance indices of countries i and j, respectively. RTA_{ijt} is a dummy taking one if either countries i or j is a member of a regional trade agreement (RTA), zero otherwise. $LLAC_{ijt}$ and $LLDC_{ijt}$ are dummy variables on landlocked status for respective

[22] The use of mirrored data provides a more accurate measure of exports, in particular for developing countries, because these countries tend to underreport their trade volumes.

developed and developing countries, taking one if either country i or country j is landlocked, zero otherwise. $\text{Distance}_{\text{ijt}}$ is relative distance between countries i and j. $\text{Contiguity}_{\text{ijt}}$ is a dummy taking one if countries i and j share a common land border, zero otherwise. $\text{Language}_{\text{ijt}}$ is a dummy taking one if countries i and j share a common official language, zero otherwise. b_0 is a constant term, t is a set of time dummies to capture year-specific effects, and ε_{ijt} is an error term. See variable descriptions in Table 4.6 below.

Table 4.6 Variable descriptions

Label	Description	Data sources
X_{ij}	Exports (reported by partner countries) from i to j in US$ current price. See the list of P&Cs in the Appendix 2.A. Final exports are calculated from deducting P&C exports from the aggregated exports reported in UN Comtrade	Comtrade
S_i	Exporter i's economic mass in US$ current price - For P&C equation: manufacturing output plus the sum of P&C imports from all partners, except for from the corresponding importer - For final good equation: GDP	WDI and Comtrade
M_j	Importer j's economic mass in US$ current price - For P&C equation: GDP plus the sum of P&C imports from all partners - For final good equation: GDP	WDI and Comtrade
Tariff	Simple average tariff rate (per cent)	WDI
LPI	Logistics performance index (1 lowest, 5 highest)	WDI
RTA	A dummy taking one if either i or j is a member of any regional trade agreements, zero otherwise	WTO extracted by de Sousa (2012)
Landlocked status (LLAC, LLDC)	A dummy taking one if i or j is landlocked, zero otherwise	CEPII and UN-OHRLLS (2013)
Distance	Relative distance between the most populated cities	CEPII
Contiguity	A dummy taking one if i and j share a common land border, zero otherwise	CEPII
Language	A dummy taking one if i and j have a common official language, zero otherwise	CEPII

Note: For Taiwan, data on bilateral trade is approximated by trade flows of Other Asia not classified elsewhere (OAS) in UN Comtrade. Other data series are drawn from the Taiwanese Statistics Year Book, except for tariffs that are from the Trade Analysis Information System (TRAINS) database of the UNCTAD.

The signs for economic mass (S_i and M_j), *LPI, RTA*, C*ontiguity*, and *Language* are expected to be positive. For economic mass, it means that the bigger the economies the more likely they will trade with each other. *LPI* is expected to have a positive sign as it measures the facilitating effects of the quality of trade-related logistics. Likewise, the sign for *RTA* is expected to be positive because forming regional grouping is expected to enhance networked trade. Common language and shared land borders will encourage more trade due to cultural closeness. The signs for *Distance, LLAC, LLDC,* and *Tariff* are expected to be negative.

In an empirical gravity model, it is important to make an appropriate measurement of different variables. In the early gravity model literature, some studies used dependent variables such as the logarithm of total trade (the sum of exports and imports) or the average of exports in both directions. Theoretical gravity models submit that such an approach is likely to produce misleading results. The correct model should apply to unidirectional export flows (Shepherd 2012).

Another issue is whether trade and GDP values should be expressed in nominal or real terms. Trade flows should be in a nominal term. This is because exports are already deflated by the multilateral resistance terms, which are special price indices. In addition, time dummies take care of the price effect on trade flows and hence it is not necessary to deflate them (Head and Mayer 2014). Similar reasoning also applies to GDP. This too should be in a nominal term. In addition, the theoretical derivations of a gravity model, including those made by Helpman (1987), Deardorff (1995), and Anderson and Van Wincoop (2003), do not justify the inclusion of GDP per capita in the reduced form of a gravity equation. In the same vein, population should also not be included in a gravity equation (Armstrong 2009b).

Data sources

This study covers 191 economies from 2000 to 2014. Given the focus of the research on landlocked developing countries, the country coverage is framed to cover as many economies as possible.[23] See Appendix 4.B for a full list of countries in this dataset. The analysis only covers trade in goods because data on services-related production sharing

[23] The rationale to use 191 economies is limited by the ability to link between different datasets on geographical and cultural factors from CEPII (224 economies), regional trade agreements from de Sousa (2012) containing 199 countries and territories, economic and policy variables from World Development Indicators, and trade flows from UN Comtrade.

is not readily available for the majority of developing countries. The starting year 2000 is chosen so as to allow for some degree of recovery from the 1997 Asian Financial Crisis.[24] The ending year is 2014, the year for which the latest data is available. The regressions that include LPI have the time dimension reduced to only 2007, 2010 and 2012 given the availability of logistics performance index data for only these three years.

Data are annual series drawn from various sources. Bilateral trade is from the Comtrade dataset of the United Nations through the World Integrated Trade Solution (WITS), while macroeconomic variables (GDP, manufacturing output, tariffs, and logistics performance index) are extracted from the World Bank's World Development Indicators (WDIs). Information on regional trade agreements is from the World Trade Organization (WTO) extracted by de Sousa (2012).[25] Landlocked status dummies are constructed from the list of countries provided in UN-OHRLLS (2013). For the remainder (distance, contiguity, language), data is drawn from the CEPII dataset by Mayer and Zignago (2011).

Estimation methods

Panel data estimation has an advantage in addressing concerns over multilateral resistance and country-specific characteristics. A fixed effects (FE) model is usually preferred to a random effects (RE) model in order to avoid potentially biased estimates from the pooled ordinary least squares (OLS) estimation (Egger 2005, Serlenga and Shin 2007). The FE model gives consistent estimates in cases in which country-specific unobserved characteristics are suspected to correlate with observed ones.[26] However, the FE estimation cannot account for policy variables, such as tariffs and logistics performance, which are central to the analysis in the current study. These country-specific variables are collinear with exporter-time and importer-time fixed effects, and will be eliminated from the FE estimation.[27]

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[24] The use of year dummies should take care of the effects of the shocks from global financial crisis or macroeconomic conditions associated with business cycles.

[25] de Sousa (2012) constructs RTA dummy among trading partners, which is accessible at http://jdesousa.univ.free.fr/data.htm.

[26] The drawback of the RE model is that it needs a strong assumption that multilateral resistance has to be normally distributed across countries, with a given standard deviation. Otherwise, the RE estimates are not consistent. In short, FE estimates are always consistent even if the true model fits the RE estimation.

[27] Some studies used frontier estimation, economic distance is accounted for by estimating a potential trade frontier that will capture trade resistance not measured in conventional gravity models (Kalirajan

Therefore, this study uses a Hausman-Taylor estimator, which is a RE model that addresses the possible endogeneity problem. Hausman and Taylor (1981) provide a multi-step method to estimate the effect of time-variant and time-invariant variables under homoscedasticity, where some independent variables are correlated with unobserved heterogeneity (Serlenga and Shin 2007).[28]

The procedure under Hausman and Taylor (1981) can be summarised in four steps. First, time-varying and time-invariant independent variables are grouped into exogenous and endogenous variables. In the first step, the effects of all time-varying variables are estimated via a fixed effects estimator and residuals are calculated. These residuals are then fed into the second step, where the effects of time-invariant variables are estimated using exogenous time-varying variables as instruments for time-invariant endogenous variables. Since the estimators of both steps are consistent, but not efficient under homoscedasticity, an efficiency enhancing generalised least square transformation is conducted in the third step. In the last step, the transformed model is estimated in one step using the within-transformed time-varying, between-transformed exogenous time-varying, and exogenous time-invariant variables as instruments. The procedure is applicable as long as there are at least as many exogenous time-varying variables as there are endogenous time-invariant variables.

4.4 Results and discussion

As discussed earlier, a Hausman-Taylor estimator takes the advantages of both the FE and RE models and addresses endogeneity by using instrumental variables from exogenous variables within the regression. The Breusch and Pagan Lagrangian multiplier test for random effects suggests that a RE model is preferred to an OLS model.[29] Trade policy variables (Tariff, LPI, and RTA) are treated as endogenous while economic mass, landlocked status, distance, language, and contiguity variables are treated as exogenous. The treatment of these explanatory variables is guided by a test of endogeneity. The results reported in Table 4.7 show the significance and expected signs

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2007, Armstrong *et al.* 2008, Kalirajan 2008).

[28] Baier and Bergstrand (2009) also provide an alternative approach that accounts for arbitrary distributions of multilateral resistance but without the inclusion of fixed effects. Their approach relies on a first-order Taylor series approximation of the outward and inward multilateral resistance terms (Shepherd 2012).

[29] For example, chibar2(01)=7863.34 with Probability of 0.0000 for the P&C exports equation.

of most independent variables. This is also confirmed by the t-statistics for individual independent variables and the F-statistics for joint significance of all variables.

Table 4.7 The determinants of global production sharing

	Parts and components	Final products
	(1)	(2)
ln(exporter's economic mass)	1.334***	1.345***
	(0.0186)	(0.0222)
ln(importer's economic mass)	0.954***	1.023***
	(0.0248)	(0.0239)
ln(importer's tariff)	–0.0932	–0.0687
	(0.0576)	(0.0463)
ln(exporter's LPI)	0.774***	1.091***
	(0.130)	(0.107)
ln(importer's LPI)	–0.271*	0.223*
	(0.141)	(0.115)
RTA	0.232***	0.138***
	(0.0529)	(0.0409)
LLAC	0.444***	0.325***
	(0.0952)	(0.107)
LLDC	–0.468***	–0.253***
	(0.0773)	(0.0863)
ln(distance)	–1.126***	–0.854***
	(0.0456)	(0.0480)
contiguity	1.211***	1.691***
	(0.189)	(0.208)
language	0.981***	0.847***
	(0.0884)	(0.0981)
constant	–34.42***	–40.97***
	(1.103)	(1.192)
observations	37,878	39,769

Note: Dependent variable is the log of exports of P&Cs and final products that are estimated in separate equations. Year-specific effects are included but not shown here. Robust standard errors are in parentheses. ***, **, and * indicate significance at 1 per cent, 5 per cent, and 10 per cent levels, respectively.

Source: Author's estimations.

The coefficients of the mass variables are significant, yielding elasticity of approximately 0.9 to 1.3, which is generally in line with other studies (Head and Mayer 2014). Distance also has a significant coefficient, yielding almost negative unity elasticity (–0.8 to –1). This is in line with median distance impact on trade in the trade

literature around –0.9 (Head and Mayer 2014).

For trade policy variables, LPI and RTA have a significant and positive impact on networked trade, as expected. This suggests that improving trade-related logistics and joining trade agreements are supportive of trade associated with production sharing through reducing the costs of services links. Specifically, an improvement in exporters' logistics performance index by one per cent will raise the exports of P&Cs and final goods by 0.7 per cent and 1 per cent, respectively; other things remain unchanged.[30] Similarly, other things remain unchanged; countries forming regional trade agreements will have their P&C exports 23 per cent higher than those that are outside regional trade agreements (or 14 per cent for the case of final exports).[31] The impact of tariffs is found to be insignificant for both P&C and final exports. This may be partly explained by the fact that tariffs are only a crude measure of trade protection given that there are also other behind-the-border barriers playing a role, but they are difficult to measure.

As for control variables, the negative sign on the LLDC dummy confirms that landlocked developing countries are disadvantaged in integrating into networked trade. But this is not the case for landlocked developed countries, given the positive sign on LLAC. Shared land borders and common languages promote networked trade as normally found gravity modelling.

These results are consistent with findings from Arvis *et al.* (2013) that landlocked status and distance are the major sources of trade costs. Nevertheless, logistics performance is found to be at least as important, and more so than tariffs. Saslavsky and Shepherd (2014) also find that logistics performance is particularly important for trade among developing countries in Asia and the Pacific, which is where the emergence of global production sharing has been most prominent.

What do these econometric results suggest? Landlocked developing countries are disadvantaged by their geographical location in integrating into international markets. The growing interconnectedness of different economies through global production sharing creates important opportunities for a developing country like Laos but also new policy challenges. Because these landlocked countries face higher trade costs than their comparable coastal neighbours, partly due to the importance of policy in addressing

[30] However, the negative sign on importers' logistics performance index for the P&C equation appears to be somewhat counter-intuitive.

[31] Calculated from 100*[exp(coefficient)–1] to get a percentage value.

their sources, policy measures can do a great deal in reducing these costs while boosting trade integration.

While infrastructure development forms an important element in enabling landlocked developing countries to better integrate into the international economy, building hard infrastructure alone without changes in policies (soft infrastructure) to improve administrative efficiency will not necessarily lead to lower transport costs (Kowalski *et al*. 2015). Logistics services are more important for limiting the costs of being landlocked than investing massively in infrastructure that neglects the functioning of logistics services (Arvis *et al.* 2010). This appears to reflect Laos' situation quite well. As discussed in Chapter 3, Laos is among the world's bottom 10 in a recent survey on logistics performance despite the efforts to transform itself to be 'land-linked'. Laos remained behind all other ASEAN members in almost all aspects including efficiency in border clearance, trade and transport infrastructure and logistics competence.

Robustness checks

To test for sensitivity of the findings, an alternative variable for services links and other estimation methods has been experimented with. First, the liner shipping index from the United Nations Economic and Social Commission for Asia and the Pacific was used instead of the logistics performance index. The results in Appendix 4.C were largely the same as those in Table 4.6, with respect to the significance and signs of all variables. However, the magnitude of the liner shipping index was somewhat lower than that of the logistics performance index.

Second, the fixed effects estimator was used with one based on linear least squares estimation and another one on Pseudo-Poisson Maximum Likelihood (PPML) estimation. These techniques are chosen given their strong theoretical underpinnings, and the fact that they have been extensively employed in recent gravity model literature, as noted earlier. The PPML method is assumed to account for zero trade flows and heterogeneity due to log-linearisation of a gravity equation (Santos Silva and Tenreyro 2006). In this dataset, zero trade flows are only 32 observations (0.029 per cent of 108,838 observations in 2007, 2010, and 2012) for P&C exports, and 3,248 observations (3.08 per cent of 105,622 observations for the three years) for final goods exports. This suggests that non-PPML estimations may not necessarily suffer from zero trade bias. As both models are estimated with an FE technique, they again cannot capture the effects of trade policy variables. However, they are provided for comparative purposes. The comparison of the coefficients points to similar behavioural

characteristics for the core variables across the two models: linear least squares and PPML with the fixed effects estimation. The magnitude of most coefficients from the Hausman-Taylor model is closer to those of the linear least squares rather than those of the PPML estimator.

4.5 Concluding remarks

This chapter has analysed trends in global production sharing and the extent to which landlocked developing countries have integrated into this type of trade. Despite developing countries' increasing participation in international production sharing, landlocked developing countries have lagged behind in this respect. Landlocked status indeed raises the costs of international trade, making landlocked economies disadvantaged.

This observation has led to econometric analysis to probe the determinants of countries' participation in networked trade. The estimation was based on a gravity model adapted for trade dominated by global production sharing. Landlocked status was found to reduce networked trade. However, improving trade-related logistics and joining regional trade agreements have a positive impact on countries' participation in global production sharing. This highlights the importance for landlocked countries to overcome their geographical disadvantage by reducing the costs of services links associated with these factors and better integrating into global production sharing.

A couple of caveats are worth noting. First, what we found are the factors determining trade associated with networked trade at the inter-country level. There is a need to further look into participation in global production sharing at the national level; for example, what the private sector views as important for them to tap into international production sharing. This issue is further examined in Chapter 5, which focuses on the manufacturing sector in Laos. Second, this chapter analysed the patterns and determinants of countries' participation in global production sharing across the board. Production sharing in textiles and garments, which is driven by buyers, is essentially different from the pattern that exists in producer-driven industries such as automotive, electronics or precision equipment production. Hence, Chapter 6 explores production sharing at the sectoral level.

5 The Determinants of Firms' Export Performance

5.1 Introduction

This chapter seeks to better understand the integration of Laos into the international economy from a firm-level perspective. It supplements the macroeconomic analysis conducted in Chapter 4. The process of economic integration ultimately depends upon the behaviour and actions of the private sector. What sorts of firms in Laos are involved in the international market and what are their distinguishing characteristics? Are the firms that participate in international trade domestic- or foreign-owned? Do those firms sell their goods and services domestically or do they also export? If so, how much is exported directly and indirectly? These questions are central to this chapter. Understanding the characteristics and behaviour of firms that are connected to the international market is important to formulating policy strategies that seek to maximise the advantages of international engagement and its capacity to promote economic growth and welfare.

Until recently, theoretical and empirical studies have shifted the focus of analysis from countries to industries and firms, resulting in new insights into factors influencing export decisions at the micro level. Theoretical contributions were pioneered by Melitz (2003) and others. Entry into foreign markets incurs a fixed cost and only firms that are highly productive can take advantage of economies of scale necessary to self-select into foreign markets (Melitz 2003). The literature suggests that exporters are generally more productive, as reflected in their larger size and other characteristics of firms, than are non-exporting firms (Bernard *et al.* 2011).

Although the empirical evidence from studies of several countries suggests regularities in export behaviours, recent international trade literature has found great heterogeneity regarding the factors influencing firms' export decisions (Greenaway and Kneller 2007, Wagner 2012, Melitz and Redding 2014). This implies that the determinants of firms' exports are not universal, but they are quite context-specific. The development model of Laos as a small, landlocked economy and a late reformer can provide more evidence to investigate this phenomenon. A study of Laos' experience can also contribute to extending this line of research to better understand the dynamism of firms and their export behaviours in other countries with similar characteristics.

Generally, increasing exports includes not only enhancing the chance of firms to sell

abroad but also intensifying their exports.[32] Therefore, knowing which factors impact firms' decisions regarding whether to export or not, and which factors affect their decisions about how much of their sales to export, is also of interest.

Studies on the determinants of firms' exports in Laos include those conducted by Kongmanila and Takahashi (2009), Kyophilavong (2011), and Nolintha and Jajri (2015). Nolintha and Jajri (2015) find that manufacturing firms in Laos have achieved some technological upgrading, and that firm performance is determined by export activities. Using a field survey of an industrial cluster among Lao garment factories, Kongmanila and Takahashi (2009) uncover that product and process innovations are important factors in determining firms' export performance and profitability. However, both studies only focus on the garment industry. In examining business obstacles, Kyophilavong (2011) finds that small and medium enterprises in Laos cited access to finance as their biggest challenge in export participation. The purpose of the current study is to investigate the effect of firm characteristics on export intensity in a specific context of Laos. In doing so, the research uses enterprise surveys conducted by the World Bank up to 2016, which is in contrast to previous studies (Kongmanila and Takahashi 2009, Kyophilavong 2011, Nolintha and Jajri 2015) that used data from their own fieldwork surveys.

The remainder of this chapter proceeds as follows. The next section explores the characteristics of manufacturing firms, revealing that exporters are more productive than non-trading firms. Section 5.3 discusses methodology to account for factors affecting exports based on the theory of firm heterogeneity, while data is described in Section 5.4. Econometric results are presented in Section 5.5, suggesting that firm size and other firm characteristics indeed play an important role in enhancing firms' exports. Section 5.6 provides concluding remarks.

[32] Ideally, the analysis should be on factors determining the participation of firms in global production sharing, but due to data limitations the focus is on the determinants of firms' exports. Firms need to have foreign linkages, either through trade or investment channels at least in a formative stage, in order to engage in global production sharing.

5.2 A preliminary analysis

Contribution of the Lao manufacturing sector

Manufacturing is one of the key sectors contributing to the Lao economy. Between 2000 and 2015, the share of industrial output in gross domestic product (GDP) rose from 17 per cent to 31 per cent. At the same time, the share of agricultural output steadily declined from 45 per cent to 27 per cent while the services share expanded from 38 per cent to 42 per cent (see Chapter 3 for more detail). Manufacturing accounted for a third of industrial output in 2015, or equivalent to 10 per cent of GDP. The manufacturing sector employs 8.5 per cent of the total workforce (Vilavong *et al.* 2016).

Manufacturing exports grew at 18 per cent on average since 1995, reaching US$2.6 billion in 2015. Manufacturing products are measured by International Standard Industrial Classification (ISIC) 15 to 37. A sectoral analysis finds that traditional exports face a declining trend amid a rapid increase in non-traditional manufacturing export items, such as metals, chemicals, and electronics (see Table 5.1). As far as traditional exports are concerned, the share of wood and furniture (ISIC 20 and 36) in manufacturing exports fell from 41 per cent in 1995 to 23 per cent in 2015. Likewise, the corresponding figures for textiles and garments (ISIC 17 and 18) were 49 per cent and 12 per cent. At the same time, exports of basic and fabricated metal products (ISIC 27 and 28) had increased, in particular from 2005 onwards, accounting for almost 28 per cent of manufacturing exports in 2015. Other non-traditional exports include chemicals (ISIC 24) as well as food and tobacco (ISIC 15 and 16). There have also been signs of a notable increase in electronics exports (ISIC 31 and 32) since 2014, which coincides with rising investments in the sector in response to the government's promotion of special economic zones.

Table 5.1 Manufacturing exports from Laos by products, 1995–2015

Description	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Food and tobacco	0.6	0.5	1.4	1.2	0.9	1.1	5.2	3.5	3.0	5.2	4.2	6.2	6.9
Textiles and garments	49.2	52.4	41.2	24.5	22.0	23.3	24.9	23.2	19.8	16.7	13.8	13.0	12.2
Leather	0.8	1.9	1.6	1.0	1.0	0.7	1.4	1.3	1.2	1.5	1.2	1.4	1.6
Wood and furniture	40.6	19.9	32.8	21.8	15.3	17.4	17.1	19.8	23.2	22.5	26.6	34.4	23.1
Paper	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Refined petroleum products	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.4	0.1	0.1	0.1	0.1	0.1
Recorded media	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.0	0.0	0.0
Chemicals	2.4	0.2	0.5	1.0	1.0	1.6	3.1	2.7	4.0	6.9	6.0	6.6	11.0
Plastic and rubbers	0.0	0.1	0.1	0.1	0.1	0.1	0.2	0.5	0.2	0.2	0.2	0.4	0.5
Non-metallic mineral products	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
Basic metals and fabricated metal products	5.8	0.0	20.1	48.8	56.3	51.2	44.0	44.1	46.0	44.2	38.0	29.4	27.5
Machinery and equipment	0.1	0.1	0.9	0.6	1.2	1.3	1.3	1.5	0.7	0.7	0.5	0.4	0.6
Electronics	0.2	0.3	1.0	0.6	1.2	1.4	1.6	1.9	1.0	1.2	1.4	7.4	15.6
Precision instruments	0.0	0.0	0.1	0.0	0.0	0.3	0.2	0.2	0.1	0.2	0.1	0.3	0.5
Transport machines	0.2	24.4	0.3	0.2	0.7	1.6	0.9	0.8	0.6	0.6	0.7	0.3	0.5
Total (%)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Note: Food and tobacco (ISIC 15 and 16), textiles and garments (ISIC 17 and 18), leather (ISIC 19), wood and furniture (ISIC 20 and 36), paper (ISIC 21), refined petroleum products (ISIC 22), recorded media (ISIC 23), chemicals (ISIC 24), plastic and rubbers (ISIC 25), non-metallic mineral products (ISIC 26), basic metals and fabricated metal products (ISIC 27 and 28), machinery and equipment (ISIC 29 and 30), electronics (ISIC 31 and 32), precision instruments (ISIC 33), transport machines (ISIC 34 and 35), and recycling (ISIC 37).

Source: Author's calculations from UN Comtrade, using partner-reported data.

Analysis on firm exporting

Consistent with findings in other studies (Bernard and Jensen 2004, Wagner 2007, Nguyen and Nishijima 2009), the proportion of firms in Laos that export is relatively low. As shown in Table 5.2, 9.8 per cent of manufacturing firms in Laos export at least 10 per cent of their total sales.[33] By comparison, Laos has a lower rate of export participation than the average the Association of Southeast Asian Nations (ASEAN) at 17.4 per cent. However, it is comparable to those in Myanmar and Thailand, at 9 per cent and 11 per cent, respectively. Within ASEAN, Malaysia has the highest export participation rate, with almost half of firms exporting at least 10 per cent of their sales, whereas Indonesian export participation is the lowest.

Table 5.2 Share of exporting manufacturers in ASEAN

Countries	**Year**	**Percentage of firms exporting directly** (at least 10% of sales)
Cambodia	2016	14.3
Indonesia	2015	5.9
Laos	2016	9.8
Malaysia	2015	49.3
Myanmar	2016	9.0
Philippines	2015	18.8
Thailand	2016	11.0
Vietnam	2015	21.4
Average		17.4

Note: Data is not available for Brunei and Singapore.

Source: Author's compilations from the World Bank's enterprise surveys.

Exporting and firm heterogeneity

The literature finds that exporting firms are more productive, and larger, on average, compared to non-exporting businesses. Bernard *et al.* (2007) find that exporters in the United States are significantly larger than non-exporters, by 97 per cent for employment and 108 per cent for export shipments. They are also more productive by 11 per cent for value-added per worker and 3 per cent for total factor productivity. In China, Renard

[33] A cut-off of 10 per cent of sales is used in order to compare with available data in the World Bank's enterprise surveys for other comparator countries.

(2002) finds that labour productivity and total factor productivity (TFP) are significantly higher in exporting firms than in non-exporters. For established exporters, exports in previous periods are positively associated with current productivity after controlling for previous firm performance and unobserved firm characteristics. Likewise, Yi (2014) finds that Chinese exporters are larger than those firms that concentrate in the domestic market, and are more productive by 42 per cent. For Indonesia, Korea, Malaysia, the Philippines, and Thailand, Hallward-Driemeier *et al.* (2002) find that total factor productivity is larger for exporters than non-exporters, and the gap is larger if the local economy is less developed. In addition, firms engaging in exporting from earlier on have higher TFP levels years later due to different firm policies, including investments in human capital. As for countries at the same level of development to Laos, Van Biesebroeck (2003) discovers exporter premia for labour productivity are around 50 per cent in sub-Saharan African countries. The author also finds that labour productivity does not differ between new and continuous exporters, but is higher compared to non-exporting counterparts.

It is interesting to know what the situation in Laos is. To assess this, an exporter premia is calculated by using (bivariate) ordinary least squares estimation, following Bernard *et al.* (2007). Exporter premia is the percentage difference of productivity in different measures and between exporters and non-exporters, *ceteris paribus (*other things remained unchanged). The dependent variables are labour productivity and other variables as reported in Table 5.3. The independent variable is an exporter status dummy. Ideally, productivity should be measured by total factor productivity (TFP) or labour productivity (value-added per employee), but due to limitations of the dataset, this research can only compute labour productivity measured by total sales per employee. This measure is also used by Hummels *et al.* (2001) and Amin *et al.* (2017) to proxy for productivity. For Laos, the calculation of value-added from total sales deducted with total production costs results in 40 negative observations and 24 missing observations.[34] Following Bernard *et al.* (2007), the current study controls for industry effects as export participation tends to correlate with characteristics specific to certain industries (see Appendix 5.A). In addition, as the data is pooled across three years to overcome a small sample, year effects are also controlled for.

[34] Total production costs are a sum of labour costs (including wages, salaries, bonuses, social security payments), the cost of raw materials and intermediate goods, fuel costs, and electricity costs.

Table 5.3 Exporter premia in the Lao manufacturing sector

	Exporter premia	Standard error
Labour productivity (in logarithm)	0.3953**	(0.1694)
Employment (in logarithm)	1.2563***	(0.1541)
Wage per worker (in logarithm)	0.1077	(0.1327)
Capital-labour ratio (in logarithm)	0.3439	(0.2524)

Note: Data is pooled across 2009, 2012, and 2016 to address small sample size. Industry- and year-effects are controlled for. ***, **, and * indicate significance at 1 per cent, 5 per cent, and 10 per cent levels, respectively.

Source: Author's calculations from the enterprise surveys on Laos of the World Bank (2017c).

There appear to be sharp differences in exporter premia in terms of labour productivity and employment but not in terms of other firm characteristics. As shown in Table 5.3, exporters are more productive by approximately 40 per cent than non-exporters as measured by labour productivity.[35] In addition, exporters are 125 per cent larger in employment than the non-exporting counterparts. However, the exporter premia with respect to capital-labour ratio and real wage per worker in the case of Laos are found to be not statistically significant.[36] Part of the explanation could be attributed to the fact that Lao manufacturing firms tend to concentrate on industries that use capital less intensively, such as garments as well as wood and furniture processing, as we observed in the analysis in Section 5.2.

The finding that exporters are more productive than non-exporters leads to the question of the direction of causality. Does high productivity encourage firms to self-select into an export market, or does exporting result in productivity growth through learning by exporting? While there is substantial evidence of selection into exporting, there is less evidence of learning by exporting (Greenaway and Kneller 2007, Bernard *et al.* 2011, Wagner 2012). Export starters are likely to be more productive than non-trading firms years before their entry into export. In addition, exporters often have higher *ex-ante* productivity growth. Evidence regarding the learning-by-exporting hypothesis is rather

[35] A more accurate value should be computed from the estimated coefficient β as $100(\exp(\beta)-1)$. This study uses an approximate of $100x\beta$ to be comparable with what is reported in Bernard *et al.* (2007).

[36] Real wage is computed from the costs of labour, including wages, salaries, bonuses, social security payments, deflated by GDP deflator. Capital is measured by net book value of machinery, vehicles, and equipment.

mixed. This is due to the fact that results for *ex-post* differences in performance between exporters and non-exporting firms point to faster growth rates in productivity for the former group in some empirical studies (Wagner 2012).

Nevertheless, some research on less-developed countries suggests productivity improvement after export entry. Van Biesebroeck (2005) finds that exporting raises productivity for sub-Saharan African countries. The author argues that economies of scale are shown to be a vital channel for raising productivity. Credit constraints along with contract enforcement problems prevents firms that only serve the domestic market from totally exploiting market size. Looking into Indonesian manufacturing firms, Blalock and Gertler (2004) find evidence of learning-by-exporting, showing that firm productivity increases by around 2 per cent to 5 per cent after the firm begins to export. However, Blalock and Gertler (2004) are interested in comparing productivity change pre- and post- market entry. In a study on Chile, Alvarez and López (2005) argue that productivity improvements from exporting occurs only for new exporters and not for permanent exporters, which implies a short-run effect of learning-by-exporting.

5.3 Theoretical framework and methodology

The analysis in the previous section only provided a partial explanation of export performance with respect to different firm characteristics in Laos. Next, we turn to explore any causal linkages by a regression analysis.

Theoretical framework

An early study by Bernard and Jensen (1999) finds that productive firms in the United States become exporters, and that exporting is linked to growth in plant size. However, the lack of productivity gains appears to suggest that a firm's entry into the export market is not likely to raise their productivity substantially, even if they tend to export continuously. Using data for Mexico, Colombia and Morocco, Clerides *et al.* (1998) find no evidence of differences in productivity growth between exporters and non-exporters. This tends to suggest self-selection; that is, exporters are more productive, not necessarily as a result of exporting, but simply because the most productive firms can overcome the fixed costs associated with entering export markets. A model of self-selection was pioneered by Melitz (2003), and has subsequently dominated recent research in the field (Bernard and Jensen 2004, Baldwin 2005, Bernard *et al.* 2011, Melitz and Redding 2014).

The theory of firm heterogeneity provides an analytical framework for understanding the behaviour of firms in international trade. There exist sunk costs in engaging in foreign markets and only firms that are highly productive (for example, producing at a lower cost) can exploit economies of scale and manage to export. Those that are less productive will shrink to operate only in the domestic market while the worst-performing firms will eventually exit (Melitz 2003). Exporting firms have to learn about new market conditions or adjust their products to meet customs and trade regulations of destination countries, which are not faced by those that operate domestically. Apart from fixed costs, exporting firms need also to pay variable costs, including international communication, marketing, and shipping. The process of export entry and exit, known as self-selection, leads to overall improvements in industry efficiency. When trade costs are reduced due to falling policy barriers or transportation costs, there is reallocation of economic activity across firms given the self-selection effect (Melitz 2003, Bernard *et al.* 2011).

Subsequent research has explored a number of dimensions of the theory of firm heterogeneity and trade. This includes studies that develop a theoretical framework about the links between comparative advantage and heterogeneous firms (Bernard *et al.* 2007), variable mark-ups and market size (Melitz and Ottaviano 2008), multi-product plants (Bernard *et al.* 2011, Mayer *et al.* 2011), international organisation of firms and trade (Antràs and Helpman 2006), and frictions in the labour market (Egger and Kreickemeier 2009, Helpman and Itskhoki 2010).

Model specification and estimation

The export behaviour of firms involves two decisions. The first is for firms to make a choice between exporting and not exporting (export participation), and the second is to decide how much of their total sales to export (export intensity). An econometric analysis to account for factors affecting the exports of manufacturing firms in Laos faces some methodological challenges. Firms' export decisions will be best understood when the complete sample of exporters and non-exporters is considered in the analysis. Only the positive value of exporting firms is likely to be observed, and estimating the determinants of export intensity using ordinary least squares (OLS) can be affected by failures to account for the complete range of values on exporting decisions, including those that do not export. To the magnitude that exporting and non-exporting firms systematically differ from each other, the distribution of the dependent variable (export intensity) in the set of uncensored observations is not normally distributed. Such

heterogeneous distribution of export intensity violates the OLS assumption of normally distributed errors, which in turn hampers the reliability of the estimates (Correa *et al.* 2007).

To address such problems, sample selection estimation techniques, including Tobit and Heckman models, can be used. A Tobit model uses all observations to estimate the regression, which assumes that export intensity can be represented by an observed latent variable (EI_{it}^{*}). Therefore, the Tobit model is expressed as

$$EI_{it}^{*} = x_{it}\beta + u_{it} \quad \text{if } x_{it}\beta + u_{it} > 0$$

$$EI_{it}^{*} = 0 \quad \text{if } x_{it}\beta + u_{it} \leq 0 \qquad (5.1)$$

where EI_{it}^{*} denotes the observed export intensity of firm i at time t, x_{it} is a set of independent variables, β is a set of coefficients to be estimated, and u_{it} denotes the error term that is assumed to be normally distributed.

One limitation of the Tobit model is that it does not allow for a theoretical explanation of the reasons leading to observations being censored (Correa *et al.* 2007). Alternatively, a Heckman model can be used, which involves regression analysis based on a two-stage decision process of firms. At the first stage, firms decide whether to export or not (export participation), which is estimated in a selection equation. At the second stage, they decide how much to export (export intensity). The regression of export intensity is then restricted to the subset of firms that export in estimating an outcome equation. Sample selection bias can be avoided using a Heckman selection model, which jointly estimates the export participation and export intensity equations.

First stage: a selection equation for export participation (EP)

$$EP_{it}^{*} = w_{it}\alpha + e_{it}$$

$$EP_{it} = 0 \text{ if } EP_{it}^{*} \leq 0$$

$$EP_{it} = 1 \text{ if } EP_{it}^{*} > 0 \qquad (5.2)$$

Second stage: an outcome equation for export intensity (EI)

$$EI_{it}^{*} = x_{it}\beta + u_{it}$$

$$EI_{it} = EI_{it}^{*} \text{ if } EI_{it} = 1, \text{ or zero otherwise.} \qquad (5.3)$$

where EP_{it}^{*} is the latent variable (export participation) of firm i at time t, w_{it} denotes a vector of independent variables with a set of coefficients α, EI_{it}^{*} is the outcome variable (export intensity), x_{it} is a vector of independent variables with a set of coefficients β,

and e_{it} and u_{it} are error terms that are assumed to be normally distributed with a joint distribution.[37]

As suggested by the literature on trade and firm heterogeneity, this research examines the determinants of firms' exports focusing on the role played by firm productivity while controlling for other characteristics. Productivity at the firm level can be measured by either total factor productivity (TFP) or labour productivity. In the current study, a reliable measure of TFP cannot be computed due to the limitations of the World Bank's enterprise surveys for Laos.

In principle, value-added per worker should be used to construct labour productivity rather than total sales per worker, but the calculation of value-added from this dataset generates too many negative and missing values, as discussed in the previous section. Thus, the current research uses labour productivity, measured by total sales per worker instead. Productivity is expected to have a positive impact on exports. The rationale is that only the most efficient firms can break into a foreign market or firms having productivity above a certain threshold find it profitable to export given the existence of sunk costs (Melitz 2003, Melitz and Redding 2012).

As for control variables, firm-specific characteristics can influence product quality or production costs, and these are crucial for explaining export performance. In selecting these independent variables, the current study follows the previous literature, subject to the availability of data in the enterprise survey (see a simple comparison of firm characteristics between exporters and non-exporters in Appendix 5.B).

First, firm size is included to capture a notion that larger firms are better at absorbing sunk costs associated with exporting. Because of the scale effect, larger firms tend to have lower average or marginal costs, which enable a firm to export more (Bernard and Jensen 2004, Srinivasan and Archana 2011).

Second, firm age matters but has ambiguous effects on firms' exporting. Foreign trade generally requires distribution channels or solid long-term relationships with buyers. The longer a firm has been operating, the stronger the channels of supply, which makes it easier for the firm to export (Wagner 2007). However, a negative relationship can also

[37] If the test of the distribution (Rho=0) is significantly different from zero, it is more likely that the sample selection problem does exist; therefore, the Heckman selection models are properly corrected for sample selection bias.

be observed. This reflects the fact that it may be more difficult for older firms to adjust to changing market circumstances (Wignaraja 2013). Other studies have also highlighted the situation wherein export-oriented firms are born and not bred into exporting (Alvarez and López 2005). That is, exporters are firms that begin to get involved in exporting activities from the time they are established.

Third, the share of foreign ownership is also incorporated. Foreign-invested firms tend to have greater tacit knowledge and foreign linkages, which can give them a competitive edge over locally owned firms (van Dijk 2002). Foreign affiliates may have access to accumulated learning experience or be able to tap into sophisticated technologies and management experience of their parent companies. In addition, foreign investment firms can have better access and connections to external markets (Harvie *et al.* 2010) or have greater access to finance (Rho and Rodrigue 2015).

Fourth, exporting performance may also be affected by importing activity. Firms that import some of their inputs are more productive in producing goods since the imported intermediaries reduce the costs of production and also have better quality (Kasahara and Rodrigue 2008). Importing also reflects degrees of firm international integration. The more firms engage in other cross-border activities, the more likely they are to be involved in exporting (Nguyen and Nishijima 2009).

Fifth, there are costs associated with engaging in exporting activities that are sunk in nature; that is, once incurred they cannot be recovered (Melitz 2003). These include the cost of learning about market conditions or establishing distribution channels as well as the costs of marketing campaigns in a foreign market (Srinivasan and Archana 2011). A firm may continue to export rather than exit exporting markets even though exporting is currently unprofitable because of sunk costs. This explains why a one-off fixed cost can induce persistence in firms' decisions to export (Roberts and Tybout 1997).

Some studies use exporter status in a previous period to capture sunk costs (Bernard and Jensen 1999, Das *et al.* 2007, Srinivasan and Archana 2011). However, this cannot be implemented in the current research because around two-thirds of the observations will be eliminated while the sample size is already small. The current study uses the frequency of exporter status in various years to account for sunk costs and persistence in exporter status. Firms that export more frequently will have higher export intensity compared to those that export less frequently (Sun 2009). Given the unbalanced panel data, this study uses weighted frequency to avoid giving too much weight to exporter status that appears only in one or two years.

There is also a need to take into account unobserved factors influencing firms' performance. These include heterogeneous effects, for instance, differences in production technology across industries or macroeconomic conditions across time. This study thus controls for unobserved heterogeneity using dummy variables for different industries and years. Spillover effects associated with regions should also be controlled for, but this dataset does not permit us to do so. Other types of firm characteristics (for example, firms having international standards or proving training to employees) have not been included as they are found to have a negative sign and are statistically insignificant in a bivariate correlation.

The variable descriptions and measurements are summarised in Table 5.4 while their descriptive statistics are provided in Appendix 5.C.

Table 5.4 Variable descriptions and measurements

Variable	Description and measurement
Export intensity (EI)	Export intensity is measured by the proportion of total sales that is exported directly.
Export participation (EP)	Export participation is a dummy taking one if at least one per cent of total sales is exported directly, zero otherwise.
Productivity	Labour productivity is measured by total sales per worker (in logarithm), and is expected to have a positive impact on export performance. To avoid an endogeneity problem, labour productivity reported 3 years ahead of the current year is used.
Size	Firm size is measured by the number of full-time employees (in logarithm), and expected to raise export intensity.
Age	Firm age is measured by the number of years in operation (in logarithm), and can have either positive or negative effects on exports.
Foreign	Foreign ownership is measured by the share of foreign equity, and is expected to raise firms' exports.
Import	Import is measured by the share of material inputs or supplies of foreign origin in all material inputs or supplies purchased.
Sunk	Sunk cost is represented by the weighted frequency of exporter status appearing in different years to capture persistence in exporting.
Industry	A dummy controls for unobserved heterogeneity effects across manufacturing subsectors based on the International Standard Industrial Classification at the two-digit level.
Year	A dummy controls for macroeconomic conditions in various years, for example, the effects of the global financial crisis or a change in relative real exchange rate.

Continuous variables (such as firm size and age) are included in logarithmic form to better fit a normal distribution and to smooth out any outliers. Therefore, the log-linear form suggests a non-linear relationship between exports and these independent variables, which are also found by Bernard and Wagner (2001). However, this cannot be done for variables with many zeroes (for instance, export share, foreign ownership) as taking logarithm will eliminate those zero observations.

Potential biases

There may be some potential biases in econometric estimation due to an endogeneity problem. The first source of this bias is from endogeneity caused by reverse causality.

There could be a bidirectional relationship between exports and productivity. Export activities can increase firm productivity, and an efficient firm is more likely to continue to export. To avoid this, total sales per worker reported for three years earlier is used as a proxy for labour productivity given no definitive conclusion about whether productive firms become exporters, or exporting leads to productivity gains. Labour productivity in the current year is also used in the estimation for robustness checking.

The second source of endogeneity bias may be caused by omitted variables such as other unobserved factors affecting firms' performance that are not accounted for in the model. These omitted variables may correlate with the error term, making estimation inference unreliable. The model specification incorporates industry- and year- effects to control for possible unobservable heterogeneous effects across these dimensions. Some industries differ in production technology (Das *et al.* 2007), or they obtain certain favourable treatment from government policies (Jongwanich and Kohpaiboon 2008). Some firms may be affected differently by macroeconomic conditions such as shocks from the global financial crisis or exchange rate depreciation (Das *et al.* 2007). In addition, there is also a need to conduct a test as to whether the use of panel data or pooled estimation is more appropriate. If individual-specific effects exist, the panel data estimation should be adopted.

Data

The current research uses Laos' enterprise survey conducted by the World Bank in 2009, 2012, and 2016. This survey has many advantages compared to those conducted by other agencies, for example, GIZ (2014). First, the sample is relatively diverse and representative of total establishments in Laos based on three levels of stratification: industry, firm size and region.[38] Second, the survey is a panel dataset, which is very useful for understanding the dynamics of the behaviour and performance of firms across time. Third, the survey has been conducted by the World Bank in several countries, which allows comparisons to be made with other studies. However, there are also some weaknesses in the data that researchers need to be aware of. The World Bank's survey may not fully reflect a complete picture about all businesses in Laos as the sample excludes micro businesses (establishments with less than five employees), state-owned

[38] Among those in the enterprise surveys, manufacturing firms have the highest share, accounting for 29.9 per cent of all firms, followed by retailers (29.1 per cent). Hotels and restaurants make up 8.2 per cent while 7.3 per cent are involved in vehicle repair businesses. The rest are engaged in other services (such as construction and communication).

enterprises, and some other types of businesses.[39]

Basically, the World Bank's survey provides information on enterprises' legal status, ownership, access to finance, infrastructure and services, sales and supplies, degree of competition with the informal economy, technological capability, government support, business environment, and labour, among other things. In the 2009 survey, the sample covered a total of 360 establishments, of which 125 were engaged in manufacturing and the rest in services. The number of establishments was expanded to 379 and 368 in the surveys conducted in 2012 and 2016, respectively. The dataset has 1,107 observations in total.

The data have been cleaned by checking for missing values and responses that were not definitively confirmed at the time of interviewing. As the focus of this research is on the manufacturing sector, only firms whose key products are identified under ISIC 15 to 37 are included. The sample, hence, contains a total of 353 observations across three years: 147, 96, and 110 observations in 2009, 2012, and 2016, respectively.

5.5 Results and discussion

As discussed earlier, the ordinary least squares (OLS) estimation of export intensity produces unreliable estimates given the potential sample section bias. However, the OLS model is estimated and shown in the appendix for comparative purposes. The results from the Tobit and Heckman selection models are reported in Table 5.5. In the Tobit estimation of Equation (5.1), the lower bound is set at zero as export intensity is observed to be bounded at this lower limit. Out of the total sample of 353 observations, 259 observations have zero value because many firms do not export. In addition, this study controls for the further censoring problem with truncation at the upper limit of 100, as seen in a histogram plotted in Figure 5.1. Failure to take this censoring nature of data into account may lead to sample selection bias. To account for possible unobserved heterogeneity, this study adopts panel estimation, as reported in the first column of Table 5.5.[40]

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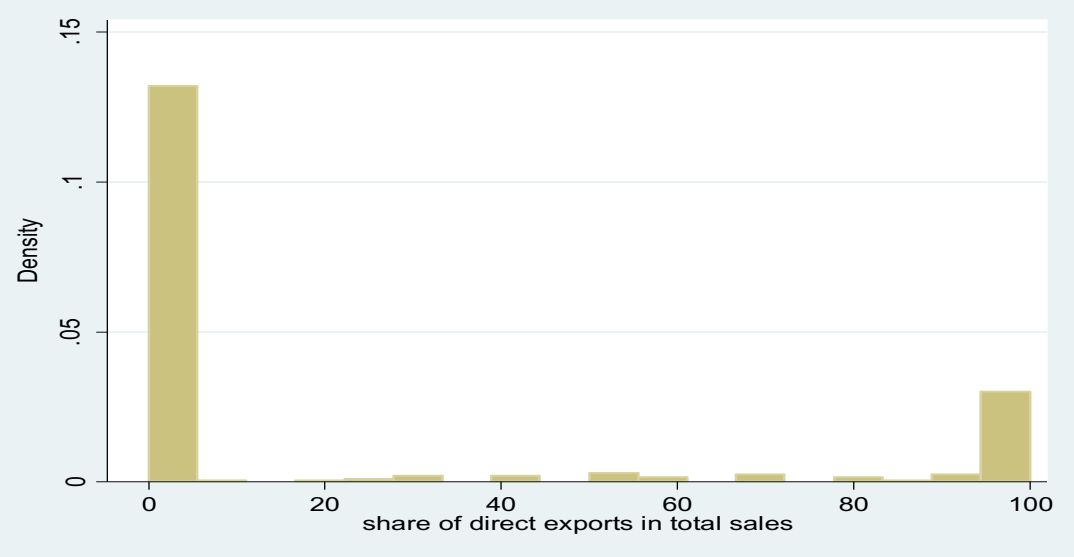
[39] A business census by the Lao Statistics Bureau reveals that 89 per cent of businesses in Laos are micro and small establishments employing fewer than nine persons. For the rest, 10.4 per cent are medium-sized enterprises with 10 to 99 employees, and only 0.7 per cent are large companies. See Vilavong *et al.* (2016).

[40] Only the Tobit random effects (RE) model can be estimated as the fixed effects (FE) method is not technically feasible.

Figure 5.1 Histogram of export intensity



The results from the Heckman estimation are reported in the second and third columns for export participation and export intensity, respectively. Both Equations (5.2) and (5.3) have the same set of independent variables representing firm characteristics. In addition, a sunk cost variable is used only in the export participation equation for identification purposes. A sunk cost is believed to affect only whether firms decide to export or not, but not how much to export. As it is not possible to estimate a Heckman model in panel data, heterogeneity effects have been controlled for with clustered standard errors using an industry dummy (ISIC at the two-digit level).

General observations from both models are that the independent variables under the export intensity equation share the same signs although their magnitude and significance levels are different. The control for sunk cost is also found to be significant, which is in line with findings in other studies (Roberts and Tybout 1997, Das *et al.* 2007, Sun 2009).

A few diagnostic tests can be performed. There are 221 observations that are censored at the lower bound (left-censored) and 50 observations at the upper found (right-censored). The random effects Tobit model is confirmed to be preferred to the OLS estimation given the significance of Sigma u and Sigma e along with the Likelihood-ratio (LR) test.[41]

[41] The LR test of Sigma u=0 has Chibar2(01) of 11.66.

Under the Heckman estimation, the inverse-Mill's ratio (Lambda) from the outcome equation (export participation) that is fed into the outcome equation (export intensity) is found to be not significant. In addition, the null hypothesis of independence between the outcome and selection equations cannot be rejected.[42] Hence, the export intensity and export participation equations should be estimated independently. In light of these diagnostic tests, the results based on the Tobit model are used for interpretation.

[42] The probability of the Wald test of the null hypothesis (Rho=0) equals to 0.3663.

Table 5.5 The determinants of firm exports

	Tobit	Heckman	
	Export intensity	Export participation	Export intensity
	(1)	(2)	(3)
Productivity (log)	1.771	0.00294	0.596
	(4.176)	(0.109)	(2.704)
Size (log)	22.11***	0.492***	1.697**
	(5.175)	(0.107)	(0.669)
Age (log)	–2.652	0.00235	–6.997***
	(12.36)	(0.238)	(1.574)
Foreign	0.295**	0.00503	0.170***
	(0.131)	(0.00620)	(0.0127)
Import	0.397**	0.00866***	0.219***
	(0.186)	(0.00281)	(0.0617)
Sunk	98.35***	12.85***	
	(14.82)	(0.766)	
Constant	–210.1**	–3.823*	91.69**
	(86.59)	(2.130)	(45.97)
Sigma u	49.34***		
	(7.081)		
Sigma e	35.30***		
	(4.872)		
Lambda			–2.090
			(2.026)
Rho	0.6615***		–0.0763
	(0.099)		(0.0841)
Observations	306	306	306

Note: Industry and year dummy are included but not shown. Standard errors are in parentheses. ***, **, and * indicate significance at 1 per cent, 5 per cent, and 10 per cent levels, respectively.

Source: Author's estimations.

Focusing on the first column of Table 5.5, labour productivity (measured by total sales per worker reported 3 years earlier) is positive but not significant. Instead, firm size, foreign ownership, and import share are found to be statistically significant. Specifically, export intensity will be raised by 0.22 percentage point in response to an increase of one additional employee, *ceteris paribus*.[43] This suggests that firm size has a positive effect on export intensity as larger firms have more resources to exploit economies of scale to overcome the initial costs of export entry, and they can export more. This is consistent with findings in Nguyen and Nishijima (2009) for Vietnam and Wignaraja (2012) in selected Southeast Asian countries.[44]

As for foreign ownership, the positive sign and significance of this variable suggests that firms with foreign ventures have an advantage over their domestically invested counterparts. An increase in foreign ownership by one percentage point will raise the intensity of firms' exports by 0.3 percentage point, *ceteris paribus.*[45] Hallward-Driemeier *et al.* (2002) find that firms with foreign ventures and those that export are significantly more productive, and the productivity gap is found to be larger the less developed is the local market. Foreign direct investment brings expertise and technologies from parent companies, which help improve local firms' productivity (Wignaraja 2012). Firms with foreign equity participation have better access to overseas business markets, including through distribution channels formed with their parent companies (Srinivasan and Archana 2011).

Likewise, an increase in the share of imported inputs by one percentage point will raise the intensity of firms' exports by 0.39 percentage point, the results which are in line with findings in Kasahara and Rodrigue (2008) in Chile, and Nguyen and Nishijima (2009) for Vietnamese manufacturing firms. Kasahara and Rodrigue (2008) uncover that importing raw materials and intermediate inputs not only improves plants' productivity but it also has a positive dynamic effect on their performance. One of the means is through plants adopting and imitating technology that is embedded in the

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[43] The marginal effect of the Tobit model is similar to what can be drawn from OLS estimation, and it is calculated from coefficient/100 for a linear-logarithm relationship.

[44] For developed countries, Bernard and Wagner (2001) find an inverse U-shape pattern of the effect in Germany. However, no significant evidence is observed in Pla-Barber and Alegre (2007) for the case of France.

[45] There is a case that firms can be controlled by foreign investors, whether they hold the majority ownership or not. A dummy for foreign ownership was also tried, but it was found to be not significant.

imported goods.

Labour productivity and firm age are found to be not statistically significant from this dataset.[46] As for productivity, the insignificance may be related to measurement errors as total sales rather than value-added are used to construct labour productivity. Another reason may be due to the fact that productivity is largely captured by firm size or foreign ownership given the strong significance of both variables in the above analysis. In other studies, productivity is found to have a significant effect on a firm's decision to export but this is not the case with export intensity. For example, Liu *et al.* (1999) find labour productivity (measured by value-added per worker) has no statistically significant effects on export intensity of firms in the Taiwanese electronics sector, as does Castellani (2002) for the case of Italy.

The insignificance of firm age comes as no surprise given that both exporters and non-exporters in Laos have an average age of around 18 years as observed in a bivariate relationship in Appendix 5.B. Part of the explanation may relate to the fact that Laos has only recently opened up the country and welcomed foreign investments (Bird and Hill 2010). This may suggest why companies in Laos are considered young in general, regardless of their exporting status. In other studies, Dueñas-Caparas (2006) finds that firm age has a positive impact on export performance in the Philippines with an inverse-U shape. This implies that at a certain threshold, the positive effect of firm maturity will begin to diminish.[47]

Robustness checks

Robust tests were performed for both the Tobit and Heckman models using labour productivity in the current period (assuming exogenous productivity) instead of 3 years earlier. The results in Appendix 5.D also find no significant effect of productivity on export intensity for the Tobit model, while the effects of other firm characteristics are significant, which is similar to the results in Table 5.5. However, the magnitude of these independent variables is slightly different from the main results. For the Heckman model, labour productivity and firm age are found to be significant for export intensity,

[46] Real wage per worker was also used as a proxy for labour productivity, and was also found to be insignificant.

[47] For developed nations, Majocchi *et al.* (2005) and Fryges (2006) find a different effect of firm age on their export performance. The former discovers a positive effect of firm age in Italy, but the latter finds the opposite when examining manufacturing firms in Germany and the United Kingdom.

which is different from the results in Table 5.5. However, firm size is now significant only for export participation but not for export intensity. In addition, the results for the OLS estimates for export intensity are reported in Appendix 5.E to gauge the extent of the bias compared to the Tobit estimates. The estimates from the fixed effects (FE) model, which is preferred to the pooled and random effects (RE) models, have magnitude lower than those from the Tobit model, suggesting that it generally underestimates the effects of the independent variables.

Before concluding, it is worth discussing the implications of the findings. First, this research exercise finds that a large proportion of businesses in Laos have not been connected to the international economy. Specifically, around 73 per cent of manufacturing firms do not export directly. This is also consistent with the analysis conducted at the macroeconomic level in Chapter 4 that the level of international integration of Laos is still low. Landlockedness, infrastructural deficiency, and customs inefficiency contribute to high trade and transport costs compared to transit neighbours. Second, both the comparative and econometric analyses suggest that firm size matters in international trade. Entry into foreign markets involves sunk costs whereby only productive firms (for instance, larger firms) can self-select to export. This implies that smaller firms may be disadvantaged, including in terms of access to finance or other resources. It also matters for firms to tap into know-how, managerial, and distribution networks by forming ventures with foreign investors. This emphasises the importance of policy that attracts FDI to enable firms to enhance their export performance. Third, the finding that imported inputs help raise firms' productivity and exports implies that facilitating importation is equally as important as facilitating exportation. This is more relevant when manufacturing is geographically fragmented and involves multi-border crossings of intermediate inputs to produce final goods. Given the geographical barriers that firms in Laos face along with the dominance of small and medium enterprises (SMEs), expanding firm size and internationalisation, including through FDI and importing, become more vital considerations.

This leads us to further explore what factors are considered important for the growth and competitiveness of the private sector in Laos. As far as the business environment is concerned, an enterprise survey conducted by the World Bank (2016b) cited competition with the informal sector as the biggest obstacle to doing business in Laos, followed by taxes and a shortage of skilled labour. However, firms gave relatively favourable scores regarding crime, theft and disorder, labour regulations, and customs

regulations. Competition with the informal sector or legally registered businesses was reported as the biggest obstacle for 27 per cent of the surveyed firms. The tax rate was also cited, in particular among small businesses, foreign-owned companies, and those with female top managers. At the same time, inadequacy in the educated workforce was viewed to be more problematic for larger firms than for small businesses. Such problems limit capacity for firms to expand and compete.

From investors' perspective, a survey conducted by ESCAP (2015) found red tape to be as the most crucial factor among firms that consider investing in Asia and the Pacific. Other factors include political stability, the protection of investors' rights, and the overall business environment. It is therefore crucial to understand what constrains firms' growth as well as their ability to compete internationally. This underlines the importance of designing policy responses to alleviate the constraints that firms face, in particular SMEs, so that the private sector in Laos can integrate into the international economy successfully.

The trade liberalisation under Laos' membership in the Association of Southeast Asian Nations and the World Trade Organization indicates that the country is on the right path in integrating into the international economy, which results in high economic growth. However, the fact that Laos was ranked relatively low by the World Bank (2017d) in terms of the ease of doing business relative to other countries (in 141th place out of 190 economies in 2018), highlights the urgency and importance for Laos to improve the business environment. This includes solving problems related to unfair competition, taxation, and skilled-labour shortage. In addition, as Laos tries to diversify its economy away from resource dependency and integrate into global production sharing, the need to improve the business environment and hence raise the competitiveness of the private sector is even more important.

5.6 Concluding remarks

This chapter has analysed the export behaviour of manufacturing firms using an enterprise survey conducted in Laos in 2009, 2012, and 2016. By this, the Tobit model was employed to control for possible sample selection bias. Firm size, foreign ownership, and the import of inputs are found to have positive effects on export intensity. This suggests that economies of scale are important for firms to overcome the initial costs of export entry. At the same time, foreign affiliation and importation give firms access to accumulated learning experience or allow them to tap into sophisticated

technologies of foreign companies. The implication is that firm size and other characteristics matter in international trade. Given the dominance of small and medium enterprises and the geographical circumstances of Laos, it is therefore crucial to understand the constraints on firms' growth and on their ability to compete internationally, so that proper policies can be devised. Having policies that encourage international linkages and open up to more foreign investment by improving the business environment will make the private sector more competitive and lead to the greater integration of Laos with global markets.

6 The Textile and Garment, and Electronics Sectors

6.1 Introduction

Laos had a humble start in global garment production sharing when it began to open up its economy and attract foreign direct investment in the mid-1980s. Over the years, Laos has increasingly tapped into other labour-intensive manufacturing activities, including the assembly of electronics components, automotive wire harnesses, camera parts, and lens polishing, as discussed in Chapter 3. This chapter reviews production sharing in textiles and garments as well as electronics, which are fragmented across global supply chains and make substantial contributions to the Lao economy. It explores the main characteristics of both sectors so that recent developments in these industries can be mapped. This aims to establish how Laos fares compared to its regional competitors, and what the country needs to do to expand trade and participation in international production sharing. The analysis builds upon research findings at cross-country and national levels conducted in Chapters 4 and 5, and should provide a better understanding at the sectoral level.

The chapter has five sections. Section 6.2 reviews global production sharing in textiles and garments while Section 6.3 deals with the case of the electronics industry. The characteristics of both sectors and recent trends in each sector are described. An analysis of the circumstances in Laos and comparable countries follows in order to draw some lessons for improving the position of Laos in international supply chains. Section 6.4 discusses the way forward, reflecting on prospects and challenges of the two industries. Section 6.5 concludes.

6.2 The textile and garment sector

Global production sharing in textiles and garments is complex and involves various players in geographically scattered locations. The textile and garment industry is one of the largest employers in developing economies, employing more people than the more sophisticated industries such as machinery, automobiles, chemicals, and fabricated metals, that have become principal employers as economies move to high-income status (Lopez-Acevedo and Robertson 2016).

The rationale of focusing on the textile and garment sector is three-fold. First, this sector makes a substantial contribution to the Lao economy, in terms of exports and employment. The labour-intensive nature of the industry also contributes to inclusive

development and poverty reduction. Second, the textile and garment industry can act as a springboard for industrial upgrading. Japan in the 1950s, newly industrialising economies in Asia in the 1970s to the 1980s, and China in the 1990s became world-class exporters primarily engaging in garment production in their formative stages of industrialisation (Gereffi and Memedovic 2003). Third, it is an ideal industry for understanding the dynamics of the buyer-driven supply chain. Backward and forward linkages in the textile and garment industry are extensive, ranging from yarn and fabrics to ready-made garments. This offers opportunities for Laos to tap into certain segments of these supply chains commensurate with the country's comparative advantage.

Sectoral characteristics

Textile and garment production is characterised by a buyer-driven supply chain. Global textile and garment production occurs predominantly through a triangular relationship, with intermediaries, mainly in East Asia, playing a key role in linking lead firms such as large retail chains and branded marketers in developed countries to low-wage manufacturers in developing countries (Gereffi 1999). This type of global production sharing is also common to other labour-intensive, consumer-goods industries, such as footwear, toys, travel accessories, and handicrafts (Athukorala 2017).

The textile and garment supply chain can be grouped into five small segments: the supply of raw materials (natural and synthetic fibres), component supply (yarn and fabrics), production networks made up of garment factories, including domestic and foreign subcontractors, exporting established by intermediaries, and marketing networks. Under the Standard International Trade Classification (SITC), textiles and garments cover textile yarn and fabrics (SITC 65), textile machinery and parts (SITC 724), and articles of apparel and clothing accessories (SITC 84). These segments are different in terms of geographical locations, labour skills, or technology requirements as well as the scale and types of firms involved (Gereffi and Memedovic 2003).

Textile and garment manufacturing can be largely divided into high-value production, which comprises factories employing advanced technology and workers with higher skills, and low-end production, which relies on cheap labour and operates under a business model with narrow margins (Chang *et al.* 2016). A substantial part of garment production, in particular cutting, sewing, and finishing, is labour-intensive, which allows many developing countries to engage in it. Because of the labour-intensive nature of garment assembly, it absorbs a large pool of unskilled labour, mainly young women (Staritz 2010). The entry barriers appear to be higher when moving upstream in

textile production. This segment is more capital-intensive and requires higher skills. Branded names and stores are competitive assets that allow lead firms to enjoy economic profits. Thus, market power and benefit distribution among players in the garment supply chain differ in each segment (Gereffi and Memedovic 2003).

Recent developments

The emergence and proliferation of global production sharing have changed the way international supply chains are organised in the textile and garment industry. The top three globally traded apparel products by export value include trousers, knit shirts, and sweaters, accounting for 46 per cent of trade in textiles and garments (Lopez-Acevedo and Robertson 2016). While production is outsourced to countries with low-cost labour, large retail chains (such as Wal-Mart) and branded marketers (such as H&M) have retained control over the major segments of the textile and garment supply chain. It tends to be difficult for large buyers to coordinate all these activities themselves, partly due to either language or communication barriers, and the sheer number of suppliers geographically dispersed across the globe (Abernathy *et al.* 2004). Therefore, many retailers have created their own procurement offices abroad to manage the outsourcing of label production. Others deal with external sourcing agents to take care of this complex task (Adhikari and Weeratunge 2007).

Intermediaries have therefore emerged to perform sourcing functions on behalf of large retailers and branded marketers. Drawing upon knowledge gained from years of involvement in the industry, the capacity of these intermediaries to handle the process of fulfilling large orders to buyers' specifications and their experience in managing production have enabled many East Asian companies to act as intermediaries for global buyers (Farole and Winkler 2014). These intermediaries include those located in Hong Kong (China), Korea, and Taiwan (China).

There was a sequential relocation of production from the United States and Europe to Japan, and then to East Asia, after each new tier of entrants that had significant labour-cost advantages over its predecessors entered the chain (Gereffi and Memedovic 2003). The East Asian model is based on highly successful exporters from newly industrialising economies (NIEs), such as Hong Kong (China), Taiwan (China), and South Korea, which successively moved through from assembly to a full-package system.

Within the Association of Southeast Asian Nations (ASEAN), Thailand has become a

chief supplier of fabrics to other member countries. With the exception of Singapore and Brunei (which do not have a strong garment industry), all other ASEAN members have sourced more inputs from Thailand (Adhikari and Weeratunge 2007). The growth of the textile and garment industry in ASEAN is attributable to a number of factors. China's rising wages has led to the relocation of certain operations, in particular low-labour-cost assembly, to countries such as Vietnam and Cambodia (Lopez-Acevedo and Robertson 2016). At the same time, the abundant, cheap, and young workforce of ASEAN economies is especially attractive for garment manufacturing, where labour costs constitute a substantial proportion of production costs (Chang *et al.* 2016).

Recently, there have been important developments in international textile and garment production sharing, particularly the phase-out of global quotas, which has resulted in adjustments in the sourcing strategies of global apparel buyers (Staritz 2010). International trade in textiles and garments was liberalised in 2005 following the termination of the Agreement on Textiles and Clothing (ATC) under the World Trade Organization (WTO), and price competition has intensified among major suppliers since then.[48] The resultant impact is that buyers have to consolidate their sourcing to a smaller number of suppliers. They tend to source from larger, more capable suppliers who can offer a variety of products at competitive prices but with consistent quality and reliable delivery. The share of the top-five exporters soared to 71 per cent of the world's textile and garment exports by 2012, a marked increase from 50 per cent in 2000. Evidently, China has dominated the market while many developing countries are increasingly facing stiff competition (Lopez-Acevedo and Robertson 2016).

Less complexity, easy codifiability, and the use of unskilled labour make the relocation of textile and garment production to less-developed ASEAN members straightforward (Gereffi *et al.* 2005). Given rising labour costs, East Asian firms coordinate triangular networks of manufacturing by first sourcing inputs from their own textile mills or established networks in the region, then relocating cut-make-trim (CMT) production, which is labour-intensive, to Vietnam, Cambodia, or Laos (ILO 2015). This type of production is the entry stage for garment manufacturers as inputs are largely supplied along with product specifications by buyers to contract manufacturers.

[48] Since the mid-1970s, global trade in textiles and garments was conducted under the Multi-Fibre Agreement (MFA), which was eventually replaced by the Agreement on Textiles and Clothing (ATC) when the WTO was created in 1995. The global quota governing international trade in textiles and garments ended with the expiry of the ATC in 2005.

The Lao textile and garment industry

The textile and garment industry had a humble start with only a single garment factory in 1984, around the time that Laos began to open up its economy. Foreign direct investment (FDI) in this sector accounted for 7.3 per cent of all approved foreign investments in the early 1990s. By 2012, this industry had become an important source of job creation, employing around 30,000 workers, a substantial increase from around 800 workers in 1990. As of 2017, 92 garment factories and associated businesses were operating in Laos.

The textile and garment industry has been a significant contributor to the socioeconomic development of Laos. Textiles and garments contributed 13.2 per cent of manufacturing output during 2005-2014 (Nishimura *et al.* 2016). The industry employs more than 20,000 workers, equivalent to one per cent of the total labour force, and equivalent to one-fifth of manufacturing employment (World Bank 2012, Nolintha and Jajri 2015).

The textile and garment industry plays an important part in Laos' development process for a number of reasons. First, technology is relatively accessible and affordable, in particular the labour-intensive assembly of garments that Laos is currently engaging in. Second, labour intensity contributes to significant employment and social spillover benefits. Third, the textile and garment industry helps develop manufacturing capacity and is expected to contribute to further industrial upgrading in Laos.

Given the labour intensity of garment production, it offers a promising entry point for female workers into the formal labour market with a higher wage premium compared to agriculture and other informal employment. Female participation in the textile and garment (and footwear) industry in Laos is as high as 86 per cent, compared to 81 per cent in Cambodia, 76 per cent in Thailand, and 77 per cent in Vietnam (Chang *et al.* 2016). Most of these women are between the ages of 16 and 25 (World Bank 2012). Equally important are social spillovers, including women's employment leading to their greater role in economic decision-making, marriage and fertility decisions, and higher education for children (Lopez-Acevedo and Robertson 2016). In addition, the organisation of textile and garment production in global supply chains can link Laos to international markets, which facilitate skill attainment and knowledge spillovers.

The expansion of the Lao textile and garment industry is attributed to a number of factors. First, economic liberalisation attracts FDI into Laos as investors have sought to expand production bases in a country that is not constrained by ATC quotas (World

Bank 2012). Second, Laos has a relatively low cost of labour. The average wage in Laos is US$78 per month, which is comparable to that of Cambodia (US$80 per month) but lower than in Thailand or Vietnam. Third, exports from Laos are eligible for duty-free access to most markets, except for the United States. As a least developed country, Laos is a beneficiary of the generalised system of preferences (GSPs), including from Australia, Canada, the European Union (EU), Japan, New Zealand, Norway, and Switzerland. Textile and garment exports from Laos are essentially driven by these preferential access schemes.

The exports of textiles and garments (SITC 65+724+84) from Laos amounted to US$248.6 million in 2015 (see detail in Appendix 6.A). Woven apparel (Harmonised System: HS 62) made up around 68 per cent of total exports of ready-made garments while 32 per cent were knits (HS 61), according the Trademap database of the International Trade Centre (ITC). Laos mainly exports a mix of low-to-medium value garments, including trousers, shorts, shirts, jackets, dresses, swimwear, and general sportswear.

Export concentration in the EU market

The European Union (EU) has historically been the largest market for textile and garment exports from Laos. The EU accounted for 81.3 per cent of the market share in 2000, which lowered to 71.5 per cent in 2015. While the importance of textile and garment exports to Belgium and France is falling, this has been offset by of export growth in Germany and the United Kingdom (see Appendix 6.A). The exports that are concentrated in the EU market stem from the advantage associated with duty-free access under the 'Everything But Arms' scheme.

Although textile and garment exports to the United States (US) expanded following the granting of a normal trade relation to Laos in 2005, the export share fell from 12 per cent in 2012 to 4 per cent or less thereafter. China and ASEAN (mainly Singapore and Thailand) together accounted for only 1.4 per cent of the total share.

At the same time, textile and garment exports from Laos to Japan are trending upward. The increasing exports to Japan appear to reflect growing FDI from Japan since 2007. Currently, one-third of garment factories feature investment by Japanese investors. Previously, Thailand used to be the major source of foreign investors in the Lao garment industry, as documented by Keola (2010).

The concentration of textile and garment exports in the EU market highlights the need

for Laos to diversify its export destinations. Tapping into other developed countries such as the United States, Canada, Japan, and Korea, to which Cambodia and Myanmar are now exporting, would help Laos to avoid possible exposure to market risk. Currently, only Cambodia has preferential access to the US while Laos and Myanmar have not yet qualified for it. Laos should, therefore, give priority to getting similar preferences from the United States. There is potential for Laos to also expand markets to ASEAN and China given its relatively low market share at present.

Laos sourcing most inputs from Southeast Asia

Laos imported almost three-quarters of its textile and garment inputs from ASEAN in 2015, mainly from Thailand, Vietnam, Malaysia, and Indonesia. The imports from China, Japan, and the EU constituted 12.7 per cent, 7.8 per cent, and 6.2 per cent, respectively. This is in contrast to Cambodia and Myanmar, where China made up almost two-thirds of their import requirements (see Table 6.1).

Table 6.1 Comparison of selected textile and garment suppliers

	Laos	**Cambodia**	**Myanmar**
Exports (US$)	248.6 million	9.6 billion	1.7 billion
Key export destinations	EU 71.5%, Japan 14.3%, US 3.9%, Canada 2.5%, ASEAN 1%, and China 0.4%	EU 34.5%, US 27.4%, Canada 7.1%, Japan 6.9%, ASEAN 2.2%, and China 2.1%	Japan 34%, EU 27.4%, Korea 23.2%, US 2.7%, China 2.5%, and ASEAN 1.8%
Product compositions	Woven apparel 68% and knits 32%	Knits 93.8% and woven apparel 6.2%	Woven apparel 65.5% and knits 34.5%
Imports (US$)	121.5 million	3.4 billion	1.8 billion
Key import sources	ASEAN 72.2%, China 12.7%, Japan 7.8%, and EU 6.2%	China 62%, ASEAN 15.7%, Korea 6%, and Japan 1.2%	China 61.1%, ASEAN 18.3%, Korea 7.8%, India 4.7%, and Japan 3.7%
Number of factories	92	447	210
Business model	CMT	CMT	CMT
Worker availability	Limited pool of workers	Limited pool of workers	Good availability
Minimum wage (US$)	$78/month	$80/month	No set wage (around $60/ month)
Shipping times (to the UK)	78.5 days (to Los Angeles)	28 days	30 days (+/– 10 days)
Compliance risk	Medium to High	Medium to High	Weak implementation of labour law and factories not familiar with international standards
Quality capacity	Most of the skilled management is foreign	Most of the skilled management is foreign	Low quality of skilled middle management

Note: Textiles and garments (SITC 65+724+84), knits (HS 61), and woven garments (62). Trade statistics is for 2015, using partner-reported data.

Source: Author's compilations from UN Comtrade and International Labour Organization (2015).

Cut-make-trim production

The majority of garment factories in Laos are involved in cutting, making, and trimming (CMT), whereby manufacturers negotiate fees only for the costs of labour performed rather than the full value of ready-made garments. Foreign buyers provide most of the design, fabric specifications and quality control. Local factories do the cutting, sewing, trimming, labelling, and packaging for shipment direct to retail outlets. Parent companies may also select fabrics or provide designs, in which case Laos-based factories provide pre-production samples for buyers' approval first.

While this type of production has promoted access to global sourcing and merchandising networks, it has limited the prospects for upgrading as greater value functions are confined to activities conducted in lead firms. Therefore, integration via triangular manufacturing networks has locked suppliers from Laos into a lower-tier position in global supply chains.

Despite this situation, the subcontracting of CMT activities is known to provide an important linkage as well as being an entry stage to exporting for domestically owned garment factories. Due to difficulties in forging direct relationships with international buyers and sourcing networks, fulfilling subcontracting orders for foreign-owned firms offers entry and experience in export-oriented garment assembly. Foreign-owned firms may support process or product upgrading through assisting in factory setup, productivity enhancement, and quality control (Farole and Winkler 2014).

Participation in international certification varying by firm size

Two-thirds of large garment firms surveyed in the Lao Garment Sector Survey in 2011 reported that they participated in an international social compliance certification system (World Bank 2012). Only one medium firm obtained certification while no small firms did.[49]

Many garment factories in Laos participate in Worldwide Responsible Accredited Production, which is a certification program for labour-intensive consumer product manufacture. One firm accredited with a social accountability scheme (SA8000) on improving working conditions, and another firm joined a business social compliance

[49] Small firms are classified as those with fewer than 100 employees while medium and large firms are those with between 100–499 employees and 500 or more employees, respectively (World Bank 2012).

initiative.

Insights from fieldwork surveys

To supplement macroeconomic data, two fieldwork trips were conducted in Laos: one in December 2016 and another in April to May 2017. Questionnaires were sent in advance to representatives of the Lao Garment Industry Association (LGIA) and seven garment companies. Face-to-face interviews were conducted with representatives of the garment association and five companies, as there was no response from two companies.

As of 2017, 92 garment factories and associated businesses were operating in Laos according to the LGIA. Among the 60 garment manufacturers for which data is available, 58 factories export their ready-made garments directly. The products manufactured by these factories include men's and women's clothing, sportswear, and uniforms. Some factories produce workwear, bedding items, and toy clothes. Only one factory produces textiles, and another makes cotton for its own use. A summary of garment companies and their product mixes is provided in Appendix 6.B.

There is no detailed information on 30 small-scale factories. These firms reportedly act as subcontractors for garment exporters and are not involved in direct exportation (Nolintha and Jajri 2015). Apart from this, there are five companies in supporting industries such as embroidery and import-export agencies (see Appendix 6.B).

Textile and garment production in Laos is largely dominated by a CMT business model. There are fewer than five factories, all of which are wholly foreign-owned, that are engaged in free on board (FOB) pricing.[50] There were initiatives by the government and donors in collaboration with the garment association to upgrade from CMT to FOB arrangements. The FOB model is expected to put Laos in a stronger position to capture higher margins domestically, and consequently provide greater opportunities for garment factories to provide decent employment to Lao workers. These efforts have not been successful to date according to fieldwork interviews with an LGIA representative.

In general, moving from CMT to FOB is considered an upgrading challenge. The upgrade involves acquiring an expansive set of capabilities in filling orders placed by lead firms, including making samples, procuring or manufacturing the required raw materials, and fulfilling international standards regarding price, quality, delivery,

[50] Under FOB pricing, buyers pay garment factories for the value of the completed clothing after being loaded on board ships.

packing, and shipping the finished garments (Athukorala and Ekanayake 2014). As for Laos, the main reason is the unwillingness of garment factories to upgrade their business model, as FOB is riskier. In addition, management also lacks capacity to make direct contacts with lead firms in the destination markets.

As far as ownership is concerned, 36 garment factories are wholly foreign-owned while 10 are in a joint-venture form (between foreign and Lao investors) and 11 are wholly owned by Lao nationals. Most large firms (100 employees or more) are wholly foreign-owned or in joint-ventures, whereas medium firms (between 20 and 99 employees) are evenly distributed between joint-ventures and wholly foreign- or national-owned establishments.

Foreign investors are predominantly from Asia, including Japan, Thailand, China, Vietnam, and Taiwan. Almost 10 firms have European investors, including Danish, Dutch, and French. All garment subcontractors are locally owned. Among the five firms in supporting businesses, two embroiderers are wholly foreign-owned (Thai), and the rest are locally owned. See detail in Appendix 6.B.

In terms of geographical distribution, virtually all garment factories are located in Vientiane Capital. Only two are in Savannakhet, two are in Champasack, and another factory is in Vientiane province. Those established outside the capital city are considered relatively small compared to the average firm size of 300. The biggest two factories employing 2,000 and 1,250 workers (both funded by European investors) are located in Vientiane Capital.

To extend the analysis in Chapter 5, Table 6.2 compares some aspects of firm characteristics among factories in the Lao garment industry. The results show that garment exporters are larger than their non-exporting counterparts as measured by firm size. This confirms the observations across the manufacturing sector made in Chapter 5 that firm size has a positive effect on export performance as larger firms have more resources to exploit economies of scale and export more. The difference with respect to labour productivity and capital-labour ratio between exporters and non-exporters is found to be quite small. Non-exporters in the garment industry appear to have higher average shares of foreign equity participation than those that focus on exporting. This is quite different from the findings in the preceding chapter. A possible explanation may be that garment firms tend to export regardless of their ownership structure or factor intensity level.

Table 6.2 Firm characteristics in the Lao garment industry

	Non-exporters	Exporters
Labour productivity (in logarithm)	17.5	17.9
Firm size	44.13	47.83
Foreign equity share	10.33	8.33
Capital-labour ratio (in logarithm)	15.6	16.2

Note: Data is pooled across 2009, 2012, and 2016 to address small sample size. There are 21 observations across the three years, of which six are identified as exporters. Labour productivity is measured by a firm's total sales per worker (value-added per worker cannot be calculated due to data unavailability).

Source: Author's calculations from the enterprise surveys of the World Bank (2017c).

Comparison with neighbouring countries

The textile and garment industry in Cambodia and Myanmar is compared in detail below as both countries are at a similar level of development to Laos. This is also expected to provide some insight into the nature of the textile and garment sector in the two countries and draw lessons learned for Laos.

Cambodia

Since the start of the mid-1990s, the textile and garment sector has played a leading role in Cambodia's industrial development trajectory. This sector has also emerged to become the largest export sector despite the country's limited pool of workers due to population size. The growth of the textile and garment industry in Cambodia has been driven by foreign direct investment, motivated by ATC-quota hopping, preferential market access, and the country's low wages (Staritz 2010, DiCaprio and Suvannaphakdy 2017). This is similar to the case of Laos.

The expansion of the textile and garment industry in the 1990s was especially attributed to Cambodia's access to the US market as opposed to the restricted trade which most Asian apparel suppliers, especially China, were subjected to. With the abolition of the Agreement on Textiles and Clothing under the WTO in 2005, imposed export quotas for other suppliers were eliminated which intensified competition in this industry. Nevertheless, the number of apparel categories exported by Cambodia that were constrained by quotas was much fewer compared to those from other regional exporters such as China, Bangladesh, and Sri Lanka (UNCTAD 2013b). This suggests that Cambodia has retained an apparent advantage in preferential market access, from which

Laos can learn.

Cambodia has a larger textile and garment industry, whether in terms of export value or industry size, compared to both Laos and Myanmar. Textile and garment exports from Cambodia were worth US$9.6 billion in 2015, of which 34.5 per cent were destined for the EU and 27.4 per cent for the US, and the rest was to Canada, Japan, ASEAN, and China, among others. Cambodia has 447 garment factories, almost five times the size of the Lao garment industry (see Table 6.1 above). The textile and garment industry (along with the footwear sub-sector) employs almost 800,000 workers, accounting for nearly 60 per cent of Cambodia's manufacturing employment in 2012 (Chang *et al.* 2016).

Although expectations about the impact of the global quota phase-out on Cambodia's textile and garment exports were initially pessimistic, Cambodia has been able to increase export value and market share. Despite the end of the ATC and weak international demand since the global economic crisis in 2008, the textile and garment sector still remains vital to the Cambodian economy (Staritz 2010, Asuyama *et al.* 2013). Textiles and garments accounted for over 77 per cent of the country's merchandise exports in 2014. In addition, Cambodia is one of only two Asian economies in which the share of textiles and garments in total exports in 2014 exceeded the level reported in 1995 (Huynh 2015).[51] Knitted apparel dominates Cambodia's exports, accounting for 93.8 per cent of ready-made garments (Table 6.1 above).

As with Laos, the development of locally embedded garment export industries in Cambodia has not yet materialised. Most firms are local affiliates of transnational suppliers and are integrated into their manufacturing networks. While this form of integration has promoted access to global sourcing networks, it has limited prospects for upgrading because higher-value-added functions are confined to headquarters. This basically locks suppliers from Cambodia into lower-tier positions in global textile and garment supply chains and has resulted in limited local linkages (DiCaprio and Suvannaphakdy 2017).

Myanmar

Myanmar experienced stagnation during years of sanctions by the international community. As global brands turn their attention to the country again, numerous local and foreign entrepreneurs are seeing investment opportunities in this industry (ILO

[51] Another country is Bangladesh.

2015). Myanmar has been increasingly viewed as a growing base for textile and garment manufacturing in ASEAN. There are 210 garment factories operating in Myanmar, which is more than twice the size of the Lao garment industry. While Vietnam has been a traditional source of markets for international buyers, the country is increasingly seen as less attractive as wages rise. On the contrary, the low-wage, unskilled workforce in Myanmar and its incorporation into the European Union's GSP makes the country an attractive location for garment production. The average wage in Myanmar's garment sector was estimated to be US$60 per month in 2012, which was much lower than the rate in Laos (US$78) and Cambodia (US$80). The challenge for Myanmar is associated with compliance risk due to the weak implementation of labour law and familiarisation with international standards, as pointed out in Table 6.1 above.

Myanmar's textile and garment exports stood at US$1.8 billion in 2015, of which 34 per cent were destined for Japan, 27 per cent went to the EU, and 23 per cent were to Korea. The US, China, and ASEAN made up a very minimal share (see Table 6.1). The industry is expected to generate US$12 billion in export revenue and to employ over 1.5 million people by 2020 (Chang *et al.* 2016). This is underscored by increasing FDI together with technical assistance provided by development partners, including the European Union.

Myanmar's garment manufacturing is also CMT-based. Most raw materials are imported, mainly from China and ASEAN, as Myanmar does not have local supply. In addition, the industry remains small and lacks linkages to the Yangon market, where the majority of manufacturing activities take place. The textile and garment industry also faces other challenges, including the high incidence of under-aged labourers, low productivity, and low occupational health and safety standards (ILO 2015).

In summary, the structure and characteristics of the textile and garment sector vary slightly in the three countries reviewed in this section. Laos has a relatively small textile and garment industry compared to Cambodia and Myanmar. While both Cambodia and Myanmar focus on the unskilled segment of garment production like Laos, the prospects for growth for Myanmar are promising given its population size and lower wages. Despite its modest size, the textile and garment industry contributes to significant employment and social spillover benefits for Laos. It also helps develop manufacturing capacity and is expected to contribute to further industrial upgrading in the country.

6.3 The electronics sector

In general, Asia has benefited substantially from the spread of international production sharing, especially in the electronics sector. The region's share of electronics in global manufacturing exports has risen strongly (Frederick and Gereffi 2013). Most trade has been concentrated in China, Hong Kong (China), Japan, Korea, and Taiwan (China).

There are three reasons for looking into electronics production sharing. First, small and light-weight parts and components mean low transport costs, which suggests that production sites do not necessarily have to be located in coastal areas. This is very relevant for Laos and other landlocked countries. There have been cases where electronics assembly facilities are located inland, including in Thailand, the Czech Republic, and Mexico. The key characteristics that these production locations have in common are that they are close to large production bases (Chiang Mai of Northern Thailand to Bangkok, the Czech Republic to Germany, and Mexico to the United States). The important point is to examine how Laos can take advantage of its geographical proximity to regional production centres in Thailand, Vietnam or even China.

Second, various segments of the electronics supply chain are characterised by modular production. This makes the diversification of production processes easier. As the electronics supply chain encompasses many countries engaged in assembly lines at different stages, it opens up opportunities for different countries to specialise in different segments of production, depending on their relative cost advantage (Athukorala 2011). This has significant implications for Laos and other countries with similar characteristics.

Third, global electronics production sharing can serve as a superior insulator against economic shocks compared with the buyer-led industries such as textiles and garments. It is more difficult to relocate technology- or capital-intensive manufacturing because lead firms tend to maintain supply relationships in which they have already invested in technology or capital (Milberg and Winkler 2010, DiCaprio and Suvannaphakdy 2017).

Sectoral characteristics

The electronics sector is a prime example of producer-driven production sharing. It reflects the power of lead firms controlling product and technology development that are considered crucial for competition in the final-product market (Kawakami and Sturgeon 2011). The bulk of global electronics production sharing takes place through

intra-firm linkages rather than in arm's-length relationships. For the former, lead firms are multinational enterprises (such as Intel, Samsung, and Apple) that control value chains through global branch networks or maintain close operational links with established contract manufacturers (Athukorala 2017). Unlike the buyer-driven type, the profits of producer-driven production are derived from scale and technological advancement. This is essentially derived from economic rents given proprietary knowledge or technology possessed by lead firms (DiCaprio and Suvannaphakdy 2017).

Another characteristic of electronics production sharing is associated with modular production. This enables diversification of production sites resulting from the relative ease of international relocation. Tightening profit margins have led to a constant search for more efficient production locations. The decision about where to locate production sites in a modular network of production takes into consideration three important factors: the complexity of transactions, the ability to codify transactions, and the capabilities of the host country (Gereffi *et al.* 2005).

The electronics supply chain encompasses the manufacture of consumer electronics goods (computers and mobile phones), industrial equipment (motors and climate control systems), household appliances (refrigerators and washing machines), as well as parts and components for all of these products (Wood and Tetlow 2013). In the current study, electronics is divided into two sub-categories: information and communication technology (ICT) products and electrical goods, following Athukorala (2011).[52] Products falling under the ICT product sub-categories cover office machines and automatic data processing machines (SITC 75), telecoms and sound recording equipment (SITC 76), and semiconductors and semiconductor devices (SITC 772+776). Electrical goods are under SITC 77, excluding SITC 772 and 776.

Recent developments

Global electronics trade has begun to shift away from developed countries towards Asia due to production relocation as a result of lower labour costs and access to raw materials in the region. More recently the growth of the consumer electronics market in Asia and improved connectivity have made it an important centre of electronics production hubs (Frederick and Gereffi 2013). Consumer electronics dominated trade, amounting to US$721 billion, while computers were second, followed by household appliances

[52] The term 'electronics' is also known as 'electrical and electronics' in some studies.

(Frederick and Gereffi 2013). Hong Kong (China) maintained a lead in the final assembly/subassemblies segment of electronics production sharing, representing 44 per cent of the world's exports. Mexico and Thailand had strong export growth while other key exporters remained steady, including the United States, Germany, South Korea, and Singapore.

The exports of electronics parts and components were worth US$616 billion in 2014. The top exporters were Hong Kong (China), Germany, Japan, Singapore, and the United States. For the past decade, leading electronics firms have produced parts and components in Japan and in Southeast Asia. Parts and components were then shipped to China for final assembly. From there the finished products were exported to the United States and other markets.

Recently, rising labour costs in China have caused some new assembly operations to relocate to lower-cost ASEAN economies. This presents opportunities for Laos as the country is seeking to expand its manufacturing activities beyond garments. These include a labour-intensive supply chain with low-skill requirements such as assembling electric motors, connectors, and wiring harnesses.

The electronics sector in Laos

Electronics has become one of the more promising industries in Laos. This industry started with just one firm around the mid-1990s. The first factory assembling electrical appliances was established by Taiwanese investors in Vientiane capital in 1994. Another factory, which is wholly locally owned was created in 2004. More and more foreign investments has come into the ICT product sub-sector, especially since 2011. The number of all firms in the electronics sector reached 15 in 2017.[53] Most of them are export-oriented and located in special economic zones (SEZs).

The total value of electronics exports from Laos increased from US$0.8 million in 2000 to US$13.4 million in 2007 and further rose to US$319.7 million in 2015. Electronics exports have expanded very rapidly from 2013 onward, as shown in Appendix 6.C. Such rapid expansion is explained by the influx of foreign investments, especially into special economic zones. Interviews with representatives of electronics firms during fieldwork revealed that many investors wanted to diversify their production base out of Thailand after a huge flood in 2011 and prolonged political conflicts. The timing also

[53] The number of electronics firms were reportedly around 20 in Nishimura *et al.* (2016).

coincided with the effort of the Lao government to promote special economic zones, initially in Savannakhet and later in Vientiane Capital and Champasack.

Concentration of electronics trade within ASEAN

Electronics exports from Laos to other ASEAN members amounted to US$305.4 million in 2015, constituting 95.5 per cent of the total market share. Within ASEAN, Thailand took the highest share of electronics exports, accounting for 94 per cent. The balance of exports went to Hong Kong (China), Japan, and Vietnam (see Appendix 6.C).

Similarly, ASEAN also dominated the sources of electronics imports to Laos. As shown in the lower panel of Appendix 6.C, two-thirds of electronics imports were sourced from Southeast Asia in 2015, mostly from Thailand. In the same year, China made up 30.5 per cent of total electronics imports to Laos while only 1.2 per cent and 0.1 per cent were imported from the European Union and the United States, respectively.

Parts and components dominating electronics trade

Parts and components (P&Cs) accounted for 90.6 per cent of electronics exports from Laos in 2015. Similarly, parts and components made up 64.8 per cent of the total imports of electronics to Laos in the same year (see Appendix 6.D).

Most electronics exports were information and communication technology (ICT) products (SITC 75+76+772+776), which were valued at US$290 million in 2015. Again, parts and components also dominated ICT exports from Laos. The exports of electrical goods (SITC 77–772–776) amounted to US$31.6 million in the same year, of which 54.3 per cent were parts and components. As for importing, parts and components dominated imports of ICT products but that was not the case for electrical goods.

Insights from fieldwork surveys

Data collection and interviews were conducted during three field trips to Laos in December 2016, April to May 2017, and October 2017. Questionnaires were sent to two factories assembling electrical appliances and were then followed up by telephone calls to clarify responses. Face-to-face interviews were conducted with the representatives of electronics component assembling firms in Vientiane Capital and Savannakhet. In addition, data collection was made through distance correspondence with the SEZ authority in Champasack to obtain information on two electronics firms within the zone.

Therefore, basic data on 13 out of 15 firms was collected as summarised in Appendix 6.E.

There are 13 firms assembling electronics components, and all of them are export-oriented. These firms are engaged in assembly functions as contract manufacturers with limited participation in higher-value-added electronics value chains. Their outputs were exported to a network of affiliate electronics firms in neighbouring countries, mainly Thailand and Vietnam. Although not highly significant, some factories export back to their headquarters in Japan. Many electronics firms are Japanese affiliates. Only two are owned by the Taiwanese and one by Canadian investors.

Two firms assemble electrical goods: one located in Vientiane capital and another in Khammouane (a province in the central part of Laos, not very far from the Vietnamese border). The Vientiane-based factory is the oldest, established in 1994, and is wholly owned by Taiwanese investors. Another factory was created in 2004 and is locally owned. The two factories are relatively small, employing less than 200 workers in total. Both of them produce similar products such as rice cookers, electric fans, and blenders. Around 90 per cent of the electrical appliances of each company are exported to Vietnam while the rest are distributed domestically. All of their inputs are imported, mostly from China, Taiwan (China), and Thailand (see Appendix 6.E).

Investors gave a few reasons why Laos is an attractive place to invest in the electronics industry. First, cheap labour is reported as a chief reason, which is similar to the case of garment manufacturing. This was also supported by the fieldwork interviews as most firms cited labour cost as their key motivation to come to Laos. Indeed, labour costs in Laos are lower than in neighbouring countries. In surveying overall personnel costs in selected Mekong economies, the Japan External Trade Organization found that Laos had the lowest costs for workers (US$1,705 per year) and engineers (US$2,959 per year). Compared with Thailand, the costs of Lao workers and engineers were about one-fourth and of middle management were around half (Nishimura *et al.* 2016).

Second, another reason for the preference for Laos is its proximity to final assembly lines, especially Thailand. The distance between Bangkok and Vientiane is less than 600 kilometres and the road access is relatively good compared to cities in Myanmar (Nishimura *et al.* 2016). This helps reduce product damage and turnaround time. In addition, it is easy for investors to provide employee training and equipment maintenance drawing resources from Thailand. Therefore, the electronics industry capitalises on these proximity advantages. Third, Laos can tap into regional electronics

production sharing because their manufacture uses electricity intensively while the country is promoting itself to become a battery of Southeast Asia.

An analysis to compare firm characteristics between exporters and non-exporters, using the World Bank's enterprise survey that was conducted for the garment industry, cannot be replicated for this sector. This is due to a lack of data as this enterprise survey contains only three observations identified as electronics firms across three years: 2009, 2012, and 2016.

Comparison with neighbouring countries

This section discusses the electronics industry in Cambodia and Thailand. Cambodia is examined as an important comparator because it competes directly with Laos. Although Thailand engages in a more advanced stage of the electronics supply chain, a forward-looking perspective can be charted for Laos.

Cambodia

A comparative study among selected Asian least developed countries by DiCaprio and Suvannaphakdy (2017) found that Cambodia had the highest rate of participation in electrical and machinery, and transport equipment production sharing (at around 40 per cent in 2011).[54] In contrast, the participation rate of Laos was less than 32 per cent while Myanmar had the lowest involvement.

Cambodia exported electronics worth US$485.7 million in 2015, which was higher than the exports from Laos. The export markets of Cambodia were more diversified than Laos', with Thailand accounting for 55.4 per cent, followed by China (10.4 per cent), and Hong Kong (10.2 per cent). Cambodia's exports of information and communication technology products and electrical goods amounted to US$293 million and US$206.4 million, respectively.

In the same year, Cambodia's electronics imports were US$1,060 million. Most imports were sourced from Thailand (38.8 per cent) and China (26.5 per cent). Other electronics suppliers to Cambodia included Singapore (14.1 per cent), Vietnam (7.3 per cent), and Korea (5 per cent). See further detail in Table 6.3.

[54] Measured by the foreign value-added employed in a country's exports plus the value-added supplied to trading partners' exports, divided by total exports.

Table 6.3 Comparison of selected electronics suppliers

	Laos	Cambodia	Thailand
Exports (US$)	319.7 million	485.7 million	67.1 billion
Key export destinations	Thailand 94%, Hong Kong 2.2%, Japan 1.6%, Vietnam 1.3%, and China 0.2%	Thailand 55.4%, China 10.4%, Hong Kong 10.2%, Korea 7.8%, and Japan 7.2%	China 20.5%, US 19.8%, EU 10.1%, Hong Kong 10.4%, Japan 7.5%, and Mexico 4.5%
Export compositions	ICT products US$290 million - P&C (94%) - Final (6%) Electrical goods US$31.6 million - P&C (54.3%) - Final (45.7%)	ICT products US$293 million - P&C (65.9%) - Final (34.1%) Electrical goods US$206.4 million - P&C (70.7%) - Final (29.3%)	ICT products US$58.5 billion - P&C (53%) - Final (47%) Electrical goods US$11.2 billion - P&C (29.2%) - Final (70.8%)
Imports (US$)	692.2 million	1,060 million	33.4 billion
Key import sources	Thailand 58.7%, China 30.5%, Vietnam 4.3%, and Singapore 1.5%	Thailand 38.8%, China 26.5%, Singapore 14.1%, Vietnam 7.3%, and Korea 5%	China 29.5%, Singapore 16%, Japan 13.2%, Malaysia 11.8%, US 5.5%, EU 5%, Korea 3.1% and Vietnam 3.1%
Employment	3,000	-	600,000
Labour costs (US$/per year) - Workers - Engineers - Middle management	 1,705 2,959 12,062	 1,887 3,996 9,054	 6,997 12,229 24,709

Note: Electronics (SITC 75+76+77), ICT products (SITC 75+76+772+776), and Electrical goods (SITC 77–772–776). Trade statistics is for 2015, using partner-reported data.

Source: Author's compilations from UN Comtrade and Nishimura *et al.* (2016).

With a recent push for investor-friendly reforms, Cambodia is seen to provide opportunities for investors seeking to set up low-cost production operations in the region. To leverage its position as a low-cost manufacturer, Cambodia makes efforts to reduce production costs. Tax holidays on company profits and duty reductions are granted to investors for a period of three years or more. Apart from that, the country has created many special economic zones to offer foreign investors enhanced infrastructure and other benefits. For example, a Japanese multinational corporation, the manufacturer of electronics and automotive parts and components, has set up Minebea (Cambodia) in the Phnom Penh special economic zone to assemble mobile phone parts using imported materials from its subsidiaries in Thailand and China (Athukorala and Kohpaiboon 2013). As traditional low-cost electronics manufacturers such as Vietnam climb up the value chain due to higher wages, Cambodia is likely to take on a larger role in the assembly of basic components for use in final electronics products (Brown 2015).

Thailand

Thailand engages in a diverse range of electronics supply chains, from production and assembly to testing and research and development. Over 600,000 people are employed in this industry. The electronics industry not only plays a significant role in Thailand's economy as the driver of export-led growth, but it also makes the country the manufacturing hub in Southeast Asia.

Electronics exports from Thailand amounted to US$67 billion in 2015, around one-quarter of the country's total exports. Thailand exported to various countries and produced a wide range of electronics products and components. The main export destinations were China (20.5 per cent), followed by the United States (19.8 per cent), and the European Union (10.1 per cent). Other key markets included Japan and Mexico. In the same year, the ICT product exports were valued at eUS$58.5 billion, of which 53 per cent were parts and components. Electrical goods exports amounted to US$11.2 billion. Electronics imports to Thailand were worth US$33.4 billion in 2015, and originated from various countries around the globe, including China, Singapore, Japan, Malaysia, the United States, the European Union, Korea, and Vietnam (see Table 6.3 above).

The role of Thailand in the supply chain of information and communication technology products is in the production of parts and components, in particular data storage components used in laptops and smartphones. Thailand is currently the world leader in producing hard disk drives (HDDs). The HDDs are used in vehicles and other consumer

electronics apart from laptops and smartphones. Thailand's exports of hard disk drives and components were US$12 billion in 2014. Seagate and Western Digital produce HDDs while other suppliers (such as Alps Electric, Hutchinson, Minebea, and NHK) focus on upstream supply chains, especially hard disk drive parts. For most downstream computer production, investors tend to base their operations in economies with large volume end-user markets, including China and the United States. The competitiveness of Thailand's HDD industry is based on its industrial clusters that contain supporting industries to manufacture most parts and components. These clusters are concentrated in the central and north-eastern regions near Bangkok (Thailand Board of Investment 2015).

The electrical goods sub-sector has witnessed steady growth as the global economy continues to recover from the economic crisis. Electrical goods accounted for 17 per cent of Thailand's electronics exports in 2015. The major electrical appliances were air-conditioners and refrigerators, with shares of 17 per cent and 6 per cent in total electrical goods exports, respectively (Thailand Board of Investment 2015). The country is, in fact, the world's second largest producer of air-conditioners.

The overall electronics industry in Thailand has consistently received a substantial share of FDI, around a quarter of total foreign investment inflows in 2011 (Wood and Tetlow 2013). Thailand has appealed to foreign investors by providing corporate tax breaks and industrial parks with reliable infrastructure. Most investors value the provision of infrastructure, which explains why Thailand has been successful in attracting foreign investment (Frederick and Gereffi 2016). Thailand also creates numerous programs to supply a qualified workforce. There are also networks of research centres that provide linkages between research communities and industries through industrial clusters. The National Electronics and Computer Technology Centre supports the development of electronics and computer technologies through research and development and collaboration on technology transfers. Another strength of Thailand is its superior logistics infrastructure. The country's extensive road and rail networks span the nation, facilitating speedy access to neighbouring countries.

In summary, the Lao electronics industry started in the mid-1990s and has become one of the more promising sectors for the country. Electronics trade was largely concentrated in ASEAN and dominated by parts and components. Laos is in direct competition with Cambodia to attract investors into electronics assembly amid rising wages in China and more-developed ASEAN members. To leverage its position as a

low-cost manufacturer, Cambodia has offered tax holidays and duty reductions. Thailand has a well-established electronics industry. The growth and dynamics of Thailand's electronics industry are driven by foreign direct investment thanks to its skilled workforce, industrial clusters, and superior logistics networks.

6.4 Prospects and challenges

Laos is participating in the labour-intensive segments of global production sharing, both in the garment and electronics sectors. Given the labour intensity of these activities, the benefits in terms of job creation, social spillovers, and poverty reduction are considerable.

The garment industry has been a significant contributor to Laos' export earnings and the largest source of manufacturing employment. Like Cambodia and Myanmar, textile and garment production in Laos is dominated by a CMT system, and the industry has no backward linkages to the textile segment. Laos still has an advantage in low labour cost with many investors consistently citing it as the main motivation for them to invest in the textile and garment sector. Laos can focus on producing garments with a long order cycle given the nature of its landlocked supply chain.

The constraint that the textile and garment industry faces is related to minimal backward linkages. As Laos does not possess a well-established traditional textile industry on which it can easily build, nor might local garment factories be of adequate size to exploit scale economies in promoting investments in textile manufacture, a viable option would be to take advantage of regional textile and garment supply chains.

The absence of supporting industries highlights the challenge that Laos struggles to compete with neighbouring countries given the cost and time penalty associated with being landlocked. Exporting a standard container from Vientiane to Los Angeles adds as much as 45 per cent to total shipping costs compared to exporting from Bangkok to the same final destination (US$4,152 versus US$2,857 per 20-foot container). In addition, Laos performs worse on the time penalty as it takes 78.5 days on average to ship a container from Vientiane to Los Angeles, which is almost double the time taken to ship from Bangkok. This excessively high time penalty is well above the average of landlocked developing countries (LLDCs) of 32 per cent, although the cost penalty of Laos is slightly better than the LLDC average of 53 per cent (World Bank 2010a).

This suggests an obvious disadvantage for Laos to participate in global production networks in terms of not only trade costs but also longer time. Since most of the inputs

for textiles and garments are from Thailand and nearby, the disadvantage is less significant for inbound than outbound logistics. Also, the disadvantage is greater for trade in fashion basics and less for basic apparel since the former is more time sensitive.

As for the electronics sector, there is potential for Laos to further engage in regional supply chains. Electronics parts and components are generally small and light-weight, and can be produced in mass quantity. Laos is expected to benefit from producing diverse electronics components that have a relatively short life and a flexibly adjusted production volume. One example is connectors for local area networks and universal serial buses as well as their cables that can change in shape and with compatible terminals. This has a small impact on the distribution cost per unit. As many electronics parts and products are also often transported by air, Laos' landlocked disadvantage can be alleviated (Nishimura *et al.* 2016).

Opportunities for Laos to further engage in electronics production sharing mainly lie with linkages to supply chains in neighbouring countries, in particular Thailand and Vietnam, or even China. In addition, there is also a good prospect for Laos to tap into electronics assembly given many industrial applications, in particular in the automotive industry, which is fast growing. The challenge is how Laos can identify segments of electronics manufacturing in which the country has a competitive edge, and what needs to be put in place to enable this industry to fully integrate into the production base in the region.

Similarly to the textile and garment industry, the heavy reliance on imported inputs is also considered a constraining factor for the electronics sector. Because of the highly dispersed production sharing in electronics, services links costs, in particular those related to the distribution of inputs among contract manufacturers in different countries, have a significant impact on the competitiveness of this industry. Laos was among the world's bottom 10 in a survey on logistics performance conducted in 2016. In fact, the country's overall logistics performance index lowered from 2.39 in 2014 to 2.07 in 2016. By comparison, Laos remained behind all other ASEAN members in almost all aspects including efficiency in border clearance, trade and transport infrastructure and logistics competence. Hence, improving trade facilitation would be an avenue to improve the position of Laos in global electronics production networks. It should be noted, however, that significant progress in has been made in recent years in modernising customs clearance procedures. A chief example is the introduction of the Automated System for Customs Data (ASYCUDA), which has reduced the time for

customs clearance. It is important that current efforts continue for Laos to better connect to regional supply chains.

In light of these developments, this study points to a number of key areas of policy that could enhance the development of the textile and garment, and electronics industries. Given the different structure and characteristics of each industry, the recommendations are elaborated in turn below.

Recommendations for the textile and garment industry

Reflecting on the challenges that the textile and garment industry is facing, Laos should make efforts in improving logistics performance, diversifying export markets, and finding niche products. The largest cost component is raw materials, which accounts for two-thirds of production costs, followed by one-fifth in labour, and less than one-fifth in rent and utilities (Lopez-Acevedo and Robertson 2016). Therefore, the critical elements in reducing production costs are raw materials. As discussed in Chapter 4, improving trade-related logistics is very important for reducing the costs of services links. Better logistics performance allows companies to move goods across borders not only quickly but also cheaply and reliably (Arvis *et al.* 2013). This helps reduce costs by lowering inventory levels, making it possible for businesses to adopt just-in-time logistics.

The second recommendation is related to market diversification. The high concentration of textile and garment exports in the EU market highlights the critical importance for Laos to diversify its export destinations. Laos may look into how to expand its market share in the US. The successful experience of Cambodia can serve this purpose, including getting GSP from the US. Diversifying markets is not only needed to reduce risks from market dependency but also to raise export growth prospects. The increasing export share in Japan provides an encouraging development, but Laos should seek to expand into other markets as well, including ASEAN and China.

The Lao textile and garment industry does not have access to maritime transport compared with Cambodia and Myanmar, which results in extended lead time to major export markets. Laos may consider finding niche products such as high functionality apparel (workwear and uniforms) and high value-added items (leavers lace used in wedding dresses).[55] For example, workwear and uniforms have a low level of

[55] Apart from these two niche products, Nishimura *et al.* (2016) also recommend fast fashion supply chains that are gaining growth prospects in ASEAN.

seasonality compared with other apparel products, which reduces the disadvantage of Laos in terms of lead time. Although leavers lace is quite unseasonal, it is influenced by various factors, including yearly trends along with buyers' demand. The high prices of this product suggest that Laos could use airfreight for faster delivery rather than relying on sea shipment.

Recommendations for the electronics industry

Key recommendations include shortening lead time, upgrading labour skills, and improving the overall business environment. Lead time has significantly increased in importance in buyers' sourcing decisions in the electronics supply chain. Efficient production sharing in this sector relies heavily on the quality of trade-related logistics to coordinate the production and distribution of parts and components as well as assembled products. Improvements in transport infrastructure and services are crucial for the industry's competitiveness given the landlocked status of Laos. Development of physical infrastructure has in fact been an important contributing factor for attracting FDI to economies such as Thailand and Malaysia.

At this stage, Laos needs to shorten transport time to Bangkok and reduce logistics costs, given existing trade patterns. In the longer term, agglomerations in Vietnam may grow. If that happens, Laos may benefit from developing special economic zones along the border areas with Vietnam and to benefit from the linkage to the agglomeration of northern Vietnam, Laos will need to improve the road infrastructure to link with Hanoi (Nishimura *et al.* 2016). With improved transport connectivity, it is hoped that Laos could link to Vietnam and also China in the future.

In addition, multinational enterprises in electronics supply chains tend to relocate their operations to medium-wage developing countries with certain levels of skills rather than those with the cheapest labour costs (Wood and Tetlow 2013). It is highly likely to remain so as rapid technology change constitutes a relentlessly moving target for economies at different levels of development. Education and training will therefore be central to improving labour skills in the electronics sector, if Laos wishes to move up the value chains.

To further integrate into a wider range of electronics assembly, Laos needs to promote export-oriented manufacturing and attract foreign direct investment. Given the fact that neighbouring countries such as Cambodia and Thailand are providing quite generous tax incentives and other benefits especially in SEZs, Laos would be under pressure to

follow suit. Because Laos is landlocked and has infrastructural deficiency, the pressure to adopt this policy is even more paramount. This is only a second-best policy though. Only a limited number of firms in these zones are found to benefit from this approach while other domestic firms that could be suppliers of intermediate goods are left to struggle with high transaction costs. Therefore, a preferred solution is for Laos to improve the business environment for all players in the country given the country's low ranking in the Doing Business survey as discussed in Chapters 3 and 5.

6.5 Concluding remarks

This chapter has found that the key advantage of Laos resides in labour-intensive manufacturing, which is the case for both the textile and garment sector and the electronics sector. The textile and garment industry in Laos is considered small compared to its neighbours but has been a significant contributor to the Lao economy. Like Cambodia and Myanmar, garment production in Laos is dominated by a cut-make-trim system, and the industry has almost zero backward linkages.

Laos is in direct competition with Cambodia to attract investors into electronics assembly amid rising wages in China and other ASEAN members. Thailand has a well-established electronics industry. Expansion in the Thai electronics industry is driven by foreign investment thanks to the nation's skilled workforce, industrial clusters, and excellent logistics networks. Similar to the textile and garment industry, reliance on the import of raw materials is a key challenge for Laos in integrating into regional electronics supply chains. Given the highly dispersed nature of electronics production processes, transaction costs associated with the distribution of inputs among contract manufacturers in the region have a significant impact on the competitiveness of Laos.

The key policy recommendations for improving the competitiveness of the textile and garment industry are to improve logistics performance, diversify export markets toward markets other than the EU, and focus on niche products that can overcome the nature of landlocked supply chain. The recommendations for the electronics industry are to reduce lead time, upgrade labour skills, and improve the overall business environment.

7 Conclusion

7.1 Summary

The lack of direct access to the sea presents trade and development challenges to landlocked developing countries as many of them are structurally disadvantaged by isolation and high international trade costs. To overcome the geographical disadvantage, Laos has embraced a process of opening up to the international economy and forging regional connectivity. Economic liberalisation that started in 1986 and the accompanying domestic reforms have paid off with a remarkable turnaround in economic performance. Laos is among the fastest growing economies in Southeast Asia. But recent growth is still driven from a narrow economic base dominated by low-productivity agriculture and natural resources. One of the key challenges for Laos is to manage its resource base in a manner that ensures broad-based growth. Laos still remains one of the least developed economies, and the goal to graduate from this status presents a pressing need to explore how the country can sustain its current growth path and ensure that development outcomes are sustainable and inclusive.

The purpose of the thesis has been to examine the integration of Laos into the international economy, focusing on the role played by global production sharing and trade costs associated with landlockedness and policy-induced factors.

After the introductory chapter, which spelt out the objective and scope of the research, Chapter 2 reviewed the relevant theoretical and empirical literature to develop a framework for examining the factors that influence global production sharing participation at country, firm, and sector levels with emphasis on the implications for landlocked countries such as Laos. With advances in information and communication, and transport technology, production processes are fragmented into different segments and relocated in economies where goods can be most efficiently produced according to fragmentation theory.

The dispersion of production processes across geographical space, made possible by falling trade costs and improved services links, is now common in many sectors and involves an increasing number of countries. Another stream of theory is relevant to the heterogenous characteristics of firms. Entry into foreign markets incurs a fixed cost and only firms that are highly productive can exploit economies of scale necessary to self-select into foreign markets. It follows that firms which are exporters are generally more productive than are non-exporting firms as reflected in their larger size and other firm

characteristics.

The fragmentation of production opens up opportunities for developing countries to tap into certain stages of international production sharing that are commensurate with their comparative advantage. East Asia, including the Association of Southeast Asian Nations, has taken advantage of the opportunities provided by this international organisation of production and trade. However, landlocked developing countries (LLDCs) are still significantly left out. These countries account for a fairly small share of global trade within production networks. This raises some questions that need to be answered. What are the recent trends in global production sharing and the level of participation by landlocked developing countries? What is the relative importance of trade costs associated with geographical and other factors in influencing the participation of countries in global production sharing? What factors determine the export performance of firms in engaging in international trade?

This chapter set out various approaches to help understand the process of economic integration within the context of Laos. It established qualitative research to analyse the integration experience of Laos (Chapter 3) and sectoral case studies (Chapter 6), and developed quantitative modelling for macroeconomic and microeconomic analyses (Chapters 4 and 5). For the macroeconomic analysis, fragmentation theory provides a basis for applying a gravity model to analyse the determinants of countries' participation in global produciton sharing in Chapter 4, focusing on geographical and policy factors that are relevant to LLDCs. Chapter 5 analysed the determinants of firm export performance using Laos as a case study, which was built upon the theory of firm heterogeneity.

Chapter 3 tracked the progress on the integration of Laos into the regional and global economy. The country has made impressive economic progress since adopting the 'New Economic Mechanism' in the mid-1980s, shifting the economy from a centrally planned regime to one that is more market-driven. Economic reform and liberalisation have been largely shaped by the country's membership in the Association of Southeast Asian Nations (ASEAN) and the World Trade Organization (WTO). This gives Laos access to wider markets and enables it to attract more foreign direct investment. Laos has also leveraged its geopolitical situation to transform its position from being 'landlocked' to 'land-linked'. Consequently, Laos has been one of the fastest growing economies in the region and has undergone structural change, which sees the growing importance of the industrial and services sectors. With economic growth of over 7 per cent in recent

decades, Laos is now a lower-middle-income country, which sets positive momentum for its target to graduate from being a least developed country (LDC). While the economic progress has been impressive, the resource sector (such as mining and hydropower) remains the principal driver of the Lao economy. Agriculture is also the main absorber of the labour force and the country's manufacturing base is narrow. Exports are also less diversified in terms of both product compositions and markets.

One of the key challenges for Laos is to manage its resource base in a way that ensures broad-based growth across a diversity of sectors and creates jobs for a larger population. This highlights the importance of utilising revenue from the current resource-based exports in growth-enhancing investments in the longer term, including in basic infrastructure and education. In addition, the non-resource sector remains a vital contributor to employment and inclusive development for Laos, which needs to be promoted through facilitating private sector development. Apart from investments in upgrading transport infrastructure, particular focus should be on further internal reforms to improve the poor business environment and logistics performance. These efforts are expected to help Laos reap benefits from its integration into the regional and global economy and to ensure a smooth transition after its LDC graduation.

Chapter 4 examined the patterns and determinants of global production sharing, with emphasis on the implications for landlocked developing countries. Despite developing countries' increasing participation in global production sharing, landlocked developing countries have lagged behind in this respect. These countries account for a rather small share of global trade within production networks. The export share of landlocked developing countries remained at 0.1 per cent of the world's exports of products dominated by global production sharing.

This observation led to econometric analysis to probe the factors that determine countries' participation in international production sharing. Chapter 4 extended gravity modelling to explain the determinants of networked trade (trade in parts and components, and final products), with an emphasis on the implications for landlocked countries. First, the gravity model was adapted by augmenting economic mass to reflect the total demand for and total supply of trading partners given the significance of trade in parts and components in international trade. Second, it examined the relative importance of geographical and policy factors in influencing trade costs with special attention paid to issues relevant to LLDCs. Third, this chapter took advantage of the availability of panel data to address potential estimation problems such as endogeneity

in trade policy variables. The study covered 191 economies between the years 2000 to 2014.

Econometric estimation showed that landlocked status reduced networked trade. However, improving services links had a positive impact on countries' participation in global production sharing. An improvement in exporters' logistics performance index by one per cent would raise the exports of parts and components (P&Cs) and final goods by 0.7 per cent and 1 per cent, respectively; other things remained unchanged. In addition, other things remained unchanged; countries forming regional trade agreements would have P&C exports 23 per cent higher than those that are outside regional trade agreements (or 14 per cent for the case of final goods exports).

This highlights the importance for landlocked economies to overcome their locational disadvantage by reducing the costs of services links associated with these factors. While infrastructure development forms an important element in enabling landlocked developing countries to better integrate into the international economy, building hard infrastructure alone without changes in policies (soft infrastructure) to improve administrative efficiency will not necessarily lead to lower trade and transport costs. Logistics services are more important for limiting the costs of being landlocked than investing massively in infrastructure that neglects the functioning of logistics services.

To supplement macroeconomic analysis, Chapter 5 evaluated the factors that affect firms' export performance. The analysis was based on the theory of firm heterogeneity, which suggests that entry into foreign markets incurs a fixed cost and only highly productive firms can self-select to export. The data were from the Lao enterprise surveys conducted by the World Bank in 2009, 2012, and 2016. The econometric estimation revealed that labour productivity had a positive (but insignificant) impact on firms' export intensity. Firm size, foreign ownership, and using imported inputs were found to be statistically significant. Larger firms have more resources to exploit scale economies to enable them to export more. Having foreign equity and using imported inputs also help improve firms' productivity through foreign expertise, marketing networks, and technologies.

Case studies of global production sharing in textiles and garments, and electronics were conducted in Chapter 6, which provides comparative perspectives on the supply chains that are driven by buyers and producers. Both sectors are well integrated into international supply chains and make substantial contributions to the Lao economy, in terms of employment and export earnings. Laos has a relatively small garment industry

compared to its neighbouring countries such as Cambodia and Myanmar. The garment sector makes up 13 per cent of Laos' industrial output and employs 20 per cent of the workforce, mostly young women. The Lao garment industry is dominated by a cut-make-trim model, with minimal local linkages. As such most raw materials have to be imported, mostly from ASEAN. The concentration of garment exports in the EU market highlights the need for Laos to diversify its export destinations. Tapping into other developed countries such as the United States, Canada, Japan, and Korea, where Cambodia and Myanmar are currently exporting to, would help Laos to avoid possible exposure to market risk. Laos should, therefore, give priority in getting preferential access to the American market. There is also huge potential for Laos to expand markets to ASEAN and China given the country's relatively low market share at the moment.

The Lao electronics industry had a humble start in the mid-1990s and has become one of the more promising sectors for the country. Laos' trade in electronics is concentrated in ASEAN and is largely dominated by parts and components. Laos is in direct competition with Cambodia to attract investors into electronics assembly amid rising wages in China and more-developed ASEAN members. Thailand has a well-established electronics industry and engages in a diverse range of global electronics supply chains, from production and assembly to testing and research and development. The growth and dynamics of the Thai electronics industry are driven by foreign direct investment thanks to the country's skilled workforce, industrial clusters, and superior logistics networks.

Cheap labour and electricity were cited by foreign investors as their key motivations to invest in the electronics industry in Laos. Another reason is Laos' proximity to final assembly lines, especially Thailand, which has a well-established electronics industry. This provides good prospects for Laos to further integrate into regional electronics supply chains by capitalising on geographical proximity advantages. Because of the highly dispersed supply chains in electronics, the costs of services links, in particular those related to the distribution of inputs among contract manufacturers in different countries, have a significant impact on the competitiveness of this industry.

The absence of supporting industries in both the textile and garment, and electronics industries highlights the challenge that Laos struggles to compete with neighbouring countries given the cost and time penalty associated with being landlocked. Exporting a standard container from Vientiane to Los Angeles adds as much as 45 per cent to total shipping costs compared to exporting from Bangkok to the same final destination. In addition, Laos performs worse on the time penalty, taking almost double the time

required to ship from Bangkok. This excessively high time penalty is well above the average of landlocked developing countries of 32 per cent, although Laos' cost penalty is slightly better than the LLDC average of 53 per cent. Therefore, improving trade-related logistics, which will reduce trade costs and lead time, would be an avenue to improve the position of Laos in global production sharing.

The findings from this research are expected to contribute an improved understanding of the interaction between economic development, the internationalisation of an economy, the microeconomics of firms, and trade policy making.

7.2 Policy implications and recommendations

A number of policy implications can be drawn from the findings of the thesis. One of the chief challenges for Laos is to transform natural resources into other types of capital so that once such resource wealth is exhausted, there are other income-generating assets to take their place. Transforming some of the resource wealth with which Laos is endowed into productive investments would benefit growth and long-term development prospects for Laos. The Lao government may consider diverting export revenue from natural resources into growth-enhancing investments, including in core infrastructure and productivity enhancement.

The results from econometric estimation suggest that although landlocked status is a binding constraint, landlocked countries can participate in global production sharing by reducing the costs of services links. While there has been investment in numerous infrastructure projects with a bid to link Laos to Southeast Asia and beyond, Laos remains among the world's bottom 10 in a recent survey on logistics performance. This highlights the critical importance of improving not only hard infrastructure but also soft infrastructure in order to better connect Laos to the region. Improving trade-related logistics is very important for reducing the costs of international trade as better logistics infrastructure and services allow companies to move goods across borders not only quickly but also cheaply and reliably. As Laos remains behind all other ASEAN economies in logistics performance, in particular efficiency in border clearance, trade and transport infrastructure, and logistics competence, the focus on improving these areas is a high priority.

To further integrate into regional supply chains, Laos needs to promote export-oriented manufacturing and attract foreign direct investment. Given the fact that neighbouring countries are providing generous tax incentives and other benefits, especially in special

economic zones, Laos would be under pressure to follow suit. Because Laos is landlocked and has infrastructural deficiency, the pressure to adopt this policy is even more paramount. This is only a second-best policy though. Only a limited number of firms in these zones benefit from this approach while other domestic firms that could be suppliers of intermediate goods are left to struggle with high transaction costs. Therefore, a preferred solution is for Laos to improve the business environment for all players in the country given the country's low ranking in the Doing Business survey. As discussed in Chapter 3, Laos' ranking is poor with respect to longer times spent on completing enterprise registration and complying with import and export requirements. Laos needs to continue reform efforts with greater focus on improving the business-enabling environment. The Lao government has recently committed to supporting the private sector. Efforts in this direction could help unlock opportunities for further economic integration of Laos and support long-term economic growth and development.

7.3 Limitations and future research

This thesis has a number of limitations, which result from the lack of data. This is a common problem when working on developing countries. The short time series for which proxies for logistics performance index were available constrained the time span employed for the study. In addition, an important missing variable in the macroeconomic analysis is trade costs associated with the quality of infrastructure. This research used distance as a proxy instead, which may not capture the full extent of infrastructural deficiency. Further research is, therefore, needed to fill this gap. In addition, the credibility of the empirical findings regarding the firm-level analysis would be improved substantially in the future by using a richer set of data and policy variables. This includes a proper measure of labour productivity. Future studies may also look into the impacts of the business environment and other macroeconomic policies on firms' export behaviour.

In conclusion, Laos has embraced a process of opening up to the international economy to overcome its geographical disadvantage. The country is among the fastest growing economies in the region, but recent growth is still driven from a narrow economic base. One of the key challenges for Laos is to manage its natural resources in a way that ensures broad-based growth and inclusive development. The findings from this research make a strong case for Laos to upgrade trade-related logistics, deepen regional

economic integration, and improve the business environment to overcome trade costs associated with being landlocked so that the country can successfully integrate into the regional and global economy.

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Appendix 2.A List of Parts and Components

Item	SITC	Product Description
1	65621	Woven textile labels etc
2	65629	Non-woven text label etc
3	65720	Non-woven fabrics nes
4	65751	Twine/cordage/rope/cable
5	65752	Knotted rope/twine nets
6	65771	Textile wadding nes etc
7	65773	Industrial textiles nes
8	65791	Textile hosepiping etc
9	65792	Machinery belts etc,text
10	72439	Sew mch needles/furn/pts
11	72449	Pts nes textile machines
12	72461	Auxil weave/knit machine
13	72467	Weaving loom parts/acces
14	72468	Loom/knitter etc pts/acc
15	72488	Parts for leather machns
16	72491	Washing machine parts
17	72492	Textile machinry pts nes
18	75230	Digital processing units
19	75260	Adp peripheral units
20	75270	Adp storage units
21	75290	Adp equipment nes
22	75991	Typewrtr parts, eacces nes
23	75993	Dupl/addr mach parts etc
24	75995	Calculator parts/access.
25	75997	Adp equip parts/access.
26	76211	Mtr vehc radio/player
27	76212	Mtr vehc radio rec only
28	76281	Other radio/record/play
29	76282	Clock radio receivers
30	76289	Radio receivers nes
31	76432	Radio transceivers
32	76491	Telephone system parts
33	76492	Sound reprod equip parts
34	76493	Telecomm equipmt pts nes
35	76499	Parts etc of sound equip
36	77111	Liquid dielec transfrmrs
37	77119	Other elec transformers
38	77125	Inductors nes
39	77129	Pts nes elec power mach.
40	77220	Printed circuits
41	77231	Fixed carbon resistors
42	77232	Fixed resistors nes
43	77233	Wirewound var resistors
44	77235	Variable resistors nes
45	77238	Elect resistor parts
46	77241	High voltage fuses
47	77242	Auto circuit breakr<72kv
48	77243	Other auto circuit brkrs

49	77244	Hi-volt isolating switch
50	77245	Limiter/surge prtect etc
51	77249	Hi-volt equipment nes
52	77251	Fuses (electrical)
53	77252	Automatic circuit breakr
54	77253	Circuit protect equi nes
55	77254	Relays (electrical)
56	77255	Other switches
57	77257	Lamp holders
58	77258	Plugs and sockets
59	77259	El connect equ nes<1000v
60	77261	Switchboards etc <1000v
61	77262	Switchboards etc >1000v
62	77281	Switchboards etc unequip
63	77282	Switchgear parts nes
64	77311	Winding wire
65	77312	Co-axial cables
66	77313	Vehicle etc ignition wir
67	77314	Elect conductor nes <80v
68	77315	El conductor nes 80–1000
69	77317	El conductor nes >1000v
70	77318	Optical fibre cables
71	77322	Glass electric insulator
72	77323	Ceramic elect insulators
73	77324	Other electrc insulators
74	77326	Ceram elec insul fit nes
75	77328	Plastic el insul fit nes
76	77329	Other elec insul fit nes
77	77423	X-ray tubes
78	77429	X-ray etc parts/access.
79	77549	Electr shaver/etc parts
80	77579	Parts dom elect equipmnt
81	77589	Domest el-therm app part
82	77611	Tv picture tubes colour
83	77612	Tv picture tubes monochr
84	77621	Tv camera tubes etc
85	77623	Cathode-ray tubes nes
86	77625	Microwave tubes
87	77627	Electronic tubes nes
88	77629	Electrnic tube parts nes
89	77631	Diodes exc photo-diodes
90	77632	Transistors <1watt
91	77633	Transistors >1watt
92	77635	Thyristors/diacs/triacs
93	77637	Photo-active semi-conds
94	77639	Semi-conductors nes
95	77649	Integrated circuits nes
96	77681	Piezo-elec crystals,mntd
97	77688	Piezo-elec assmbly parts
98	77689	Electrnic compon pts nes
99	77812	Electric accumulators
100	77817	Primary batt/cell parts

101	77819	Elec accumulator parts
102	77821	Elec filament lamps nes
103	77822	Elec discharge lamps nes
104	77823	Sealed beam lamp units
105	77824	Ultra-v/infra-r/arc lamp
106	77829	Pts nes of lamps of 7782
107	77831	Ignition/starting equipm
108	77833	Ignition/starting parts
109	77834	Veh elect light/etc equ.
110	77835	Veh elect light/etc part
111	77861	Fixed power capacitors
112	77862	Tantalum fixd capacitors
113	77863	Alum electrolyte capacit
114	77864	Ceram-diel capacit sngle
115	77865	Ceram-diel capacit multi
116	77866	Paper/plastic capacitor
117	77867	Fixed capacitors nes
118	77868	Variable/adj capacitors
119	77869	Electrical capacitr part
120	77871	Particle accelerators
121	77879	Parts el equip of 778.7
122	77881	Electro-magnets/devices
123	77882	Elec traffic control equ
124	77883	Elec traffic control pts
125	77885	Electric alarm parts
126	77886	Electrical carbons
127	77889	Elec parts of machy nes
128	78410	Motor veh chassis+engine
129	78421	Motor car bodies
130	78425	Motor vehicle bodies nes
131	78431	Motor vehicle bumpers
132	78432	Motor veh body parts nes
133	78433	Motor vehicle brake/part
134	78434	Motor vehicle gear boxes
135	78435	Motor veh drive axle etc
136	78439	Other motor vehcl parts
137	78535	Parts/access motorcycles
138	78536	Parts/acces inv carriage
139	78537	Parts,acces cycles etc
140	78689	Trailer/semi-trailer pts
141	79199	Rail/tram parts nes
142	79283	Aircraft launchers etc
143	79291	Aircraft props/rotors
144	79293	Aircraft under-carriages
145	79295	Aircraft/helic parts nes
146	79297	Air/space craft part nes
147	84552	Girdles/corsets/braces..
148	84842	Headgear plaited
149	84848	Parts for headgear
150	87119	Binoc/telescope part/acc
151	87139	Electron/etc diffr parts
152	87149	Microscopes parts/access

153	87199	Parts/access for 8719
154	87319	Gas/liq/elec meter parts
155	87325	Speed etc indicators
156	87329	Meter/counter parts/acc.
157	87412	Navigation inst part/acc
158	87414	Survey instr parts/acc.
159	87424	Pts nes of inst of 8742
160	87426	Meas/check instr part/ac
161	87439	Fluid instrum parts/acc
162	87454	Mech tester parts/accs
163	87456	Thermometer etc part/acc
164	87461	Thermostats
165	87463	Pressure regulators/etc
166	87469	Regul/cntrl inst part/ac
167	87479	Elec/rad meter parts/acc
168	87490	Instrument part/acc nes
169	88113	Photo flashlight equipmt
170	88114	Camera parts/accessories
171	88115	Flashlight parts/access
172	88123	Movie camera parts/acc.
173	88124	Movie projector part/acc
174	88134	Photo equip nes part/acc
175	88136	Photo,cine lab equip ne
176	88422	Spectacle frame parts
177	88431	Camera/etc objectiv lens
178	88432	Objective lenses nes
179	88433	Optical filters
180	88439	Mounted opt elements nes
181	88571	Instr panel clocks/etc
182	88579	Clocks nes
183	88591	Watch cases,case parts
184	88592	Watch straps/bands metal
185	88593	Watch strap/band non-mtl
186	88597	Clock cases,case parts
187	88598	Clock/watch mmnts unass
188	88599	Clock/watch parts nes

Note: The list is limited to SITC 65, 724, 75, 76, 77, 78, 79, 84, 87, and 88.

Source: Adapted from Athukorala and Talgaswatta (2016).

Appendix 3.A Exports from Laos by products, 2010–2016

Description	2010	2014	2015	2016	Average 2010–16
All products (US$ thousand)	9,001	9,949	2,418	9,019	7,680
Agricultural share (%)	11.8	4.2	11.0	12.0	8.3
Animal (HS 01–05)	1.5	0.5	0.6	1.7	1.1
Vegetable (HS 06–15)	2.7	0.8	6.4	2.7	2.5
Food (HS 16–24)	7.6	2.9	4.0	7.6	4.7
Non-agricultural share (%)	88.2	95.8	88.9	88.0	91.9
Minerals (HS 25–26)	1.6	4.0	17.7	2.8	4.5
Fuels (HS 27)	23.5	8.0	7.4	15.4	16.4
Chemicals (HS 28–38)	5.5	4.9	6.8	4.7	5.4
Plastics and rubber (HS 39–40)	3.5	3.8	2.7	2.7	3.4
Hides and skin (HS 41–43)	0.1	0.7	0.1	0.3	0.2
Wood (HS 44–49)	1.2	1.4	2.5	1.9	1.7
Textiles and garments (HS 50–63)	0.8	6.1	4.9	3.0	2.4
Footwear (HS 64–67)	0.2	0.3	0.6	0.2	0.3
Stones and glass (HS 68–71)	5.6	2.6	5.4	3.7	3.6
Metals (HS 72–83)	10.5	19.9	18.8	10.0	14.5
Machinery and electronics (HS 84–85)	20.8	33.2	17.2	26.0	23.9
Transport equipment (HS 86–89)	13.3	8.2	3.5	15.4	13.2
Others (HS 90–99)	1.6	2.7	1.3	1.9	2.4
Total	100.0	100.0	100.0	100.0	100.0

Source: Author's calculations from UN Comtrade, using partner-reported data.

Appendix 3.B Exports from Laos by destinations, 2000–2016

	2000	2005	2010	2011	2012	2013	2014	2015	2016
World	335.08	554.95	1,897.25	2,811.42	3,034.29	3,564.40	4,380.04	3,812.86	4,444.96
Advanced Economies	152.40	205.02	341.90	463.12	515.58	548.07	494.89	472.96	541.25
Australia	0.48	6.69	1.89	6.19	45.75	50.89	2.25	2.89	7.98
Belgium	14.10	16.19	17.69	16.88	16.41	33.42	18.06	15.41	17.11
Canada	1.46	5.73	7.86	6.67	9.97	10.81	14.90	18.51	19.29
Denmark	1.04	0.61	4.58	5.93	7.82	9.97	7.86	9.06	14.16
France	27.98	43.49	16.26	18.02	13.33	14.34	18.20	17.65	15.67
Germany	20.57	28.89	55.10	75.63	70.76	86.91	85.35	75.71	75.25
Hong Kong	0.43	0.03	3.25	4.23	2.87	14.83	2.97	8.20	4.70
Italy	9.53	9.22	13.23	20.32	23.73	19.95	17.66	14.76	28.85
Japan	11.34	7.58	35.48	91.60	116.62	101.47	109.59	91.89	108.74
South Korea	0.54	1.99	18.86	4.08	10.70	11.78	17.02	26.81	23.10
Netherlands	11.68	13.88	14.20	30.50	40.85	47.07	40.37	23.00	17.35
New Zealand	0.02	0.07	0.16	0.27	0.17	1.67	3.91	2.75	5.98
Norway	2.35	1.41	0.25	0.33	0.82	1.23	1.03	1.53	1.63
Portugal	0.11	0.82	0.83	2.71	2.79	2.46	12.63	2.53	2.36
Singapore	0.84	1.37	2.65	0.44	5.06	5.42	14.61	12.62	4.97
Slovak Republic	0.43	0.00		0.00	0.00				
Spain	5.42	3.65	5.11	7.66	8.80	9.31	5.38	7.47	3.77
Sweden	4.76	2.34	1.28	1.38	1.17	2.98	9.76	20.44	18.01
Switzerland	4.21	3.76	1.21	1.90	4.14	4.47	4.08	4.38	53.93
Taiwan	2.76	8.58	6.61	10.62	7.40	12.38	14.95	13.37	16.23
United Kingdom	17.60	39.94	72.59	98.68	99.09	74.30	59.22	47.99	47.98

United States	9.15	4.25	58.40	55.52	23.63	28.79	31.06	42.57	51.86
Emerging & Developing Countries	182.68	349.93	1,555.35	2,348.29	2,518.71	3,016.32	3,885.14	3,339.90	3,903.70
Asia	178.79	340.92	1,544.21	2,324.98	2,475.85	2,989.63	3,870.70	3,320.23	3,867.29
Brunei			0.01	0.02	0.00	0.00	0.00	0.00	0.00
Cambodia	0.04	0.19	1.42	0.87	4.02	5.07	6.38	19.03	20.26
China	6.06	24.10	530.20	756.54	740.58	962.87	1,661.39	1,224.62	1,267.55
India		0.09	18.90	63.26	132.78	105.41	56.29	134.97	162.18
Indonesia	1.09	0.06	0.58	1.22	3.11	7.12	48.36	0.76	3.96
Malaysia	0.15	12.23	2.11	0.70	0.41	1.19	1.21	2.78	11.66
Nepal						0.09	0.78	1.42	1.31
Philippines			0.01	0.09	0.04	0.01	0.47	0.16	2.51
Sri Lanka			0.00	0.01		0.09	0.00	0.39	7.16
Thailand	71.48	212.11	715.70	1,067.90	1,173.73	1,277.48	1,331.88	1,381.76	1,780.35
Vietnam	99.75	91.98	275.23	433.98	419.53	630.23	762.36	553.29	609.93
Europe	2.50	6.64	8.73	13.75	9.75	16.37	6.15	14.70	4.87
Romania	0.01	0.15	0.36	0.85	0.97	7.32	0.04	0.00	2.81
Turkey	0.57	0.52	1.24	1.09	1.68	2.40	2.26	1.36	1.45
Commonwealth of Independent States	0.04	0.71	0.80	3.64	2.26	2.47	3.00	1.34	27.06
Russia	0.04	0.36	0.47	1.91	1.43	1.50	1.67	0.74	26.25
Ukraine		0.35	0.28	0.72	0.60	0.76	1.02	0.50	0.70
Middle East & North Africa	0.56	0.82	0.61	1.01	27.16	4.68	2.27	1.38	1.40
Morocco		0.01	0.00	0.00	0.02	0.04	0.02	0.28	0.47

Saudi Arabia	0.21	0.20	0.25	0.11	0.27		0.18	0.24	0.19
United Arab Emirates		0.01	0.01	0.31	25.87	3.66	1.36	0.45	0.42
Sub-Saharan Africa	0.67	0.45	0.15	1.85	1.26	1.36	1.75	1.32	1.75
Western Hemisphere	0.13	0.39	0.85	3.07	2.43	1.81	1.27	0.93	1.33
Memorandum Items									
ASEAN	173.35	317.94	997.71	1,505.22	1,605.90	1,926.52	2,165.27	1,970.40	2,433.64
EU	120.69	169.43	212.41	293.56	296.22	316.33	280.71	250.06	245.36

Note: Unit in US$ million. Free on board (FOB) price. Data is reported by trading partner. Only key trading partners are shown. See country grouping in www.imf.org

Source: Direction of trade statistics of the IMF (2017).

Appendix 3.C Imports to Laos by sources, 2000–2016

	2000	2005	2010	2011	2012	2013	2014	2015	2016
World	654.93	1,200.60	3,448.79	4,421.98	6,109.07	7,029.96	7,672.62	7,229.96	6,506.28
Advanced Economies	124.65	170.46	421.99	662.15	790.06	668.22	824.65	777.67	532.56
Austria	0.01	0.04	2.85	5.18	7.54	7.62	8.36	18.58	10.28
Australia	4.01	19.16	23.92	25.82	39.24	40.47	34.04	20.97	17.64
Belgium	1.41	11.92	19.67	32.98	36.12	30.88	30.35	24.64	27.79
Canada	0.13	0.72	2.88	7.61	10.03	6.49	11.26	4.80	9.22
Czech Republic	0.28	0.06	0.69	0.43	0.27	0.60	0.39	3.40	6.25
France	26.48	12.99	59.16	141.92	42.19	37.27	62.90	12.64	12.59
Germany	3.48	10.84	23.36	40.78	164.29	51.88	117.56	48.19	37.36
Hong Kong	7.57	7.97	28.92	31.27	26.48	32.85	41.50	23.40	20.47
Italy	0.40	1.45	15.79	13.52	12.03	9.42	11.28	10.49	15.67
Japan	22.78	20.55	65.77	82.79	145.65	128.70	146.44	110.96	124.12
South Korea	4.72	14.77	118.99	163.74	174.94	198.27	165.40	180.59	136.90
Netherlands	2.29	0.99	1.88	2.02	2.32	8.78	3.18	3.72	4.99
Singapore	31.72	42.48	24.39	36.85	31.85	28.03	126.64	260.40	46.51
Switzerland	0.41	1.65	1.36	1.27	4.98	36.81	10.37	3.70	4.43
Taiwan	3.16	2.15	4.15	2.37	3.37	4.05	3.90	3.23	4.10
United Kingdom	5.86	2.92	5.53	13.89	5.68	7.28	5.84	10.32	7.96
United States	4.56	10.39	12.83	27.65	35.50	25.86	30.19	26.06	32.73
Emerging & Developing Countries	530.28	1,030.13	3,026.80	3,759.83	5,319.01	6,361.74	6,847.97	6,452.28	5,973.72
Asia	527.07	1,015.02	3,009.54	3,734.46	5,289.30	6,311.13	6,793.41	6,427.19	5,945.73

Brunei	0.02		0.13	0.22	0.00	0.00	0.02	0.02	0.01
Cambodia	3.32	0.22	0.94	1.31	2.19	0.62	0.12	5.78	6.04
China	36.48	111.66	505.04	500.41	990.29	1,823.80	1,958.50	1,352.10	1,071.35
India	5.30	5.05	8.72	15.50	29.11	48.26	67.28	54.66	25.44
Indonesia	0.93	1.86	5.83	9.12	25.21	6.20	4.82	8.21	6.23
Malaysia	1.83	6.65	15.20	14.67	13.71	24.13	26.23	15.70	19.66
Myanmar		0.00	0.00						0.04
Philippines	0.05	0.76	0.32	0.65	0.57	0.85	0.12	16.51	0.73
Thailand	403.81	815.47	2,262.97	2,901.93	3,780.58	3,920.84	4,230.36	4,419.50	4,203.99
Vietnam	74.90	73.35	210.34	290.55	446.68	485.33	505.86	554.71	609.43
Europe	0.31	0.17	6.58	12.45	3.61	7.59	6.25	2.92	5.38
Commonwealth of Independent States	1.62	11.55	9.30	8.84	22.23	40.19	45.95	20.06	19.05
Azerbaijan									
Belarus			1.85		11.72	0.47	5.95	1.70	2.63
Kazakhstan								0.02	
Russia	1.62	11.55	7.39	8.78	10.44	39.55	39.67	16.62	13.90
Middle East & North Africa	1.00	0.14	0.33	0.27	0.50	1.11	1.27	1.01	1.39
Sub-Saharan Africa	0.04	3.04	0.18	0.76	1.16	0.84	0.61	0.41	0.72
Western Hemisphere	0.25	0.22	0.86	3.05	2.22	0.88	0.47	0.69	1.46
Memorandum Items									
ASEAN	516.58	940.79	2,520.12	3,255.30	4,300.79	4,466.00	4,894.17	5,280.83	4,892.64
EU	43.54	49.86	142.90	288.17	317.57	166.72	252.86	143.91	138.07

Note: Unit in US$ million. Cost freight and insurance (CIF) price. Data is reported by trading partner. Only key trading partners are shown. See country grouping in www.imf.org

Source: Direction of trade statistics of the IMF (2017).

Appendix 3.D A breakdown of manufacturing exports, 1990/91–2015/16

	1990/91			2000/01			2015/16		
	P&Cs	Final	Total	P&Cs	Final	Total	P&Cs	Final	Total
Electronics	0.2	0.3	0.5	0.2	0.2	0.4	31.0	8.9	39.9
Automobiles	0.2	0.7	0.9	0.4	22.6	23.0	1.0	0.3	1.3
Other transport	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Textiles and garments	0.1	73.1	73.2	0.0	70.1	70.1	0.0	27.3	27.3
Scientific equipment	0.0	0.3	0.4	0.0	0.1	0.1	0.1	0.2	0.3
Photographic equipment	-	0.2	0.2	0.0	0.0	0.0	0.0	0.8	0.8
Misc. manufacturing	-	3.39	3.4	0.0	0.3	0.3	0.0	3.1	3.1
Share in manufacturing exports (%)	0.6	78.0	78.6	0.6	93.2	93.9	32.3	40.6	72.8

Note: Manufacturing (SITC 5+6-68+7+8+9), electronics (SITC 75+76+77), automobiles (SITC 78), other transport equipment (SITC 79), textiles and garments (SITC 65+724+84), scientific equipment (SITC 87), photographic equipment (SITC 88), and miscellaneous manufacturing (SITC 89). The calculation is a two-year average to avoid annual data fluctuations. "-" data is not available.

Source: Author's calculations from UN Comtrade, using partner-reported data.

Appendix 4.A Deriving a gravity equation for networked trade

This appendix follows Baldwin and Taglioni (2011) to show how a gravity model is derived from consumer utility and production cost functions. There are two equations for modelling trade dominated by global production sharing: Equation (A.3) for trade in final goods, and Equation (A.9) for trade in parts and components (P&Cs).

Trade in final goods

Given the constant elasticity of substitution (CES) preference for differentiated products, expenditure in a destination nation (d) or an importing country (j) on a variety supplied by an origin nation (o) or an exporting country (i) is

$$v_{od} \equiv \left(\frac{p_{od}}{P_d}\right)^{1-\sigma} E_d; \quad \sigma > 1 \qquad \text{(A.1)}$$

where v_{od} denotes the spending in the destination country, p_{od} is the consumer price in the destination country of certain variety produced in the origin country, P_d represents the price index of all varieties in the destination country, σ is the elasticity of substitution across varieties, and E_d denotes the consumer expenditure of the destination country. Note that P_d is underlined by the CES assumption and σ is assumed to be greater than 1.

The profit maximisation for the origin country's producers is expressed as $p_{od} = \mu_{od} m_o \tau_{od}$, where μ_{od} denotes an optimal price mark-up, m_o is a marginal cost, and τ_{od} is bilateral trade costs. The price mark-up is assumed to be identical across all destination countries following Dixit-Stiglitz monopolistic competition. By this, price variation is portrayed by 'mill pricing', that is, 100 per cent pass-through trade costs to consumers in the destination country.

Given the Dixit-Stiglitz competition assumption, the price mark-up becomes $\sigma/(\sigma - 1)$. This implies that consumer prices in the domestic market within the origin country are equal to $p_{oo} = \sigma/(\sigma - 1) m_o \tau_{oo}$, where τ_{oo} is a unity with an assumption of zero internal trade costs. Given this price index and an assumption of symmetry of varieties across different origins, taking summation over all varieties yields

$$V_{od} = n_o \mathrm{p}_o^{1-\sigma} \frac{\tau_{od}^{1-\sigma}}{P_d^{1-\sigma}} E_d \qquad \text{(A.2)}$$

where V_{od} is bilateral trade flows (measured in the numeraire), n_o is the number of the origin country's varieties. All varieties are assumed to be supplied to the destination

country, known as the Dixit-Stiglitz-Krugman model.

Assuming a market-clearing condition, the expenditure function can be transformed to a gravity equation. Demand matches supply when the spending function in Equation (A.2), after summing over all destinations, equals the aggregate output of the origin country. In the case of horizontal trade when there is no international production sharing, it is valid to measure the mass variable (Y_o) by the origin or exporting country's GDP. Hence, the market-clearing condition implies $Y_o = n_o p_o^{1-\sigma} \sum_d \tau_{od}^{1-\sigma} P_d^{\sigma-1} E_d$.

Solving the above equation yields $n_o p_o^{1-\sigma} = \frac{Y_o}{\Omega_o}$, where Ω_o denotes a market-potential index. Ω_o is the summation of trading partners' market sizes weighed by distance-related factors. This places lower weight on countries that are more remotely located to the world market than other countries. That is, $\Omega_o \equiv \sum_d \tau_{od}^{1-\sigma} P_d^{\sigma-1} E_d$. Plugging this into Equation (A.2), the gravity equation for trade in final goods becomes

$$V_{od} = \tau_{od}^{1-\sigma} E_d Y_o \frac{1}{P_d^{1-\sigma}} \frac{1}{\Omega_o} \qquad \text{(A.3)}$$

where P_d is the CES price index of the destination or importing country, Ω_o denotes the market-potential of the origin or exporting country. The product $P_d^{1-\sigma}\Omega o$ is called the multilateral resistance term.

In standard gravity modelling, aggregate expenditure E_d is proxied by the GDP of the destination or importing country, aggregate output Y_o is proxied by the GDP of the origin or exporting country, and τ is bilateral trade costs.

Trade in parts and components

To apply gravity modelling in trade in parts and components, additional assumptions are made as regards the exchange of intermediate goods in Krugman and Venables (1996). That is, CES aggregate supply equals CES aggregate demand.

In this case, an indirect utility function (V) of a consumer can be expressed as

$$V = \frac{I}{P^c}; \qquad P^c \equiv P_A^{1-\alpha} P^{\alpha}; \; P \equiv \left(\int_{\in G} P_i^{1-\sigma} \, di\right)^{\left(\frac{1}{1-\sigma}\right)} \qquad \text{(A.4)}$$

where I denotes the income of a consumer, P^c is the ideal price of a consumer, P_A is the price of sector A, $\propto$ is a Cobb-Douglas expenditure share for M-sector varieties, σ is the elasticity of substitution across varieties, P is the CES price index of M-sector varieties, P_i is the consumer price of variety I, and G is the set of all varieties.

A firm's cost function (C) is

$$C[w, P, x] = (F + a_x x) w^{1-\alpha} P^{\alpha} \qquad \text{(A.5)}$$

where x is the output of a variety, F and a_x are fixed and variable cost parameters respectively, w is a wage, and α is a Cobb-Douglas cost share for part and component inputs.

Because of optimal mill pricing under Dixit-Stiglitz competition and the identity of σ across varieties, the price of every variety is identical for goods consumed by consumers and used by producers. Given $a_x = 1 - 1/\sigma$, a landed price becomes

$$p_{od} = \tau_{od} w_o^{1-\alpha} P_o^{\alpha}; \quad \text{for any origin and destination countries} \qquad \text{(A.6)}$$

Using Shepard's and Hotelling's lemmas on Equations (A.4) and (A.5), as well as adding the origin country's aggregate demand, yields an expression resembling Equation (A.2) for parts and components

$$V_{od} = n_o p_o^{1-\sigma} \frac{\tau_{od}^{1-\sigma}}{P_d^{1-\sigma}} E_d; \qquad E_d \equiv \alpha(I_d + n_d C_d) \qquad \text{(A.7)}$$

where I_d, n_d, and C_d denote consumer income, number of varieties, and the total cost of a variety in destination country. Note that aggregate expenditure E_d now includes purchases by consumers and producers (for parts and components).

Solving for $n_o C_o$, using the market-clearing condition, we have

$$n_o C_o = n_o p_{oo}^{1-\sigma} \sum_d \tau_{od}^{1-\sigma} P_d^{\sigma-1} E_d; \quad C_o \equiv C[w_o, P_o, x_o] \qquad \text{(A.8)}$$

where C is a cost function expressed in Equation (A.5). A gravity equation for trade in parts and components can be obtained by plugging the solution of Equation (A.8) into Equation (A.7)

$$V_{od} = \tau_{od}^{1-\sigma} E_d C_o \frac{1}{P_d^{1-\sigma}} \frac{1}{\Omega_o} \qquad \text{(A.9)}$$

Equation (A.9) is the gravity equation extended to trade in parts and components. It has trade costs (τ) the same as those expressed in Equation (A.3). However, the mass variables are now different as shown that $E_d \equiv \alpha(I_d + n_d C_d)$ and $C_o \equiv C[w_o, P_o, x_o]$. As for E_d, this means that instead of using GDP as a proxy, it is now influenced by both the demand of consumers (final demand I_d) with income as a demand shifter and the demand of producers (intermediate demand C_d) with production costs as a demand shifter. The explanation for production cost C_o, and how it can be measured is further

explained in Equation (A.11).

As argued by Baldwin and Taglioni (2011), a gravity model for trade in parts and components should take into account the importance of intermediate inputs in determining the mass variables. In the destination country, the mass variable should have GDP added with the sum of imports of parts and components from all sources (except for from the corresponding country to avoid putting trade flows on both sides of a gravity equation). This is to reflect the direct definition of total production costs composed of primary and intermediate inputs. That is, the mass variable for the destination country d (or the importing country j) is

$$E_d \equiv Y_d + \sum_{i \neq o} V_{d,i}^{P\&Cs} \tag{A.10}$$

where Y_d is proxied by GDP and $V^{P\&Cs}$ is the value of bilateral imports of parts and components.

As for the origin country o (or the exporting country i), the mass variable is constructed by exploiting the definition of a cost function. In other words, instead of GDP (which is the gross value), the proxy should be manufacturing value-added of the origin country plus the sum of the imports of parts and components from all sources (except for itself due to a lack of data). That is,

$$C_o \equiv VA_o^{mfg} + \sum_{i \neq o} V_{i,o}^{P\&Cs} \tag{A.11}$$

where VA_o^{mfg} is manufacturing value-added or output and $V^{P\&Cs}$ is the same as explained in Equation (A.10).

Appendix 4.B List of countries

1	Afghanistan	41	Côte d'Ivoire
2	Albania	42	Croatia
3	Algeria	43	Cuba
4	Andorra	44	Cyprus
5	Angola	45	Czech Republic
6	Antigua and Barbuda	46	Denmark
7	Argentina	47	Djibouti
8	Armenia	48	Dominica
9	Australia	49	Dominican Republic
10	Austria	50	Ecuador
11	Azerbaijan	51	Egypt
12	Bahamas	52	El Salvador
13	Bahrain	53	Equatorial Guinea
14	Bangladesh	54	Eritrea
15	Barbados	55	Estonia
16	Belarus	56	Ethiopia
17	Belgium	57	Faroe Islands
18	Belize	58	Fiji
19	Benin	59	Finland
20	Bhutan	60	France
21	Bolivia	61	Gabon
22	Bosnia and Herzegovina	62	Gambia
23	Botswana	63	Georgia
24	Brazil	64	Germany
25	Brunei Darussalam	65	Ghana
26	Bulgaria	66	Greece
27	Burkina Faso	67	Grenada
28	Burundi	68	Guatemala
29	Cambodia	69	Guinea
30	Cameroon	70	Guinea-Bissau
31	Canada	71	Guyana
32	Cape Verde	72	Haiti
33	Central African Republic	73	Honduras
34	Chad	74	Hong Kong
35	Chile	75	Hungary
36	China	76	Iceland
37	Colombia	77	India
38	Comoros	78	Indonesia
39	Congo	79	Iran
40	Costa Rica	80	Iraq

81	Ireland	121	Namibia
82	Israel	122	Nepal
83	Italy	123	Netherlands
84	Jamaica	124	New Zealand
85	Japan	125	Nicaragua
86	Jordan	126	Niger
87	Kazakhstan	127	Nigeria
88	Kenya	128	Norway
89	Kiribati	129	Oman
90	Korea, Democratic People's Republic	130	Pakistan
91	Korea, Republic	131	Palau
92	Kuwait	132	Panama
93	Kyrgyzstan	133	Papua New Guinea
94	Laos	134	Paraguay
95	Latvia	135	Peru
96	Lebanon	136	Philippines
97	Lesotho	137	Poland
98	Liberia	138	Portugal
99	Libya	139	Qatar
100	Lithuania	140	Romania
101	Luxembourg	141	Russian Federation
102	Macao	142	Rwanda
103	Macedonia, former Yugoslav Republic	143	Saint Kitts and Nevis
104	Madagascar	144	Saint Lucia
105	Malawi	145	Saint Vincent and the Grenadines
106	Malaysia	146	Samoa
107	Maldives	147	Sao Tome and Principe
108	Mali	148	Saudi Arabia
109	Malta	149	Senegal
110	Marshall Islands	150	Serbia
111	Mauritania	151	Seychelles
112	Mauritius	152	Sierra Leone
113	Mexico	153	Singapore
114	Micronesia	154	Slovakia
115	Moldova	155	Slovenia
116	Mongolia	156	Solomon Islands
117	Montenegro	157	Somalia
118	Morocco	158	South Africa
119	Mozambique	159	Spain
120	Myanmar	160	Sri Lanka

161 Sudan
162 Suriname
163 Swaziland
164 Sweden
165 Switzerland
166 Syrian Arab Republic
167 Taiwan, China
168 Tajikistan
169 Tanzania
170 Thailand
171 Timor-Leste
172 Togo
173 Tonga
174 Trinidad and Tobago
175 Tunisia
176 Turkey
177 Turkmenistan
178 Tuvalu
179 Uganda
180 Ukraine
181 United Arab Emirates
182 United Kingdom
183 United States
184 Uruguay
185 Uzbekistan
186 Vanuatu
187 Venezuela
188 Vietnam
189 Yemen
190 Zambia
191 Zimbabwe

Appendix 4.C Robustness checks with liner shipping index

	Parts and components	Final goods
	(1)	(2)
ln(exporter's economic mass)	1.018***	1.059***
	(0.0137)	(0.0174)
ln(importer's economic mass)	0.806***	0.914***
	(0.0176)	(0.0184)
ln(importer's tariff)	0.00650	0.0683**
	(0.0341)	(0.0303)
ln(exporter's liner shipping index)	0.296***	0.188***
	(0.0217)	(0.0185)
ln(importer's liner shipping index)	0.0477**	0.0489**
	(0.0227)	(0.0201)
RTA	0.122***	0.124***
	(0.0333)	(0.0288)
LLAC	0.303***	0.209
	(0.115)	(0.134)
LLDC	–1.125***	–0.905***
	(0.0762)	(0.0907)
ln(distance)	–1.232***	–1.065***
	(0.0471)	(0.0527)
contiguity	1.102***	1.422***
	(0.217)	(0.247)
language	0.946***	0.774***
	(0.0887)	(0.103)
constant	–22.80***	–28.56***
	(0.833)	(0.954)
observations	102,365	103,200

Note: Dependent variable is the log of exports of P&Cs and final products that are estimated in separate equations. Year-specific effects are included but not shown here. For landlocked countries, the liner shipping index of their key transit country is used. Robust standard errors are in parentheses. ***, **, and * indicate significance at 1 per cent, 5 per cent, and 10 per cent levels, respectively.

Source: Author's estimations.

Appendix 4.D Robustness checks with fixed effects estimator

	Linear least squares		PPML	
	P&C	Final	P&C	Final
	(1)	(2)	(3)	(4)
LLAC	0.855***	0.738***	0.472**	(estimates cannot be shown as the estimation fails to converge)
	(0.207)	(0.195)	(0.194)	
LLDC	–1.261***	–1.120***	–2.005***	
	(0.118)	(0.124)	(0.360)	
RTA	0.697***	0.688***	0.498***	
	(0.0346)	(0.0333)	(0.0652)	
ln(distance)	–1.380***	–1.331***	–0.616***	
	(0.0177)	(0.0172)	(0.0343)	
contiguity	0.800***	0.854***	0.281***	
	(0.0673)	(0.0638)	(0.0927)	
language	0.890***	0.923***	0.0850	
	(0.0350)	(0.0341)	(0.0854)	
exporter-time FE	Yes	Yes	Yes	
importer-time FE	Yes	Yes	Yes	
year-FE	Yes	Yes	Yes	
observations	46,586	43,369	46,618	

Note: Dependent variable is the log of exports for the first and second columns and the exports in level for the third and fourth columns. Only 2007, 2010 and 2012 data are considered for compatibility with the results from the Hausman-Taylor estimator. Robust standard errors are in parentheses. ***, **, and * indicate significance at 1 per cent, 5 per cent, and 10 per cent levels, respectively.

Source: Author's estimations.

Appendix 5.A Exporter status across industries

Industries	ISIC	2009		2012		2016	
		Exporter	Non-exporter	Exporter	Non-exporter	Exporter	Non-exporter
Food and tobacco	15–16	1	14	1	11	1	19
Textiles and garments	17–18	2	7	0	4	4	4
Leather	19	29	22	15	11	8	10
Wood and furniture	20 & 36	0	8	1	7	3	4
Paper	21	8	20	7	10	9	14
Refined petroleum	22	0	4	0	1	0	0
Recorded media	23	0	4	0	5	0	3
Chemicals	24	0	0	0	0	0	4
Plastic and rubbers	25	0	4	1	0	1	5
Non-metallic minerals	26	0	8	0	5	0	3
Basic and fabricated metals	27–28	0	8	0	12	0	5
Machinery and equipment	29–30	1	1	0	2	0	12
Electronics	31–32	0	1	1	0	0	1
Precision instruments	33	1	0	0	0	0	0
Transport machines	34–35	0	4	0	2	0	0
Total number of firms:		42	105	26	70	26	84

Source: Enterprise surveys on Laos in 2009, 2012, and 2016 (World Bank 2017c).

Appendix 5.B Export participation and firm characteristics

	Exporter (26.6% of 353 obs.)	**Non-exporter** (73.4% of 353 obs.)
Firm size (%)		
- Small (19 employees or less)	6.4	39.0
- Medium (20–99 employees)	30.9	47.1
- Large (100 employees or more)	62.7	13.9
Firm age (years)	17.7	17.8
Foreign ownership (%)		
- Wholly local owned (0%)	63.8	84.2
- Partially owned (1–99%)	8.5	7.3
- Wholly foreign owned (100%)	27.7	8.5
Capital intensity	230	175
Labour productivity	17.45	17.55
Manager's experience (years)	19.1	15.3
If a firm provides training (%)		
- Yes	41.3	19.8
- No	58.7	80.2
If a firm owns websites (%)		
- Yes	57.5	23.2
- No	42.5	76.8
If a firm obtains internationally recognised standards (%)		
- Yes	17.2	10.9
- No	82.8	89.0

Note: A firm has an exporter status if at least one per cent of its sales is exported directly. The total number of observations is 353 across three years. The calculation has been adjusted for missing data in some variables.

Source: Enterprise surveys on Laos in 2009, 2012, and 2016 (World Bank 2017c).

The comparison between exporters and non-exporters finds that that around 27 per cent of manufacturers in Laos engage in direct exporting.[56] In other words, the majority of Lao businesses (73 per cent) do not export their products at all. In addition, the larger businesses are, the more they tend to engage in exporting. That is, large and medium establishments account for 63 per cent and 31 per cent of exporters, respectively. Similarly, firms with higher capital intensity, more experienced management, along with those introducing websites have a higher tendency to enter export markets.

The representation is, however, somewhat mixed in respect to firm age, ownership structure, training, and productivity as measured by (real) total sales per worker. The majority of firms do not have any foreign ventures regardless of their exporting status. Specifically, wholly local-owned firms account for 64 per cent of exporting firms, but 84 per cent of the non-exporting group. The average age of both the exporters and non-exporters is around 18 years. When asked whether firms provide formal training for their employees, the responses are not much different between exporters and non-exporters. Apart from that, a large proportion of firms, whether they are exporters or non-exporters, do not have internationally recognised standards, such as International Standard Organization ISO 9000 or 14000.

[56] Calculated from 353 observations pooled across three years: 2009, 2012, and 2016.

Appendix 5.C Descriptive statistics

Variables	No. of observations	Mean	Standard Deviation	Min	Max
Export intensity	353	22.2521	39.2484	0	100
Productivity (current period)	351	17.5289	1.2770	13.0270	23.8368
Productivity (3 years earlier)	316	17.5793	1.6224	1.9449	21.1586
Size (log)	353	3.7247	1.4101	0.6931	7.2442
Age (log)	349	2.7468	0.51714	0.6931	4.8598
Foreign	352	18.0114	36.2484	0	100
Import	339	38.9617	45.3668	0	100
Industry	353	22.1473	5.4346	16	36
Year	353	2011.997	2.9595	2009	2016

Appendix 5.D Robustness checks with productivity in current period

	Tobit	**Heckman**	
	Export intensity	Export participation	Export intensity
	(1)	(2)	(3)
Productivity (log)	6.490	0.107	1.796*
	(8.365)	(0.105)	(0.933)
Size (log)	47.79***	0.482***	1.869
	(13.29)	(0.119)	(1.717)
Age (log)	–19.54	0.0380	–8.940***
	(29.42)	(0.215)	(3.459)
Foreign	0.947***	0.00472	0.146***
	(0.366)	(0.00573)	(0.0157)
Import	0.851**	0.00857***	0.155***
	(0.431)	(0.00263)	(0.0503)
Sunk	250.3***	13.42***	
	(47.03)	(0.724)	
Constant	–470.2***	–5.747***	79.73***
	(169.5)	(1.925)	(14.99)
Sigma u	103.7342***		
	(22.1568)		
Sigma e	70.0134***		
	(16.3538)		
Rho	0.6870		–0.1716
	(0.1452)		(0.0779)
Lambda			–3.1655
			(1.56)
Observations	332	332	332

Note: Standard errors are in parentheses. Sector and year dummy are included but are not shown. ***, **, and * indicate significance at 1 per cent, 5 per cent, and 10 per cent levels, respectively.

Source: Author's estimations.

Appendix 5.E Least squares estimation of export intensity

	Pooled	Fixed Effects	Random Effects
	(1)	(2)	(3)
Productivity (log) (3 years earlier)	–0.360	1.577	–0.190
	(1.094)	(1.619)	(1.070)
Size (log)	8.238***	14.57***	7.749***
	(1.529)	(5.391)	(1.527)
Age (log)	–1.489	2.288	–1.322
	(3.615)	(10.41)	(3.532)
Foreign	0.164***	0.326***	0.160***
	(0.0516)	(0.116)	(0.0509)
Import	0.0653	0.143	0.0600
	(0.0548)	(0.0999)	(0.0536)
Sunk	52.53***		53.86***
	(5.759)		(5.662)
Constant	–12.19	–102.2**	–13.92
	(22.19)	(44.43)	(21.63)
Sigma u		45.9948	9.7531
Sigma e		22.2630	22.2630
Rho		.8102	0.1610
Observations	306	306	306
R-squared	0.551	0.507	

Note: Standard errors are in parentheses. Sector and year dummy are included but are not shown. ***, **, and * indicate significance at 1 per cent, 5 per cent, and 10 per cent levels, respectively.

Source: Author's estimations.

Appendix 6.A Laos' trade in textiles and garments by destinations, 2000–2015

	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Export share (%)												
Australia	0.0	0.2	0.1	0.1	0.1	0.6	0.3	0.6	0.1	0.3	0.4	0.6
Canada	1.0	3.1	2.4	3.0	1.9	2.7	3.1	2.2	3.4	3.2	3.0	2.5
China	0.0	0.1	0.1	0.1	1.1	0.3	0.3	0.3	0.4	0.4	0.3	0.4
Japan	0.4	0.8	1.0	1.1	2.1	3.6	4.2	5.6	9.7	12.3	11.6	14.3
Korea	0.0	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.2	0.3	0.2	0.2
Switzerland	0.4	0.4	0.8	1.0	0.5	0.3	0.4	0.6	1.5	1.5	1.4	1.7
United States	6.9	1.6	4.3	5.7	13.4	9.9	13.7	12.0	4.1	3.0	3.6	3.9
ASEAN	0.2	0.9	1.0	1.6	1.9	1.3	2.5	1.8	1.9	1.2	1.2	1.0
Singapore	0.1	0.1	0.0	0.0	0.1	0.0	0.1	0.0	0.1	0.1	0.1	0.0
Thailand	0.1	0.7	0.9	1.5	1.8	1.2	1.8	1.3	1.2	0.7	0.4	0.9
Vietnam	-	0.1	0.0	0.1	0.0	0.1	0.5	0.3	0.4	0.3	0.7	0.1
European Union	81.3	81.6	78.6	74.8	69.5	68.8	63.7	64.5	68.0	66.9	69.3	71.5
Austria	0.8	2.1	2.3	2.5	1.7	1.7	1.7	1.4	1.3	1.5	2.0	2.2
France	23.5	27.0	19.4	18.5	13.0	9.8	8.3	6.2	4.3	4.2	4.2	3.7
Germany	15.4	15.2	19.0	23.2	17.9	23.3	21.5	21.6	22.7	27.2	27.6	24.9
Spain	2.4	2.5	2.7	3.1	2.8	2.7	2.7	3.0	3.9	3.7	2.2	3.3
Italy	6.5	4.4	3.4	3.6	4.7	2.7	3.6	3.6	5.2	6.1	5.4	4.7
Netherlands	8.5	6.2	6.2	3.7	2.8	5.2	4.8	4.3	5.2	4.9	8.0	5.5
Sweden	0.6	0.6	0.1	0.1	0.1	0.0	0.3	0.2	0.2	0.1	1.2	3.0
United Kingdom	15.6	23.6	27.0	21.6	25.0	25.5	22.5	25.3	24.3	17.0	15.9	17.6
World (US$ million)	133.6	182.4	198.5	200.9	238.2	212.7	251.0	294.6	277.2	277.7	285.0	248.6

Import share (%)												
Australia	0.1	0.2	0.2	0.2	0.1	0.6	0.1	0.7	0.3	0.1	0.2	0.2
China	9.6	6.4	6.2	4.9	2.5	25.1	52.8	11.7	19.0	14.6	12.7	12.7
Hong Kong, China	0.7	0.5	0.5	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
India	0.2	0.2	0.1	0.3	0.0	0.1	0.4	0.0	0.1	0.2	0.5	0.3
Japan	0.1	0.2	0.2	0.5	0.4	0.6	0.6	2.2	4.2	5.9	6.3	7.8
Korea	2.2	0.9	0.4	0.4	0.1	0.2	0.1	0.7	1.0	0.6	1.2	1.1
Pakistan	0.9	-	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
United States	0.2	0.1	0.4	0.2	0.1	-	0.0	0.0	0.1	0.1	0.0	0.0
ASEAN	81.3	88.7	89.3	91.0	91.3	71.0	43.4	79.1	69.0	71.2	73.7	72.2
Indonesia	0.9	0.4	0.3	0.5	2.0	1.6	1.4	3.1	1.5	1.3	1.9	2.8
Malaysia	0.2	1.3	1.9	5.8	4.3	2.2	2.2	4.3	3.0	4.4	6.2	5.1
Thailand	47.5	71.0	72.0	69.7	73.7	57.6	34.3	61.7	55.4	54.8	53.2	51.1
Vietnam	32.6	15.9	15.0	14.9	11.0	9.6	5.5	10.0	9.1	10.6	12.3	12.6
European Union	2.4	1.0	0.7	1.2	4.2	1.2	2.2	4.7	4.6	5.5	5.3	6.2
France	0.1	0.2	0.1	0.6	3.0	0.4	0.9	0.9	0.8	1.0	0.8	0.5
Germany	0.5	0.6	0.3	0.3	0.3	0.3	0.4	0.1	0.2	0.8	0.4	0.3
Italy	0.1	0.1	0.1	0.2	0.7	0.2	0.1	1.6	2.1	1.7	0.7	0.3
Sweden	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.2
United Kingdom	0.1	0.1	0.1	0.1	0.0	0.2	0.6	1.8	1.3	1.0	1.6	2.8
World (US$ million)	64.7	103.2	100.2	108.6	121.2	133.2	269.8	133.9	136.3	137.0	138.5	121.5

Note: Textiles and garments (SITC 65+724+84). Only selected members of ASEAN and the EU are shown. "-" missing data.

Source: Author's calculations from UN Comtrade, using partner-reported data.

Appendix 6.B List of firms in the Lao textile and garment industry in 2017

	Company name	**Location**	**Investor**	**Employee**	**Production capacity** (piece/month)	**Main products**
	Garments					
G1	Alpilao International	Vientiane Capital	Italian	1,252	250,000	Polo shirts, jackets, T-shirts, sweaters, knitted items
G2	Anta Apparel	Vientiane Capital	Thai	96	100,000	Jogging suits, T-shirts, polo shirts
G3	Aishin Lao	Vientiane Capital	Japanese	351	42,000	Women's pants
G4	Be Cooperative Export	Vientiane Capital	Thai	494	90,000	Jogging suits, T-shirts, Polo shirts
G5	Creative Business	Vientiane Capital	Japanese	85	5,000	Polo shirts, bedding items, baby garments
G6	Diep Vu	Vientiane Capital	Dutch	713	200,000	Workwear
G7	Diep Vu 2	Vientiane Capital	Dutch	192	-	Workwear
G8	Daosavanh Garment	Vientiane Capital	Lao	39	50,000	T-shirts, Polo shirts, and uniforms
G9	Done Garment	Vientiane Capital	Lao	123	45,000	Jackets, jogging suits
G10	Intimate Fashion (Lao)	Vientiane Capital	Thai	211	50,000	Men's and women's underwear
G11	Nybo Asia (Lao)	Vientiane Capital	Danish	107	15,000	Pants and jackets
G12	International Garment	Vientiane Capital	Lao	120	70,000	Jogging suits, jackets
G13	Great Lao Garment	Vientiane Capital	Taiwanese	511	4,904	Shirts
G14	Hatchi Laos	Vientiane Capital	Japanese	244	20,000	Bedding items
G15	Hi-tech Laos Apparel	Vientiane Capital	Thai-Lao	600	800,000	Boxer brief, T-shirts, knitted items
G16	Hakers Lao	Vientiane Province	Taiwanese-Lao	269	52,000	-
G17	K.B. Yagi Lao	Vientiane Capital	Japanese	290	7,250	Men's suits
G18	Kianvilay Garment	Vientiane Capital	Lao	190	120,000	Jackets, T-shirts, polo shirts

G19	Kianvilay Santisouk Garment	Vientiane Capital	Lao	190	-	Police uniforms
G20	Lao Apparel	Vientiane Capital	Thai-Lao	91	-	Shirts
G21	Lanexay Toys Clothing	Vientiane Capital	Japanese	100	200,000	Toys clothes
G22	Lao Universe Garment	Vientiane Capital	Taiwanese-Lao	214	46,000	Sports wear
G23	Lao Cotton	Vientiane Capital	Lao	67	2,066	Shirts, curtains
G24	Lao Yamaki	Vientiane Capital	Japanese	348	60,000	Men's shirts
G25	Lao Apparel 2	Vientiane Capital	Thai-Lao	687	150,000	Shirts
G26	Mega-Lao	Vientiane Capital	Thai-Lao	126	99,497	Polo shirts, T-shirts
G27	Pro Corporate	Vientiane Capital	Malaysian	166	25,000	Polo shirts, T-shirts
G28	Riccardo Garment	Vientiane Capital	Pakistani	199	30,000	Trousers, shorts, school uniforms
G29	Scavi-Lao Garment	Vientiane Capital	Vietnamese	631	350,000	Underwear, brassieres
G30	Santei-Lao	Vientiane Capital	Japanese-Lao	240	30,000	Ladies' suits
G31	Santei-Lao 2	Vientiane Capital	Japanese-Lao	243	7,800	Men's pants
G32	Santic-Lao	Vientiane Capital	Japanese	470	10,000	Men's suit, jacket, pants
G33	Sirivatana International	Vientiane Capital	Thai	600	25,000	Pop-up books
G34	Sakura Garment Lao	Vientiane Capital	Japanese	210	20,000	Uniforms, shirts
G35	Trio Lao Export	Vientiane Capital	Austrian	2,097	130,000	Workwear
G36	Trimax	Vientiane Capital	Thai	687	240,000	T-shirts, Polo shirts, uniforms and jackets
G37	Tailon Lao	Vientiane Capital	Japanese	295	10,338	Uniforms, workwear
G38	V.L. Garment	Vientiane Capital	Lao	246	60,000	Jeans
G39	Venture International (Lao)	Vientiane Capital	Dutch-German-Vietnamese	909	150,000	Workwear
G40	Vanysa Garment	Vientiane Capital	Lao	85	30,000	Polo shirts
G41	Vision Manufacturing	Vientiane Capital	French	200	400,000	Shorts, jackets, trousers

G42	Eger Vision Garment	Vientiane Capital	Lao	110	30,000	Shorts, jackets, trousers
G43	Viet Thu Garment	Vientiane Capital	Vietnamese	420	50,000	Pants, shorts, shirts, track suits
G44	Lao Yamaken Apparel	Vientiane Capital	Thai-Japanese	100	20,000	Pullover, cardigan
G45	General Wear	Vientiane Capital	Thai	90	10,000	Jackets, pants
G46	Mascot International (Lao)	VITA (Vientiane Capital)	Danish	150	-	Workwear
G47	Subli Sports Clothing	Vientiane Capital	French	50	6,000	Sports wear
G48	Tominaga Garment	Vientiane Capital	Japanese	260	30,000	Shirts, uniforms
G49	V.N.L Garment	Vientiane Capital	Lao	100	20,000	Jogging suits, jackets
G50	No. 2 Garment	Vientiane Capital	Lao	50	10,000	Jackets, jogging suits, polo shirts
G51	Mondo Yagi Lao	Vientiane Capital	Japanese	75	4,200	Ladies' suits
G52	S.V.K Garment	Savannakhet	French-Thai	76	12,000	Men's shirts
G53	Fulic Lao	Savannakhet	Chinese	135	50,000	Brassieres
G54	Ando Garment	Champasack	Japanese-Lao	56	6,000	Kimono Yukata
G55	Jiem Pathana	VITA (Vientiane Capital)	Thai	-	-	Textiles
G56	Lao Comfort Garment	VITA (Vientiane Capital)	Chinese	-	-	Shirts, pants
G57	Valitha Heran Ando	Champasack SEZ	Japanese-Lao	52	-	Clothing and textiles
Supporting industries						
G58	D and D Import-Export	Vientiane Capital	Lao	22	-	Import-export company
G59	Embroidery Lao	Vientiane Capital	Thai	28	120,000	Embroidery
G60	Lee Lar Embroidery	Vientiane Capital	Lao	16	20	Embroidery
G61	A&A Embroidery	Vientiane Capital	Thai	13	-	Embroidery
G62	SPP Printing & Embroidery	Vientiane Capital	Lao	10	-	Embroidery and printing

Source: The Lao Garment Industry Association.

Appendix 6.C Laos' trade in electronics by destinations, 2000–2015

	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Export share (%)												
China	-	-	0.4	0.1	0.0	0.9	1.0	0.8	1.8	5.6	0.7	0.2
Hong Kong, China	0.7	0.0	4.4	0.6	0.2	7.3	1.1	0.3	1.0	2.6	0.7	2.2
Japan	-	-	-	0.4	0.0	-	0.3	0.0	-	4.7	1.7	1.6
South Korea	5.7	0.4	-	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ASEAN	43.0	65.1	87.8	94.3	92.9	78.2	91.9	92.7	94.3	83.2	96.0	95.5
Brunei	-	-	0.0	-	-	-	-	-	-	0.0	-	-
Indonesia	-	-	-	-	-	-	1.2	1.7	-	0.0	0.0	-
Cambodia	-	-	1.9	-	-	0.2	0.1	-	-	0.0	0.0	-
Malaysia	-	0.1	0.1	0.6	0.1	0.2	0.1	0.2	0.6	2.2	0.5	0.1
Myanmar	-	-	-	-	-	-	-	-	-	-	-	-
Philippines	-	-	-	0.0	0.0	-	0.0	0.0	0.0	-	0.1	-
Singapore	1.0	-	0.0	0.0	0.0	0.0	0.5	0.8	0.3	0.2	0.1	0.2
Thailand	42.0	31.5	55.9	73.2	76.5	60.9	81.6	77.3	81.6	69.2	92.9	94.0
Vietnam	-	33.5	29.8	20.5	16.3	16.8	8.3	12.8	11.8	11.6	2.5	1.3
EU	46.5	29.8	0.3	1.9	2.6	0.3	0.7	1.3	1.0	0.3	0.2	0.1
United States	-	0.7	0.2	0.0	0.7	11.6	3.2	-	-	-	-	0.0
World (US$ million)	0.8	6.5	7.7	13.4	18.1	17.1	23.6	17.9	22.1	30.8	166.1	319.7

Import share (%)												
China	8.6	26.7	31.8	27.3	33.2	47.6	32.5	34.7	30.2	71.6	67.5	30.5
Hong Kong, China	0.0	0.0	-	-	-	-	-	0.0	-	-	-	-
Japan	1.4	0.7	0.4	1.5	3.2	5.0	0.4	0.6	0.5	0.2	0.3	0.5
South Korea	0.9	0.6	1.3	3.3	0.8	0.9	3.3	0.9	0.3	0.1	0.1	0.6
ASEAN	64.8	56.2	58.4	57.1	45.7	36.1	59.1	59.5	66.2	25.1	28.9	66.0
Brunei	-	-	-	-	-	0.0	-	-	-	-	-	-
Indonesia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cambodia	-	-	-	-	0.1	0.0	0.2	-	0.0	0.0	-	0.0
Malaysia	0.7	1.1	1.7	1.3	0.2	0.1	0.5	0.8	0.7	0.6	0.3	0.5
Myanmar	-	-	-	-	-	-	-	-	-	-	-	-
Philippines	0.0	-	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	1.0
Singapore	3.5	0.6	0.4	1.2	0.9	1.1	1.6	1.7	0.8	0.6	0.4	1.5
Thailand	59.6	53.0	53.4	52.1	38.8	32.7	52.6	53.2	61.9	21.0	25.0	58.7
Vietnam	0.9	1.5	2.8	2.5	5.5	2.2	4.1	3.8	2.6	2.9	3.2	4.3
EU	20.6	5.7	3.6	8.0	9.8	4.4	2.3	1.7	1.1	1.3	2.0	1.2
United States	1.1	3.2	1.5	0.4	1.2	0.5	0.3	0.3	0.2	0.1	0.2	0.1
World (US$ million)	67.8	102.7	117.2	137.4	225.5	281.1	218.5	300.6	569.5	927.5	1,201.1	692.2

Note: Electronics (SITC 75+76+77). "-" missing data.

Source: Author's calculations from UN Comtrade, using partner-reported data.

Appendix 6.D Laos' trade in electronics by products, 2000–2015

	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Exports												
Electronics (US$ million)	0.8	6.5	7.7	13.4	18.1	17.1	23.6	17.9	22.1	30.8	166.1	319.7
- P&C (%)	95.1	64.7	64.8	76.8	83.1	67.3	80.8	76.3	82.5	73.7	94.1	90.6
- Final (%)	4.9	35.3	35.2	23.2	16.9	32.7	19.2	23.7	17.5	26.3	5.9	9.4
ICT products	0.4	2.4	1.6	1.6	1.9	2.7	2.7	2.2	3.3	9.7	144.6	290.0
- P&C (%)	92.1	91.9	73.3	70.0	88.7	26.0	54.4	40.5	85.3	91.8	99.7	94.0
- Final (%)	7.9	8.1	26.7	30.0	11.3	74.0	45.6	59.5	14.7	8.2	0.3	6.0
Electrical products	0.4	4.3	6.9	12.5	16.6	14.8	21.6	16.3	20.0	23.7	23.4	31.6
- P&C (%)	87.1	46.9	55.7	73.5	80.3	73.3	81.7	78.5	77.5	58.1	51.7	54.3
- Final (%)	12.9	53.1	44.3	26.5	19.7	26.7	18.3	21.5	22.5	41.9	48.3	45.7
Imports												
Electronics (US$ million)	67.8	102.7	117.2	137.4	225.5	281.1	218.5	300.6	569.5	927.5	1,201.1	692.2
- P&C (%)	32.4	49.7	53.8	37.2	51.2	39.0	47.5	54.6	47.6	29.4	62.0	64.8
- Final (%)	67.6	50.3	46.2	62.8	48.8	61.0	52.5	45.4	52.4	70.6	38.0	35.2
ICT products	35.6	54.3	60.6	58.9	105.2	157.1	125.3	181.4	411.4	730.4	1,003.4	476.7
- P&C (%)	41.6	52.3	61.6	35.0	37.0	33.4	39.6	50.8	45.4	21.6	65.9	72.0
- Final (%)	58.4	47.7	38.4	65.0	63.0	66.6	60.4	49.2	54.6	78.4	34.1	28.0
Electrical products	35.0	56.5	65.6	91.1	146.2	147.2	112.7	148.5	202.1	257.7	515.6	330.2
- P&C (%)	20.4	40.0	39.1	33.4	52.4	38.8	48.1	48.4	41.8	44.6	16.3	32.0
- Final (%)	79.6	60.0	60.9	66.6	47.6	61.2	51.9	51.6	58.2	55.4	83.7	68.0

Note: Electronics (SITC 75+76+77), ICT products (SITC 75+76+772+776), and electrical products (SITC 77–772–776). See the list of parts and components in Appendix 2.A.

Source: Author's calculations from UN Comtrade, using partner-reported data.

Appendix 6.E List of firms in the Lao electronics industry in 2017

	Company name	**Location**	**Investor**	**Estab. year**	**Registered capital** (US$)	**Employee**	**Key export markets**	**Sources of imports**
	ICT products sub-sector							
E1	Asahi-Maxima Lao	Vientiane Capital	Japanese	2003	200,000	90	Thailand 100%	Thailand 100%
E2	Celestica Lao	Savannakhet SEZ	Canadian	2015	1,000,000	594	Thailand 100%	Thailand, China, and others
E3	Cvilux Lao	Savannakhet SEZ	Taiwanese	2016	Under construction			
E4	Dai-ichi Denshi Lao	Vientiane Industrial and Trade Area (Vientiane Capital)	Japanese	2011	300,000	515	Vietnam 100%	China, Singapore, Thailand, and Vietnam
E5	Daiwa Harness Lao	Champasack SEZ	Japanese	2015	1,000,000	32	Thailand 100%	Thailand
E6	Juifang Technology Lao	Vientiane Industrial and Trade Area	Taiwanese	2016	1,100,000	60	China 100%	China 100%
E7	Kitani Electric Laos	Savannakhet SEZ	Japanese	2015	1,000,000	36	Malaysia 100%	China
E8	MMC Electronics Lao	Vientiane Industrial and Trade Area	Japanese 75%, and Thai 25%	2014	4,000,000	380		
E9	Misuzu Lao	Savannakhet SEZ	Japanese	2015	1,000,000	57	China 80%, and Japan 20%	China, Malaysia, and Vietnam

E10	Shidengen Lao	Champasack SEZ	Japanese	2015	1,000,000	80	Japan 70%, and Indonesia 30%	Japan 50%, and Thailand 50%
E11	TSB Lao	Vientiane Capital	Japanese 90%, and Thai 10%	2008	1,000,000	450	Thailand 60%, Vietnam 10%, and Others 30% (Malaysia, Japan, and Singapore)	China 80%, and others 20% (Japan and Malaysia)
E12	Tokyo Coil Engineering	Vientiane Capital			(no information)			
E13	Vientiane Automation	Vientiane Capital			(no information)			
	Electrical goods sub-sector							
E14	Jiplai Enterprise	Vientiane Capital	Taiwanese	1994	1,000,000	100	Vietnam 90%, and Laos 10%	Taiwan 90%, Thailand 5%, and Vietnam 5%
E15	PP International	Khammouane	Lao	2004	1,000,000	73	Laos 10%, and Vietnam 90%	China 70%, and Thailand 30%

Source: Author's compilations from data collected from special economic zone authorities and company profiles.