Why is Indonesia Left Behind in Global Production Networks?

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Declaration

Unless otherwise indicated this thesis is my own work

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Acknowledgment

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Abstract

International trade in electronics and automotive including their parts and components has grown rapidly in the last two decades, but Southeast Asia's largest economy, Indonesia, is lagging behind in its export and import performance. This research uses a comparative perspective in examining Indonesia's role in electronics and automotive production networks in the context of the contemporary debate on opportunities for reaping gains from economic globalization through engagement in global production networks.

This research aims to answer two questions, the first addresses the determinants of a country's participation in the global production network; the second is why Indonesia is being left behind in the global production networks. To the best of the author's knowledge, this study is the first systematic analysis to determine why Indonesia has been left behind in global production networks.

The analysis is conducted at two levels: macroeconomic and firm-level analysis. The macroeconomic analysis is based on the Jones and Kierzkowski's fragmentation theory. The unbalanced panel trade data for 98 countries for the period 1988-2007 for the electronics and automotive sectors are estimated using the least square dummy variable method. Meanwhile, the firm-level analysis is based on Robert and Tybout's model on firm heterogeneity and its implications for international trade. The random effect probit dynamic model is adopted for the estimation using Indonesia's firm level data for the electronics and automotive sectors for the period 1990 – 2007.

From the macroeconomic analysis, the service link cost variables are a more important determinant than the production cost variables in determining a country's participation. Infrastructure is the most important determinant in developing countries for both the electronics and automotive sectors, followed by labour quality and FDI openness. For developed countries, trade openness is the most important determinant in the electronics sector and trade cost the most important in the automotive sector. For both, the second most important is labour quality in the electronics sector and infrastructure in the automotive.

Indonesia is being left behind in the electronics global production network because of the poor condition of its infrastructure; the relatively more restrictive investment policies towards foreign investment, and the low education level which hampers the absorption capacity in technology which is important in the electronics sector.

With the huge domestic market in Indonesia which creates economies of scale, it is expected that the Indonesian automotive industry could participate more in the global production network than it does in its current condition. However its participation is hampered because of its investment policies, trade costs and the continuing high protection in the automotive sector. All of these factors influence the openness of trade.

From the firm-level analysis, a decision to engage in the global production networks through export activities depends on firm characteristics as well as sunk cost and a location spillovers effect. For both electronics and automotive sectors, larger and foreign owned firms with higher labour quality and located in similar locations are more likely to participate in the production networks.

It is concluded that Indonesia needs to improve its infrastructure condition, investment policies and education level to increase its participation in the global production networks.

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List of Abbreviations and Acronyms

AC	Average Cost
ACFTA	ASEAN-China Free Trade Agreement
ADB	Asian Development Bank
ADP	Automatic Data Processing
AFC	Asian Financial Crisis
AFTA	ASEAN Free Trade Area
ARI	Agriculture Resource Intensive
ASEAN	Association of South East Asian Nation
ATPM	*Agen Tunggal Pemegang Merek* - Sole agent
BEC	Board Economic Classification
BIDA	Batam Island Development Agency
BKPM	*Badan Koordinasi Penanaman Modal* - Investment Coordinating Board
BOP	Balance of Payment
BPPC	*Badan Penyangga Produksi Cengkeh* - Clove Marketing Board
BPS	*Biro Pusat Statistik* – Central Board of Statistics
BULOG	*Badan Urusan Logistik* - The Bureau of Logistics
CBU	Completely Built Up
CEM	Contract Electronics Manufacturing
CGI	Consultative Group on Indonesia
CIF	Cost Insurance Freight
CKD	Completely Knock Down
COMTRADE	Commodity Trade Statistics Database
CPI	Consumer Price Index
DPR	*Dewan Perwakilan Rakyat* - the House of Representatives
DSP	*Daftar Skala Prioritas* – Priority Investment List
EPZ	Export Processing Zone
ERP	Effective Rate of Protection
EU	European Union
FC	Fixed Cost
FDI	Foreign Direct Investment
FOB	Freight On Board
GAIKINDO	*Gabungan Industri Kendaraan Bermotor Indonesia* – Association of Indonesian

	Automotive Industries
GATT	General Agreement on Tariffs and Trade
GDP	Gross Domestic Product
GIAMM	*Gabungan Industri Alat-Alat Mobil dan Motor* - Indonesia Automotive Parts & Components Industries Association
GNI	Gross National Income
H-O	Heckscher-Ohlin
HS	Harmonized System
IC	Integrated Circuit
ICT	Information and Communications Technology
IDB	Islamic Development Bank
ILO	International Labour Organization
IMF	International Monetary Funds
ISIC	International Standard Industrial Classification
IT	Information Technology
ITA	Information Trade Agreement
ITRI	Industrial and Technology Research Institute
JAPIA	Japan Auto Parts Industries Association
JETRO	Japan External Trade Organization
KBLI	*Klasifikasi Baku Lapangan Usaha Indonesia*
KLUI	*Klasifikasi Lapangan Usaha Indonesia*
LCR	Local Content Requirement
LOI	Letter of Intent
LPI	Logistic Performance Index
LSDV	Least Square Dummy Variable
M&A	Merger and Acquisition
MC	Marginal Cost
MNC	Multi National Corporation
MRI	Mineral Resource Intensive
MSME	Micro, Small and Medium Enterprises
n.e.s	Not elsewhere specified
NAFTA	North America Free Trade Agreement
NIE	New Industrialized Economies
NSC	National Semi Conductor
NTB	Non Tariff Barriers

OEA	Original Equipment Assemblies
OECD	Organisation for Economic Co-operation and Development
OEM	Original Equipped Manufacturing
OICA	*Organisation Internationale des Constructeurs d'Automobiles* - International Organization of Motor Vehicle Manufacturers
PCB	Printed Circuit Boards
PMA	*Penanaman Modal Asing* - Foreign Investment
PMDN	*Penanaman Modal Dalam Negeri* – Domestic Investment
PPP	Purchasing Power Parity
R&D	Research and Development
REM	Replacement goods
RER	Real Exchange Rate
RERP	Real Effective Rate of Protection
RIM	Research in Motion
RTA	Regional Trade Agreements
SAR	Special Administrative Region
SEZ	Special Economic Zone
SGS	*Société Générale de Surveilance*
SI	*Statistik Industri* – Manufacturing Survey
SITC	Standard International Trade Classification
SKD	Semi-Knocked Down
SME	Small Medium Enterprise
SMT	Surface Mount Technology
SUV	Sport Utility Vehicle
TC	Total Cost
TFYR	The Former Yugoslavia Republic
TPN	Timor Putra Nasional
TRIMS	Trade Related Investment Measures
UN	United Nation
UNCTAD	United Nations Conference on Trade and Development.
VER	Voluntary Export Restriction
WDI	World Development Index
WPI	Wholesale Price Index
WTO	World Trade Organization

Note: $ is US$ unless indicated otherwise

Chapter 1: Introduction

1.1 The issues

The pattern of global manufacturing trade has changed substantially over the last two decades with a rapid increase in the parts and components trade compared to other manufactured goods. This rapid increase in the parts and components trade has happened because of technology development and innovations in telecommunication and transportation. These developments have enabled firms to fragment their production process into smaller segments in which components of production or assemblies can be relocated to different places. The trade and investment liberalization in many developing countries made it possible for other countries to relocate there. In addition, these production blocks have a tendency to cluster together in close proximity to take advantage of the agglomeration arising from a pool of workers with specialized skills, the availability of specialized inputs and services and technological spillovers.

A production network is a nexus of interconnected functions and operations through which goods and services are produced, distributed and consumed (Henderson *et al.*, 2002). A global production network takes place when an industry can fragment their production process into smaller segments, thus enabling components of production or assemblies to be relocated in several countries with a vertically integrated production process. Global production networks are also known as "international production sharing" (Ng and Yeats, 2001), "distributed manufacturing" and "dispersed manufacturing" (Cheng and Kierzkowski, 2001).

This pattern is more apparent in Asian countries' trade, with a significant increase in the share of parts and components for electronics and automotive. The electronics and automotive sector are the most dynamic, largest and fastest growing industries in the world. In fact, the electronics sector has become an engine of export growth in some Asian countries; although the development of the automotive sector in Asia has not been as rapid as electronics. Both sectors are extensively fragmented in their production processes and this fragmentation allows more countries with different levels of income and technology to participate in the production network by specializing in their niche markets.

However, Indonesia, Southeast Asia's largest economy, is lagging behind in its export performances. In the electronics sector in 2010, Indonesia's export of electronics parts and components in 2010 was the lowest compared to the other ASEAN-5 countries (Indonesia, Malaysia, Philippines, Thailand and Singapore). Indonesia's export value was only $6.4 billion while of that of the other ASEAN-5 countries were more than $20 billion. In the automotive sector, Indonesia's export of auto parts in 2010 was around $5 billion, lower than Thailand ($13.7 billion) and Singapore ($7.5 billion) but higher than the Philippines ($3.3 billion) and Malaysia ($3 billion). The low export value in these two sectors reflects Indonesia's low participation in the global production networks.

Since product fragmentation becomes important for a country, especially a developing country, the fact that Indonesia is lagging behind these other countries raises a concern that Indonesia is missing out on opportunities for reaping gains from economic globalization through engagement in global production networks. Therefore, it is necessary to examine what factors affect a county's participation in the global production networks and then compare them with the Indonesian condition.

The fragmentation theory developed by Jones and Kierzkowski (1990) stated that product fragmentation is made possible by three contributory factors. First is the development in production technology that enabled slicing the production process into different production blocks. Second is trade liberalization and third is advancement in communications and transportation that have contributed to the decline in the cost of service links. Many empirical studies have been conducted to examine the factors affecting a country's participation in the global production networks but no one has yet systematically analysed why Indonesia has been left behind in these global production networks.

In addition to the macroeconomic level analysis, with the availability of more detailed firm level data in many countries, a firm level model has been developed to examine whether firm characteristics influence a firm's decision to participate in the global production networks through export. The heterogeneous firm trade theory was developed by Bernard *et al.* (2003) and Melitz (2003). Although several studies have been conducted on Indonesia's manufacturing sector no one has conducted a study on Indonesia and the global production networks using firm level data.

This research is written with the intention to fill the gap in the empirical studies.

1.2 Main Research Questions and Expected Contributions

Two main research questions are addressed in this research. The first is what factors determine a country's participation in the global production networks? The second question is why has Indonesia been left behind in the global production networks?

The three main contributions of this research are as follows. First, to the best of the author's knowledge, this study is the first systematic analysis to determine why Indonesia has been left behind in the global production networks, especially in the electronics and automotive sectors.

The existing studies focus either on the overall Indonesian manufacturing sector, or on the global electronics and automotive sectors.

Second, this research covers both macroeconomic factors and firm characteristics to determine why Indonesia is a laggard in the global production networks. In addition, to confirming the results from the estimation models, fieldwork was conducted in Indonesia. Semi-structured interviews with firms in the electronics and automotive industries enriched the analysis with first-hand information from actual participants of the global production networks.

Third, the policy implications drawn from this research will assist the Indonesian government to set up policies supporting participation in the global production networks. Recently, Indonesia has depended heavily on resources based exports. With the high unemployment rate, the development of industries that can absorb a large number of employees is crucial. Therefore an increase participation in the global production network serves that purpose.

1.3 Scope of Study

Since there are many different definitions of a global production network, in this study, a global production network is defined as transactions of parts and components between parent firms of Multi National Corporations (MNCs) and their foreign affiliates (intra-firm transaction), and trade between an MNC parent firm and unaffiliated suppliers in these items (arm's length subcontracting transactions). It involves the physical transportation of parts and components across national borders. Therefore this definition excludes transactions between foreign affiliates with local firms in the same country, as well as domestic sub-contracting arrangements (local production networks).

The production network trade includes both trade of parts and components and final assembly. In this research, participation in the global production network is measured only by the export of parts and components. The exclusion of final assembly exports is because it is less traded internationally, especially in the automotive sector. The import of parts and components is not a good indicator of global production sharing because not all imported parts and components are used in export production and from trade data alone it is not possible to distinguish whether the imported input is used for production or consumption.

The analysis focuses on the electronics and automotive sectors, which are the most dynamic, largest and fastest growing industries in the world. Both sectors are also significantly fragmented in the production process and this allows more countries with different levels of income and technology to participate by specializing in their niche markets. The electronics sector refers to a broader definition of electronics which includes both electronics and electrical goods. For simplification, it will be referred to as the electronics sector throughout this research.

The classification of parts and components for the electronics and automotive sector follows Athukorala's (2011) classification. For the automotive sector, the list of parts and components has been modified by including other parts and components which are considered to be auto parts by the Japan Auto Parts Industries Association (JAPIA) and the Indonesian Automotive Parts and Components Industries Association (GIAMM). Additional parts and components include tyres, safety glass, automotive electronics parts, brakes, and safety airbags.

As mentioned earlier, two levels of analysis are conducted in this research. The first is the macroeconomic level analysis based on the fragmentation theory developed by Jones and Kierzkowski (1990). This analysis covers 98 countries which had more than a 0.01 percent share of world manufactured goods export in 2007. The cut-off using the share of manufactured export was chosen to avoid a selection bias problem. The macroeconomic level covers the period 1988 – 2007. The dataset was assembled from six different databases: the UN COMTRADE, the ILO Laborsta, Index of Doing Business, UNCTAD database, the World Development Indicators (WDI) and the Logistic Performance Index by The World Bank. The initial point is 1988, because it is the first year the UN COMTRADE database commenced reporting under SITC Revision 3, on which the commodity listing of parts and components in this study is based. The end point is 2007, since this was the latest year for which data for most of the variables are available, and data for 2008 – 2009 are liable to have been affected by the global financial crisis.

The firm-level analysis adopts Roberts and Tybout's (1997) dynamic model of export participation with entry cost. This analysis utilizes a rich database, namely the annual manufacturing survey of medium-and-large scale establishments (*Statistik Industri,* or SI) conducted by the Indonesian Central Board of Statistics (*Badan Pusat Statistik).* The survey covers all manufacturing establishments with 20 or more employees. This survey is also accompanied by a census which is conducted every ten years, carried out in the years ending with 6. This research covers the period 1990 – 2007 which includes the crisis period (between 1997 – 2000). Because of the concern about data quality during the crisis period, the analysis will focus on the pre- and post-crisis period, i.e. 1990 – 1996 and 2001 – 2007. However, the crisis period and whole period estimations are also conducted for comparison.

The interviews were conducted with 18 electronics and automotive firms located in the Greater Jakarta area in early 2010. The firms were not selected randomly but from the list provided by the Indonesian Association of Electronics and Electrical Goods Producers (*GB Elektronika)* and the Indonesian Automotive Parts and Components Industries Association (*GIAMM)*.

1.4 Structure and Preview

The thesis consists of 9 chapters. Chapter 2 summarizes the current understanding of global production networks which can be explained by fragmentation theory, agglomeration theory and models of firm heterogeneity. The first two theories will form the basis for the macroeconomic level analysis, and the last theory will be the basis of the firm-level analysis in the Indonesia case study. This chapter also describes in detail the coverage and level of analysis of the research, accompanied by a discussion of the measurement issues that arise with each level of analysis.

Chapter 3 discusses the development of the electronics and automotive global production networks in general, followed by the trends and mapping of each sector in Asia. The reason to focus the discussion on Asia is to have a comparison among Asian countries so as to identify Indonesia's position in the electronics and automotive global production networks.

Chapter 4 surveys Indonesia's trade and investment policies to provide a backdrop for further analysis on the reasons why Indonesia has been left behind in the global production networks. It includes historical development and policy regimes in electronics and automotive sectors. This chapter also describes Indonesia's economic development in the past three decades which has influenced the development of the Indonesian electronics and automotive sectors.

Chapter 5 develops an analytical framework to examine factors affecting a country's participation in global production networks. There are two level of analysis developed in this chapter, the first is the macroeconomic analysis based on Jones and Kierzkowski's (1990) fragmentation theory and the second one is the firm-level analysis based on Roberts and Tybout's (1997) firm heterogeneity model.

Chapter 6 provides the estimation results and analysis at the macroeconomic level of the determinants of the participation in the global production networks. The analyses were conducted on the two sectors covered in this research. In each sector, the analyses are conducted at the aggregate level (all countries and all parts and components) as well as the disaggregated level (developing and developed countries, and at the subsector level).

Chapters 7 and 8 are the case studies on Indonesia's electronics (Chapter 7) and automotive sectors (Chapter 8) as examples of Indonesia's participation in the global production networks. Each chapter begins with a discussion on production networks in Indonesia. The estimation results and analysis of the firm-level analysis are discussed in these chapters as well as the results from the fieldwork which confirm the estimation results (both macroeconomic and firm-level analyses).

Chapter 9 summarises the major findings, draws policy implications and discusses limitations and suggestions for future research.

The findings can be summarized as follows. First, from the macroeconomic analysis, the service link cost variables are a more important determinant than the production cost variables in determining a country's participation. Infrastructure condition is the most important determinant in developing countries for both the electronics and automotive sectors. For developed countries, trade openness is the most important determinant in the electronics sector and trade is the most important determinant in the automotive sector. For both, the second most important is labour quality in the electronics sector and infrastructure condition in the automotive sector.

Second, Indonesia is being left behind in the electronics global production network because of the poor condition of its infrastructure which affects trade costs; relatively more restrictive investment policies towards foreign investment; and the low education level which hampers the absorptive capacity in technology. With its huge domestic market, it is expected that the Indonesian automotive industry can participate more in the global production network than it currently does. However participation is hampered because of its investment policies, trade costs and the continuing high protection in the automotive sector.

Third, from the firm-level analysis, a decision to engage in the global production networks through export activities depends on firm characteristics as well as sunk cost and the location spillovers effect. For both the electronics and automotive sectors, larger and foreign owned firms with higher labour quality and located in similar locations are more likely to participate in the production networks.

It is concluded that Indonesia needs to improve its infrastructure condition, investment policies and education level to increase its participation in the global production networks.

Chapter 2: Global Production Networks: A Survey of Theory

2.1 Introduction

Traditional trade theory such as the Ricardian and Heckscher-Ohlin models, which are based on comparative advantage, effectively explained trade patterns until the 1980s. In these models, differences in resources and endowments, capital-labour endowments ratios, and technological capabilities among countries largely determine the pattern of production location and international trade. However, the current trade pattern in East Asia, which is dominated by the trade of parts and components, can no longer be fully explained by the traditional comparative advantage theory. The commodity composition of exports and imports has become more similar in many East Asian countries, although specialization among countries is still happening where those countries with low wages still specialize in labour intensive activities and those with high technology capacity specialize in technology intensive activities.

This chapter summarizes the current understanding of global production networks which can be explained by fragmentation theory, agglomeration theory and models of firm heterogeneity. The first part of the chapter discusses the definition and some examples of global production networks. The second part summarizes the theory on fragmentation and agglomeration. These will form the basis of the macro level analysis while the firm heterogeneity model will be the basis of the firm level analysis in the Indonesia case studies. The third part describes the coverage and level of analysis of this research, accompanied by a discussion of measurement issues that arises with each level of analysis. The final section provides the conclusion.

2.2 Global Production Network

A production network is the nexus of interconnected functions and operations through which goods and services are produced, distributed and consumed (Henderson *et al.*, 2002). A global production network takes place when an industry can fragment their production processes into smaller segments, thus enabling components of productions or assemblies to be relocated in several countries with a vertically integrated production process. Global production networks are also known as "international production sharing" (Ng and Yeats, 2001), "distributed manufacturing" and "dispersed manufacturing" (Cheng and Kierzkowski, 2001).

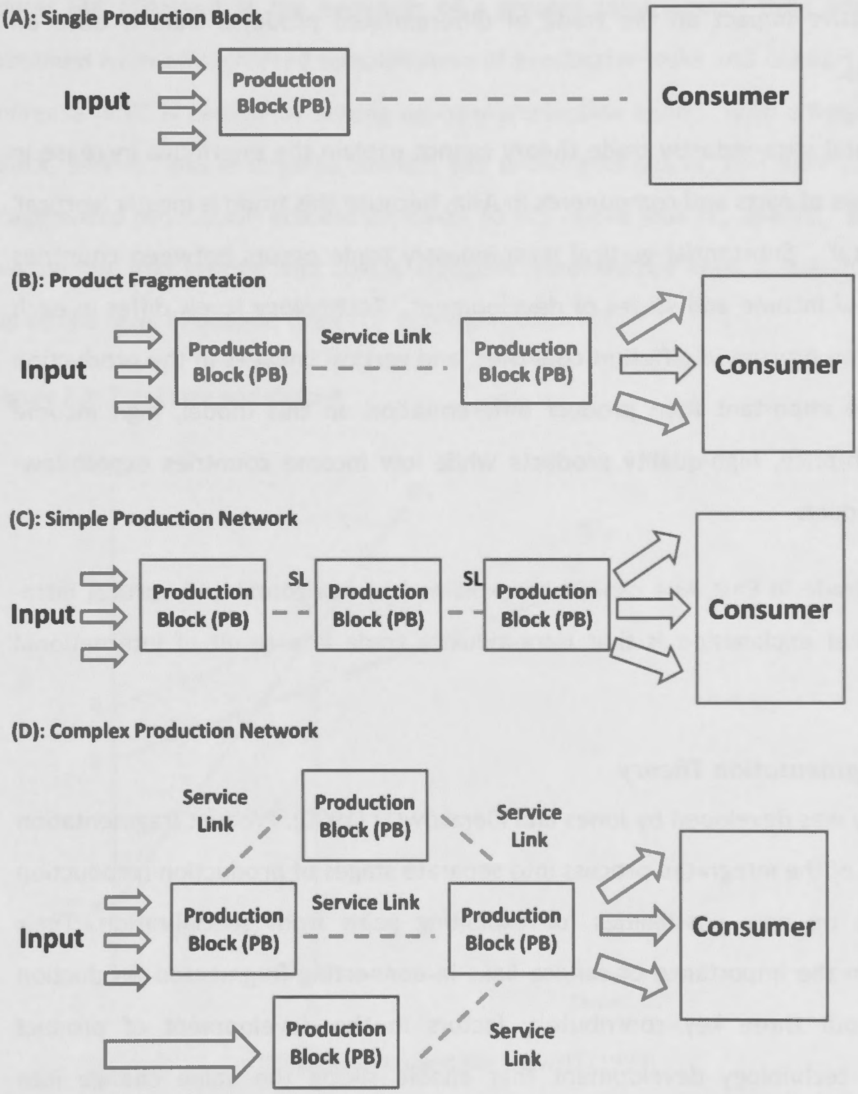
In the initial formulation, all production processes were conducted in one place as a single integrated production block as shown in Figure 2.1 (A). However technology development together with innovations in telecommunications and transportation promoted the development of a fragmented production process which consists of more than one production block as shown in Figure 2.1 (B). These production blocks are not independent, but are connected through service links such as transportation, design, quality control, insurance, R&D, telecommunications and others services. Several patterns of interdependence between production blocks and service links can be envisaged. Figure 2.1 (C) shows that an output of one production block can become an input for another production block, while in Figure 2.1 (D) a more complex relationship among production blocks exists where there is a simultaneous operation of production blocks and the output of each of these is assembled in the last production block. The degree of fragmentation can be measured by the number of stages or production blocks. As the degree of fragmentation increases, so does the importance of service links.

Production networks started in the electronics and clothing industries and then gradually spread into other industries such as sport footwear, automobiles, televisions and radio receivers, sewing machines, office equipments, power and machine tools, camera and watches and printing and publishing. One example of the global production network is Japanese car producers. Toyota, for example, has an assembly centre for cars in Thailand. This assembly centre imports parts from several countries in East Asia, assembles those parts and then exports the finished cars to Japan and other East Asian markets. Toyota also has another assembly centre for SUVs in Indonesia that follows the same pattern, where Toyota Indonesia imports parts and components from several countries and then assemblies these parts and components before exporting the SUVs to Japan and the East Asian markets.

Computer producers in the United States also procure most parts and components from affiliates and arms length firms in many countries and then assemble them and export the further processed parts and finished products to world markets. Lately, many US computer companies have spread their final-assembly centres to other countries in Asia to exploit the location advantage in East Asia.

The global production network is conducted in different ways depending on the type of the final goods. For standard consumer goods such as clothing and footwear, the global production network takes place through the arm's length relationship with international buyers acting as keys in linking producers in developing countries and sellers in developed countries. On the other hand, for more vertically integrated products such as electronics and automotive, global production networks evolve in several stages. At the beginning stage, the MNC established a subsidiary in a host country to perform a specific role that was once done at home. As the production process is established, is spreads beyond the MNC and the subsidiaries begin to subcontract some activities to local (host-country) firms providing detailed specifications and even fragmenting their own technology. Many firms that were not part of MNC networks began to procure components globally through arm's length trade. However the production of final goods was still under the supervision of MNCs for quality control purpose.

Figure 2.1: Production Network



Source: Jones and Kierzkowski (1990)

2.3 A Survey of Theory on Production Network

The first model that discusses the intra-industry trade was pioneered by Krugman (1980) and Helpman and Krugman (1985) and is based on horizontal product differentiation. In the horizontal intra-industry trade, export and import are distinguished by variety within a product group and this can well explain the trade patterns among developed countries in Europe. Kimura *et al.* (2007) characterized the main elements in the horizontal intra-industry trade as follows, first, the technology for producing differentiated goods is high tech or physical/human capital intensive so developed countries can produce such products. Second, products are usually specified as horizontally differentiated across the demand and supply side. Third, with monopolized competition, international trade liberalization generates variety effects in addition to price/quantity effects and fourth, transportation costs are typically formalized as having a larger negative impact on the trade of differentiated products than it does on homogenous products.

However the horizontal intra-industry trade theory cannot explain the enormous increase in the intra-industry trade of parts and components in Asia, because this trade is mostly 'vertical' rather than 'horizontal'. Substantial vertical intra-industry trade occurs between countries with different levels of income and stages of development. Technology levels differ in each stage of the production process in different countries, and vertical linkages in the production process appear more important than product differentiation. In this model, high income countries export high-price, high-quality products while low income countries export low-price, low-quality products.

Since intra-industry trade in East Asia cannot be explained by horizontal and vertical intra-industry trade, another explanation is that intra-industry trade is a result of international fragmentation.

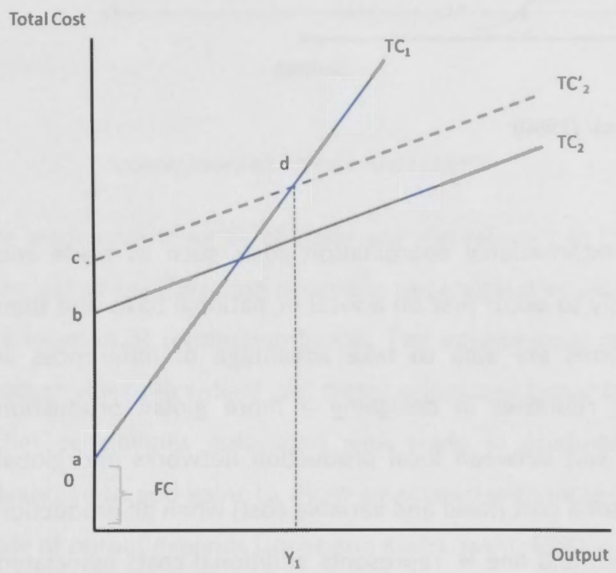
2.3.1 Product Fragmentation Theory

Fragmentation theory was developed by Jones and Kierzkowski (1990). Product fragmentation is the breaking down of the integrated process into separate stages of production (production blocks) which opens up new possibilities for exploiting gains from specialization. Their discussion focused on the importance of service links in connecting fragmented production blocks. They point out three key contributory factors in the development of product fragmentation, first, technology development that enable slicing the value change into different tasks with different factor proportions characteristics. Second, trade liberalization and third, advances in communications technology that contribute to decline in the cost of service links.

Growth of a firm's output level, increasing returns to scale and the advantages of specialization encourage a firm to switch a production process from a vertically integrated process to fragmented production blocks connected by service links. The service links include transportation, telecommunications and various other coordination tasks, which are often subject to economies of scale.

When a firm's output increases above Y_1 as shown in Figure 2.2, a firm can choose either to stay at an integrated production process, with Total Cost (TC_1) which consists of some Fixed Cost (0A) and Marginal Cost (MC), or it can switch to a fragmented production process with Total Cost of TC_2. Here, TC_2 is flatter than TC_1 because of trade-off between MC and FC, where lower MC obtained at the expenses of a greater total sum of fixed costs. A lower MC is obtained from an increased specialization of productive tasks and division of labour, while an increase in FC is caused by setting up new production blocks. With a fragmented production block, service links emerge to connect the production blocks, therefore the total cost of the fragmented production process increases to TC_2'. Note that TC_2 and TC_2' are parallel because we assume that service links cost is independent of output level. If service links cost is driven up by the level of output, then TC_2' is steeper than TC_2.

Figure 2.2: Total Cost and Output

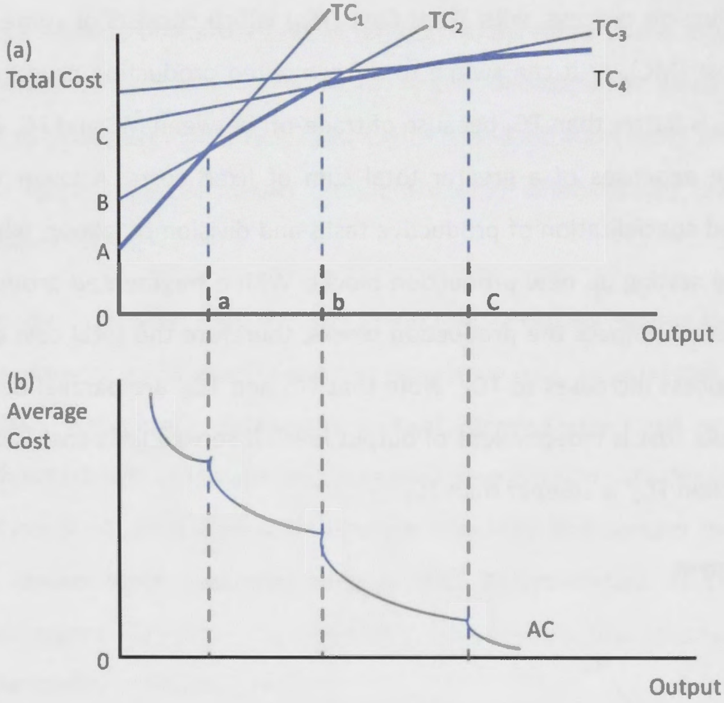


Source: Jones and Kierzkowski (1990)

The process described in Figure 2.2 can be repeated to higher orders, creating a number of production blocks and connecting service links as shown in Figure 2.3. For any degree of fragmentation the combination of fixed cost and marginal cost within the production blocks ensures that average cost declines with output. This rate of decline accelerates when the degree of fragmentation is higher.

When the production cost *per se* drastically falls and the cost of the service links connecting the production blocks becomes low enough, fragmentation will occur. Production cost relates to local economic factors such as wage rates and income. Service link costs depend heavily on the nature of technology in each industry.

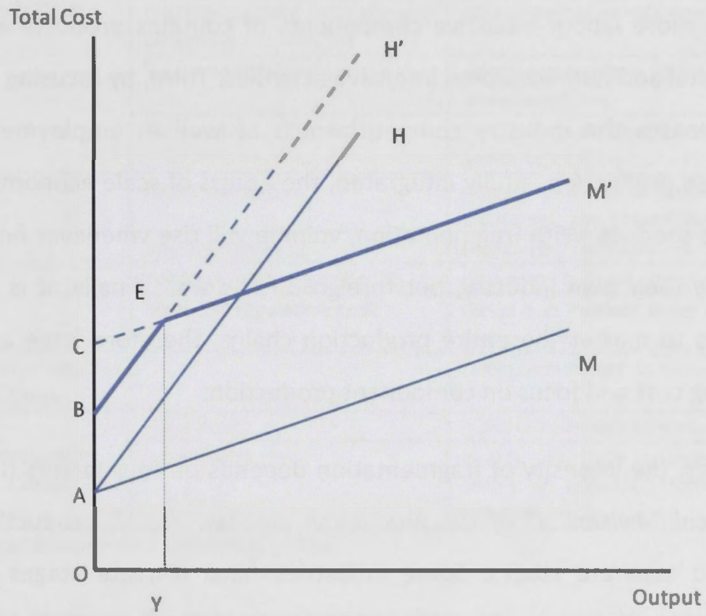
Figure 2.3: Total Cost, Average Cost and Output under Fragmentation



Source: Jones and Kierzkowski (1990)

Following the significant reduction in international coordination costs such as trade and regulatory barriers, fragmentation is likely to occur first on a local or national basis and then spread to the international market. Firms are able to take advantage of differences in technologies and factor prices among countries in designing a more global production network. Figure 2.4 shows the comparison between local production networks and global production networks. Line H represents total cost (fixed and variable cost) when all production blocks are located in one country (Home) and line H' represents additional costs associated with local service links. Suppose now that a firm can locate a production block in another country in order to take advantage of factor endowments and technologies available in that country. The home country has a lower marginal cost in the first production block and the foreign country has a lower marginal cost in the second block. The cost of fragmented production with using a different location is represented in line M (Mixed), where the first production block is located in the home country and second, the production block is located in the foreign country. Line M is flatter than line H due to lower marginal costs. However the service link costs to connect the two production blocks allocated in the two countries is higher than the domestic service link costs as shown by the higher fixed cost: AB (local production networks) is lower than AC (international/global production networks). Therefore a firm will switch to an international production network when its output level is higher than Y_2.

Figure 2.4: Total Cost and Output: Effect of Foreign Service Links



Source: Jones and Kierzkowski (1990)

The traditional theories of trade are still relevant in the product fragmentation theory. The principle of specialization according to comparative advantage is still a basis for a decision on the location of production blocks. The international market place, with its variety of factor productivities (Ricardian) and factor prices and factor intensities (Heckscher-Ohlin) provides a richer possibilities associated with trade in production blocks according to comparative advantage to add gains to those associated with increasing returns and fragmentation as the scale of output expands (Jones and Kierzkowski, 1990, p. 40).

On the analysis level, the introduction of cross-border fragmentation complicates the analysis since it increases the number of products being traded from two products in the traditional theory into six tradable items if each of the final products has two tradable parts and components. The answer as to which country will specialize on which item depends not only on the standard considerations of comparative advantage in the production blocks, but also on the relative cost and efficiency of service links between any pair of countries (Arndt and Kierzkowski, 2003).

Product fragmentation becomes important for a country, especially a developing country, for several reasons. First, fragmentation and component specialization eliminates the need to gain competency in all aspects of productions and allows emerging countries to enter into the network of global production sharing by focusing on the mastery of just one facet of the production process. Second, given the relative factor endowments, a country may begin by developing competency in the more labour-intensive components of complex products and gradually move on to more capital and human-capital intensive activities. Third, by focusing on its factor endowments, it increases the industry competitiveness as well as employment, output and wages. Fourth, when production is fully integrated, the access of scale economies is limited by volume of the end-product. With fragmentation, volume will rise whenever firms in one country supply not only their own industry, but foreign one as well. Finally, it is no longer necessary for producers to master the entire production chains, therefore large and small firms can save the learning cost and focus on component production.

Based on production technology, the intensity of fragmentation depends on four factors (Lall *et al.*, 2004). First, *the technical "divisibility" of the production process*: not all production processes can be divided into separate stages. Some industries have discrete stages of production and components with different scale, skill and technology requirements which enable the stages then to be separated and located at different locations and different ownership. Electronics and automotive manufacturing are examples of these industries. On the other hand, the chemical industry, for example, has continuous production process is not economically separable. Second, *the factor intensity of the process:* the relocation of a production process to a low-wage site is economical only if it is labour intensive and the reduced cost from labour is greater than the transportation and coordination costs. Third, *the technological complexity of each process:* it is not always economical to relocate a labour intensive process to a low-wage site unless the technology accompanying this process is simple and stable enough to be conducted by low-wage countries. Fourth, *the value-to-weight ratio of the product:* the distance of relocation depends on the value-to-weight ratio of the product. If the parts and components are light and of high value then the relocation of the process to a further location in order to exploit cost differences is still economical. If the parts and components are heavy and have low value then it is economic to relocate to proximate areas and encourage agglomeration.

Service links are essential for production networks in order to connect production blocks into one integrated production process. Following Kimura and Takahashi (2004) elements of service link costs can be categorized into four groups: trade costs, investment costs, communications costs and coordination costs.

Table 2.1: Elements of Service Link Costs

Category	Subcategory	Details
Trade Costs	transportation costs	shipment charge, freight charge
	policy barriers	tariff barriers: ad valorem tariff, specific tariff, non-tariff barriers (quotas, others)
	information costs	search costs for sellers or buyers, research costs for preference of foreign people
	costs associated with the use of different currencies	cost of exchange rate volatility, risk edge and uncertainty
	legal and regulatory costs	direct and indirect costs to deal with legal regulatory issues and procedures
	local distribution costs	cost to utilize local infrastructure, and to efficiently deliver goods to local consumers
Investment Costs	policy barriers	indirect cost due to prohibition to entry, absence of national treatment, and other FDI discriminated measures
	information costs	search cost for suppliers
	contract enforcement costs	direct and indirect costs to make sure
	legal and regulatory cost	direct and indirect costs to deal with legal regulatory issues and procedures
Communications Costs		telecommunications costs, internet fee
Coordination Costs	timeliness	indirect costs due to inadequateness of time delivery
	uncertainty	indirect cost due to uncertainty regarding coordination of a series of activities from production to shipment of end products

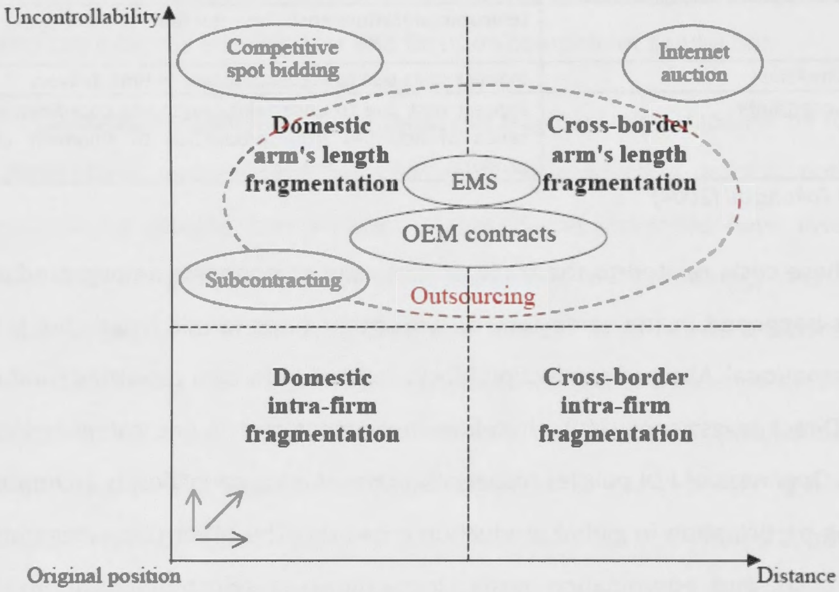
Source: Kimura and Takahashi (2004)

Trade costs are those costs related to the trade of parts and components among production blocks whether it happened in the same firm or with other firms (arm's length firm), both domestic and international. Most of production blocks located in foreign countries conducted through Foreign Direct Investment (FDI), therefore investment cost is one category in total service link costs. Openness of FDI policies, especially in developing countries, is an important factor determining participation in global production networks. The other two categories are communications costs and coordination costs. Innovations in telecommunications have significantly reduced the communications costs and encouraged the development of production networks. Timeliness as one aspect in coordination costs becomes important as a firm realizes that to hold inventories is costly. "Just-in-time" technology developed by Japanese production networks has proven effective in holding down production costs. Therefore infrastructure development is crucial prerequisite for global production network participation.

Kimura and Ando (2005) proposed a two-dimensional fragmentation concept in explaining the fragmentation phenomenon in East Asia (Figure 2.5). Fragmentation can occur in two axes, the horizontal axis represents physical distance and the vertical axis represents managerial controllability. The main difference between these two axes is on service link costs. For fragmentation along the horizontal axis, service link costs increase as production blocks are located more distance with each other while marginal cost decreases as a result of locational advantages. On the other hand, for fragmentation along the vertical axis, service link costs increase in terms of managerial controllability as fragmentation occurs with arm's length firms and marginal cost decreases owing to "de-internalization" advantages through the counterpart's ownership advantages such as better technology and managerial ability in some production process.

The production networks in East Asia have been formed with sophisticated combination of intra-firm and arm's length transaction along flexible de-internalization decision to outsource some fragmented production processes and with more developed industrial clusters (Kimura and Ando, 2005, p. 318).

Figure 2.5: Two-dimensional Fragmentation



Source: Kimura and Ando (2005)

2.3.2 Agglomeration Theory

Another important force in global production networks is industrial clustering or agglomeration. Yeung (2007) argues that there is an intricate links between the global production network and industrial clusters. The global production network is a globalized or decentralized phenomenon while an industrial cluster is a localized or concentrated constellation of different configurations of the global production network. Global production networks are constantly looking for better production locations and require good network economies. Whilst industrial clusters localize these highly globalized production activities, they need both local and non-local links to be sustained.

The classical agglomeration theory was pioneered by Marshall (1890) and it offers an explanation for the localized concentration of people and economic activities using external economies of scale. External economies of scale arise when there is a growth in the size of the industry and are available for many firms in it. Agglomeration advantages arise from three sets of localization economies, namely a pooled market for workers with specialized skills, the availability of specialized inputs and services, and technological spillovers. Ohlin (1933) and Hoover (1937, 1948) offer a variety of plausible explanations for agglomeration economies, including economies of scale and scope within the firm, the development of varied labour market and pools of specialized skills, enhanced interaction between local suppliers and customers, savings on transport costs and shared industries. Weber (1929) introduces agglomeration in location theory and acknowledges that the agglomeration will result in transportation cost savings. The later work on industrial agglomeration and clusters in classical agglomeration brought attention to the different kinds of linkages including production, service and marketing linkages that exist between industries (Myrdal 1957; Hirschman 1958). In general, the classical theory of agglomeration focuses on the external economic scale, industrial linkages and the mechanisms that give economic advantages to the individual firm located close to other similar and related firms.

New economic geography, initiated by Krugman (1991) and Fujita *et al.* (1999), reviews early agglomeration theory in its focus on spatial externalities as key drivers of the geographic concentration of industry. Krugman introduces inter-regional labour immobility into the model which implies that agglomeration becomes endogenous where manufactures production will tend to concentrate where there is a large market, but the market will be large where manufactures production is concentrated.[1] The new economic geography points out that the observed agglomeration is the result of two opposing forces, namely agglomerating (centripetal) forces and dispersion (centrifugal) forces. Agglomerating forces are basically Marshallian externalities that tend to lead to the clustering of economic activities such as labour market pooling, technological spillovers, intermediate goods supply and market size, whilst centrifugal or dispersion forces include labour immobility, increases in land rents and external diseconomies such as congestion and environmental problems that developed with increased concentration. The focus of the new economic geography is on market, technological and other externalities. The key determinants of spatial agglomeration or dispersion are transportation costs, labour (im)mobility, and the relative size of pecuniary

[1] Krugman (1991) argues that this circular causation happens when an economy is characterized by a lower transportation cost, a higher manufacturing share of stronger economies of scale and manufacturing will concentrate in region which gets head start.

externalities (market size effects). The major contribution of the new economic geography is the introduction of increasing returns to scale and monopolistic competition.

It seems that product fragmentation and agglomeration work in opposite directions. Product fragmentation relocates production blocks in different locations while agglomeration clusters several production blocks in proximate locations. However, as argued by Jones and Kierzkowski (2001) in their "horizontal aspect of vertical fragmentation", fragmentation may encourage subsequent agglomeration at the global level. Production processes across the industry have similar fragments which lead to horizontal spread and encourage technological progress. With technological progress, these fragmented products become more similar and useful in a range of industries. This process leads to another form of agglomeration where agglomeration happens not at the firm level but at the industry level. Examples of fragmented products which are used in different industries are the use of computer chips not only in computers but also in toasters, laser devices and other products.

2.3.3 Empirical Studies on Fragmentation and Agglomeration

Many studies have been conducted to analyse factors affecting product fragmentation. Deardorff (2001) explains that trade liberalization in services can stimulate a fragmentation of production of both goods and services by lowering the service link costs in order to connect production blocks, therefore product fragmentation will increase international trade and the gains from trade even further. Golub *et al.* (2007) elaborate further on the Jones and Kierzkowski's framework and argue that development of service links entails substantial fixed costs consisting of both sunk cost and maintenance cost for infrastructure. A country which invests to reduce service-links costs, or lower a cost of producing a particular fragment, will benefit from service-link costs spillover to many other possible fragments, although some services are of particular importance to particular sectors.

Besides the service link costs, exchange rates and tariffs also affect production network development. Traditionally, the appreciation of domestic currency raises imports and lowers exports. However in the production networks the relationship can reverse. The responsiveness of a country's exports to the exchange rate should decline as the share of imported components for use in the manufacture of its exports rises. Arndt and Huemer (2005) use trade data between the U.S. and Mexico to examine the effect of cross-border production sharing on the sensitivity of trade to the exchange rate and to other key variables. Their findings strongly support that conjecture showing that, while the exchange-rate effect follows traditional lines for variables in which network trade is unimportant, the relationship fades as the share of network trade rises.

Since goods move several times across international borders during the fragmentation production process, then the reduction of tariffs will affect the fragmentation. Yi (2003) developed a theoretical model to demonstrate the impact of tariff reduction on fragmentation. He shows a non-linear relation between tariff reduction and growth of trade in the last 50 years. Global reductions in tariffs lead to a magnified reduction in the cost of producing these goods since each time these goods cross a border, a tariff is incurred. In turn, the magnified cost reduction leads to a magnified increase in trade. In addition, because of tariff reductions, it may be efficient for goods that were previously produced entirely in one country to now become vertically specialized. This also leads to an increase in trade. Then, through both an internal margin and an external margin, trade in vertically specialized goods grows faster than trade in regular goods, and trade growth overall is higher than that predicted by standard trade models.

Other literature on fragmentation focuses on the impact of fragmentation on several key variables such as the factor price in general, wages, and welfare. Deardorff (1998) discusses how fragmentation affects the price of factors. Fragmentation will occur when the cost savings from producing fragmentation in countries with different factor prices are large enough to offset any additional costs or resources. Fragmentation will lead to factor price equalization when it is not obtained initially. Deardorff (2005) further explains that fragmentation may hurt particular groups and countries but it is likely to increase world income overall and will be beneficial on average. Feenstra and Hanson (2008) argue that fragmentation will increase the gap between skilled and unskilled workers in the US trade in intermediate input will shift demand away from lower skilled workers and increase demand of higher skilled workers and hence will increase the wage of higher skilled workers.

Empirical studies on East Asia region

Many studies have been conducted to examine the product fragmentation phenomena in the East Asia region. Kimura *et al.* (2007) compares product fragmentation in the European Union and East Asia. The hypothesis is that the European model is dominated by horizontal differentiated products, while the East Asian model is dominated by product fragmentation. They use an augmented gravity model which includes a common language variable, a common national border, a dummy variable for location (Europe or East Asia) in addition to income and distance. Their study supports the hypothesis on the difference between trade patterns in Europe and East Asia. Actual trade flows in East Asia are larger than predicted by the gravity model and intra-industry trade in East Asia is largely caused by the different level of income and location advantages amongst East Asian countries. A large income disparity between exporter and importer countries is closely related to the high trade flows in parts and components. Differences in location advantages and service link costs are relevant and significantly explain the trade flows in parts and components in East Asia.

Another study conducted by Athukorala and Yamashita (2006) uses more variables compared to Kimura *et al.* and uses parts and components as well as final goods trade. In addition to income, distance, language and borders, this study also includes infrastructure variables such as the number of connected phones and electricity production as a proxy for service links. They also include Regional Trade Agreements (RTA) as a factor to investigate whether the recent formation of RTAs benefits or is detrimental to the production networks. Their study shows trade in parts and components is significantly affected by the market size of the export destination, while economic disparity determines the direction of trade flows but does not significantly explain final goods trade flows. Relative wage rates only affect the trade in parts and components. They find that Ricardian comparative advantages better explain the trade patterns in East Asia compared to the Heckscher-Ohlin factor endowment model.

Using bilateral trade data in the East Asia region, Athukorala (2011) shows that the region is dominated by the growing trade in components and this makes the East Asian region more reliant on extra-regional trade for its growth dynamism. He argues that the intra-region trade data should be interpreted with caution because it could lead to the wrong conclusion if conventional trade data are used. When he focused on final trade data (total manufacturing trade without parts and components), the degree of intra-regional trade was significantly lower, which suggests extra-region trade is more important for East Asia. Therefore, he concludes that the process of product fragmentation in East Asia strengthened the global approach to trade and investment policy-making rather than the regional approach.

Kimura (2006) lists eighteen facts of international production and distribution networks in East Asia based on several studies using international trade data, microdata on Japanese multinational enterprises and casual observations. Among these facts there are two closely related to the product fragmentation. The first is that a low wage level is still an important motivation for MNCs to invest in developing East Asia, but many other elements of location advantage seem to be increasingly important in direct investment decisions (Fact 12). The second is that 'service links costs' for connecting remotely located production blocks seem to have either fallen, or at least stabilized over time, together with the explosive quantitative expansion in transactions in East Asia (Fact 14).

Empirical Studies on Industrial Cluster

There are some empirical studies that have been conducted on the relation between the global production network and industrial clusters. Yeung (2007) studies several industrial clusters in Southeast Asia and concludes that industrial clusters in selective Southeast Asian high growth regions are plugged into dynamic global production network through the cross-border activities of lead firms and their strategic partners. These industrial clusters enjoy the first-mover advantages and the major players that come to the regions bring ancillary firms with them and create larger industrial clusters.

Hayakawa *et al.*(2009) differentiate the industrial distribution in East Asia and Europe using the spatial relationship among countries within a region for the electric machinery industry using spatial econometric analysis. They conclude that in East Asia, international production and distribution networks, which exploit differences in location advantages among countries within the networks, have developed dramatically in machinery industries. As the network-forming firms have geographically diversified across East Asia, a certain scale of the production of electric machinery has come to exist in each of the countries in the region. In contrast, industrial location in Europe has come to be agglomerated in particular countries as European integration proceeds. The key difference is the range of factor proportions in the respective regions as consistent with the H-O model.

Kimura (2009) argues that both agglomeration and fragmentation are effectively utilized in East Asia. East Asia proves that the sophistication of production fragmentation can foster the development of industrial agglomerations in which active technology spillovers may occur. However, in order to participate in international production/distribution networks, a country must host the first wave of production blocks invested by MNCs. In the beginning, the operation tends to be thin in value-added and significant technological transfer or spillover may not be expected for a while if the technology absorption capacity is not well developed. He proposes a four-layer spatial structure where firms interact with each other. The first layer, local, covers transactions usually at arm's length with a gate-to-gate lead time and a delivery frequency of once or more per day. The geographical area of these transactions corresponds to industrial agglomeration in which a tight just-in-time system with frequent deliveries and monitoring is operated. The second layer, sub-regional, includes transactions with a delivery frequency of once or more per week. For intra-firm transactions, the second layer covers transactions between plants held by the same multinationals. For arm's length transactions, parts and components with a modular interface comprise a large portion. An example of the second layer is the North-South corridor between Bangkok and Singapore, is roughly 1,500 km, which involves three countries: Thailand, Malaysia and Singapore. The traffic connection between Singapore and Malaysia is known to be dense with multiple bridges and high-grade highways. In addition, the cross-border operations between Malaysia and Thailand are developing gradually, accompanied by an improvement in customs clearance at the border and the mutual acceptance of trucks without re-loading (Kimura, 2009, p. 15). A large portion of the second-layer transactions are transactions among industrial agglomerations. The third layer includes transactions with a typical delivery frequency of once per week which covers an entire East Asia region. The fourth layer includes transactions covering the entire world.

2.3.4 New Theories on Firms and International Trade

Fragmentation and agglomeration theories can explain the global production network phenomenon in the macro level by comparing the countries' participation in the network. Moreover it is also interesting to consider firms' decisions in participating in global production networks through export and/or import. Old trade theory (Ricardian and Heckscher-Ohlin theories) and new trade theory have included firms in the analysis but they do not specifically discuss an individual firm's decisions on export and import.

Old trade theory is based on comparative advantages because of differences in productivity (Ricardian model) and differences in factor intensity and factor abundance (H-O model). The models have profit maximization firms with constant returns to scale but they do not have a definitive boundary and deterministic role in determining the pattern of commodity trade. The model can explain clearly how the inter-industry trade among countries and gain from trade is due to specialization according to comparative advantage.

New trade theory, pioneered by Krugman (1979), explicitly has a firm which follows Dixit-Stiglitz monopolistic competition. However *all* firms in the economy export because each firm produces a different type of commodity and consumers with a "love of variety" preference function will reach a higher utility with more variety of products. The reason that *all firms* export is because they do not face a fixed cost in exporting. Gains from trade come from a wider set of varieties available to the consumer because of trade.

Both theories assume a representative firm which is sufficient to explain trade pattern among countries but they cannot provide sufficient explanation on why some firms in the same industry do export and some do not. This lacuna has led to the development of a heterogeneous firm trade theory. The first one is efforts to link export and import activities with firm characteristics and find that exporting firms are more efficient than non-exporting firms. However it does not explore further on the reasons for the differences.

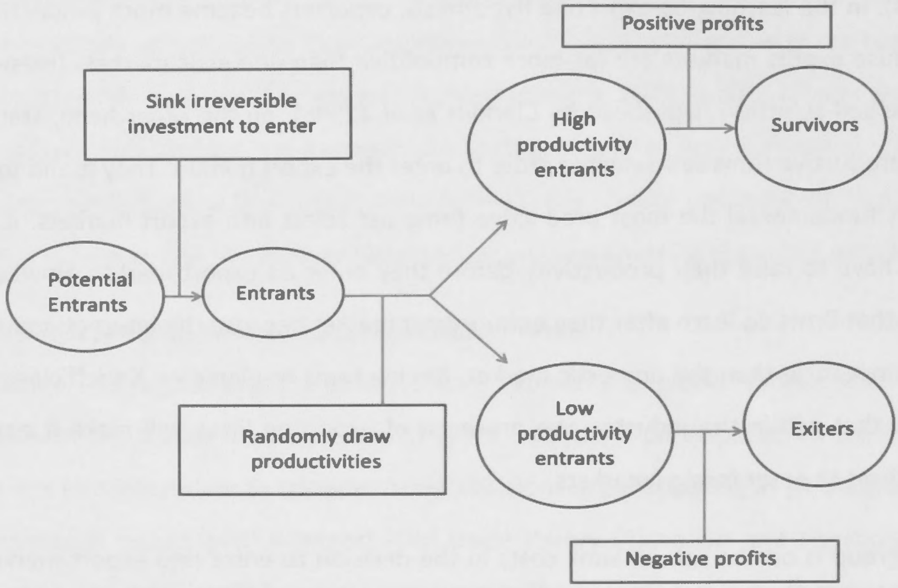
This leads to second group of studies, which concludes that exporting causes efficiency gains (learning-by-exporting hypothesis), or more productive firms become exporters (self-selection hypothesis). In the learning-by-exporting hypothesis, exporters become more productive over time, because export markets are far more competitive than domestic markets (Biesebroeck (2003). The self-selection hypothesis by Clerides *et al.* (1998), on the other hand, states that the more productive firms self-select in order to enter the export market. They found that self-selection is fundamental the most productive firms self-select into export markets. It means that firms have to raise their productivity before they enter an export market. However it is very likely that firms do learn after they enter export market because the international market is more competitive than the domestic market, forcing firms to eliminate X-inefficiency. They also found that within the industry, the presence of exporting firms will make it easier for domestic firms to enter foreign markets.

The third group is on the role of sunk costs in the decision to enter into export market. The sunk costs may include the cost of international marketing, establishing a distribution system, the cost of gathering information about the export markets, and hiring employees with specific language training. Once these costs are incurred, they cannot be recovered. Roberts and Tybout (1997) proposed a dynamic model of export participation with entry cost. The decision to export is made in a similar way to a rational firm's decision to begin producing a new product. The profit-maximizing firm makes its export decision based on the expected current and future profit from exporting and taking into account the sunk cost of exporting. A firm will be an exporter if the expected profits are positive.

In the early 2000s, there were at least two models developed to provide natural explanation of this fact. The first model, developed by Bernard *et al.* (2003), introduces firm-level heterogeneity into a Ricardian model of trade into firm-specific comparative advantages. The second model by Melitz (2003), introduces firm productivity heterogeneity into Krugman's model of trade under monopolistic competition and increasing returns. The Melitz paper is based heavily on Hopenhayn (1992b; 1992a) which explains the endogenous selection of heterogeneous firms in an industry.

The Melitz model can be summarized as Figure 2.6 from Falvey *et al.* (2004). Potentially competitive firms can enter an industry by paying a sink irreversible investment and they face uncertainty on their productivity in the industry. Once inside the industry a firm draws its productivity from a fixed distribution and the productivity remains fixed thereafter, but the firm faces a constant exogenous probability of exit. Firms produce horizontally differentiated products within the industry under monopolistic competition conditions.

Figure 2.6: Productivity Uncertainty and Firm Entry/Exit

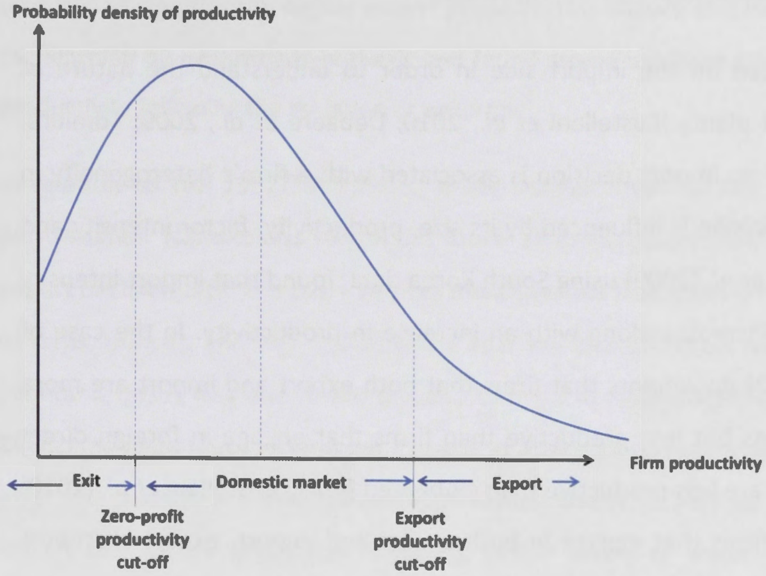


Source: Greenaway and Kneller (2007)

With the existence of a fixed cost, a firm that has a productivity level below a certain threshold (the "zero-profit productivity cutoff") would make a negative profit and choose to exit from the industry. Fixed and variable costs of exporting ensure that among the survival firms, only those firms that have productivity level above a higher threshold (the "export productivity cutoff") can export their product, while firms who have a productivity level between the "zero profit productivity cutoff" and the "export productivity cutoff" will stay in the industry but focus on the domestic market. When trade barriers decline it increases the profit for exporting firms and reduces the export productivity cutoff. Labour demand for the industry increases because of the expansion of the existing exporter and the new firms begin to export because of the lower export productivity cutoff. The increased demand for labour pushes the cost of labour up and reduces the profit of non-exporting firms and also pushes the firms that are on the margin to exit the industry. With the exit of low-productive firms from the industry, output and employment are reallocated to higher-productivity firms, and then the productivity level of the industry increases (Figure 2.7).

The firm heterogeneity theory can be applied in explaining a firm's participation in the global production networks as long as the firm is one of production blocks in the vertically integrated production process. The firm's activities may cover export, or import or both export and import.

Figure 2.7: Productivity Heterogeneity and Industry Reallocation



Source: Greenaway and Kneller (2007)

2.3.5 Empirical Studies on Firm Heterogeneity Theory

The empirical works on firm heterogeneity has been made possible by the availability of more comprehensive firm level data in several countries. The subsequent analysis of firm heterogeneity covers other firms' characteristics such as size, ownership, location, factor intensity and some unique characteristics.

Empirical studies were conducted on a firm's decision on export and import for both developed and developing countries. Studies on developed countries reveal that a firm's decision to engage in international trade is influenced by its size, productivity level, factor intensity, and agglomeration spillover and industry specific factor. Bernard *et al.* (2007) utilize a US firm trade transaction database to analyse differences between trading and non-trading US firms. They found that exporters are larger, more productive, more skill-and capital-intensive and pay higher wages compared to non-exporters. It also suggests the self-selection model where a firm needs to increase its productivity before entering an export market. Greenaway *et al.* (2008) look at another aspect of firm heterogeneity in manufacturing firms in the United Kingdom. Using the data for 1988-2002, they found that spillover associated with agglomeration can raise the probability of export market entry, and once a firm has entered the international market, it is likely to have an even greater productivity increase. Wagner (2003) argues that not only large firms can be successful in an export market; some small firms are highly successful as well. These small firms have unique characteristics such as innovation efforts and managerial attitudes which enable them to successfully penetrate international markets as described by Harvie *et al.* (2010) in their analysis of ASEAN SMEs characteristics which determine their participation in production networks.

Empirical studies are conducted on the import side in order to understand the nature of heterogeneity across different plants (Castellani *et al.*, 2010; Debaere *et al.*, 2009; Tomiura, 2007). These studies find that an import decision is associated with a firm's heterogeneity in the same way as an export decision is influenced by its size, productivity, factor intensity and industry fixed effect. Debaere *et al.* (2009) using South Korea data, found that import intensity increases as export intensity increases along with an increase in productivity. In the case of Japanese firms, Tomiura (2007) documents that firms that both export and import are more productive than domestic firms but less productive than firms that engage in foreign direct investment. Firms that import are less productive than globalized firms. Castellani *et al.* (2010) compare the productivity of firms that engage in both export and import, export or import only, and domestic sales. Firms engaged in both export and import the most productive compared to other and firms that specialize in import are more productive than firms that specialize in export. This suggests that self-selection is stronger in the decision to import than to export. Higher diversification (both in products and markets) is strongly associated with higher productivity.

In addition to studies on developed countries, there are several studies on firm heterogeneity in developing countries (Cole et al., 2008; Harvie *et al.*, 2010; Hallward-Driemeier *et al.*, 2002). Clerides *et al.* (1998), and Roberts and Tybout (1997), using Colombia data find that there are sunk entry and exit costs in the export markets. Similar to developed countries, size, productivity and location are important characteristics in determining a firm's engagement in international trade. Another firm characteristic which influences firm engagement in international trade is the ownership status of the firm. Foreign ownership raises the probability of exporting compares to domestic ownership and it also depends on the country of ownership. A study on five East Asian countries (Indonesia, Korea, Malaysia, the Philippines and Thailand) reveals that it is not simply that more-productive firms self-select into international markets; rather, firms that explicitly target export markets consistently make different decision regarding investment, training, technology and the selection of inputs and thus raise their productivity (Hallward-Driemeier *et al.*, 2002).

Owing to a rich data on Indonesia's medium-and-large scale establishment, some studies have been conducted on Indonesia's firm characteristics and export activities. Sjöholm (2003) and Sjöholm and Takii (2008) found that foreign networks through foreign owner or import have a positive effect on Indonesia's exports and he found no spillover on exports from a large regional presence of FDI. Ramstetter and Takii (2005) found similar result that foreign plants usually had significantly higher export propensities. Blalock and Gertler's (2004) result supports the learning by exporting hypothesis and found strong evidence that firms experience a jump in productivity following the initiation of exporting.

In relation to the 1997/1998 crisis, many studies focus on the impact of crises on export performance. Narjoko and Hill (2007) found an ambiguous result on the effect of firm size on export decision after the crisis refutes the argument that small firms are more flexible in times of crisis. Narjoko and Atje (2007) found that the lack of export response after the 1997/1998 economic crises was due to the inability of firms in immediately engaging in export activities. Blalock and Roy (2007) examined the export puzzle of surprising absence of export-led growth after the massive currency devaluation during the crisis period. They found that consistent with trade theory prediction following better terms of trade, entry into export markets increased dramatically; on the other hand many pre-crisis exporting firms quit exporting.

2.4 Research Coverage

Since there are many different definitions of a global production network, it is useful to define a precise one appropriate to this study. In this study, a global production network is defined as transactions of parts and components between parent firms of MNC and their foreign affiliates (intra-firm transaction), and trade between an MNC parent firm and unaffiliated suppliers in these items (arm's length subcontracting transactions). It involves physical transportation of parts and components across national borders. Therefore this definition excludes transactions between foreign affiliates with local firms in the same country, as well as domestic sub-contracting arrangements (local production networks).

As mentioned previously, production networks occur in many sectors, starting from a low technology sector such as garment and textile, and then progressing to a medium technology sector such as automotive and power machine to a high technology sector such as electronics, computer and camera.[2] This research will focus on two sectors, namely electronics and automotive, which are the most dynamic, largest and fastest growing industries. In fact, the electronics industry has become an engine of export growth in some Asian countries. Both industries are also extensively fragmented in the production process and this allows more countries with different levels of income and technology to participate in the production network by specializing in their niche markets. Although electronics sector is classified as high technology manufacture, some of the production stages are very labour intensive accompanied by relatively simple and stable technology which can be conducted by low-wage

[2] The technology classification of exports follows Lall (2000).

countries. On the other hand, the automotive sector, classified as medium technology manufacture, requires considerable local technological capabilities to be efficiently undertaken. Many components are heavy, therefore relocation in close proximity is preferable to a more distant location. This condition leads to agglomeration in the automotive industry.

There are two main research questions to be answered; the first question is on the determinants of a country's participation in global production networks. The second is why Indonesia has been left behind in global production networks.

To answer these questions, the analysis will be conducted at two levels, macro level and firm level analysis. The first is based on fragmentation and agglomeration theories to determine factors affecting a country's participation in global production networks and thereby to explore Indonesia lags behind other developing countries. The second analysis is based on firm heterogeneity theory in order to determine whether differences in firm characteristics influence its decision to participate in a global production network. The second analysis will be conducted employing Indonesia case studies of the electronics and automotive sectors.

2.4.1 Macroeconomic level analysis

Macro level analysis in this study is conducted using published parts and components trade data to represent transactions between parent firms of MNC and their foreign affiliates (intra-firm transaction) and trade between MNC parent firms with unaffiliated suppliers in these items (arm's length subcontracting transactions) across countries. There have been some efforts to define the parts and components based on the trade data available. The first attempt to identify parts and components was conducted by Yeats (2001) and Ng & Yeats (2001) who use SITC Rev.2 for commodities with labels 'parts and components'. However this approach missed many parts and components not labelled as 'parts and components' in the SITC classification. Athukorala and Yamashita (2006) use SITC Rev.3 which is a significant improvement on the SITC Rev.2 and provides separation of parts and components trade in the "miscellaneous goods" sector (SITC 8). Athukorala (2011) has improved the 2006 list. In that paper he explains in detail how to construct the database for parts and components by mapping parts and components in the UN Broad Economic Classification (BEC) Registry with the Harmonized System (HS) of trade classification at the six digit level. Information gathered from firm-level surveys conducted in Thailand and Malaysia was used to fill gaps in the list. Data compiled at the HS 6-digit level were converted to SITC using the UN HS-SITC concordance.

The analysis is conducted for two sectors. The classification of the sectors is based on Athukorala's (2011) list with some modifications. The electronics sector is classified further into three subsectors, consumer electronics, industrial electronics and electronics components. The consumer industry subsector consists of parts and components for consumer electronics. The industrial electronics subsector consists of parts and components for electronics data processing, electronics office equipments and telecommunication, ant the electronic components subsector includes other parts and components such as semiconductors. The full list of electronics parts and components is provided in Appendix 2.1.

For the automotive sector, the list has been modified by including other parts and components considered to be auto parts by the Japan Auto Parts Industries Association (JAPIA) and the Indonesian Automotive Parts and Components Industries Association (GIAMM). The additional parts and components are tyres, safety glass, automotive electronics parts and accessories. The full list of automotive is provided in Appendix 2.2.

Although trade in global production network includes trade in parts and components as well as final assembly goods; in this research, participation in global production network is measured by export value of parts and components only.

Using trade data for the analysis has several advantages. First, it differentiates trade of parts and components with trade of ordinary intermediate input (raw materials). Trade of parts and components represents the global production network while trade of raw materials is mainly driven by resource endowments and it is not part of the rapidly growing global production networks.

The second advantage of using trade data is that covers both the export and import sides of production. The import side of production can be regarded as passive participation in the global production network while the export side of production represents the active participation in global production networks. It is expected that the value of both export and import of parts and components increases significantly when a country participates in global production networks.

However there are some limitations to the trade data. First, this may suffer from measurement issues such as double counting because parts and components may travel across borders several times during the process of production and the trade data will be an effective overestimate of the "true" trade volumes. Second, for the import data, it is quite difficult to distinguish whether the imported parts and components are used in production process or as final consumer product. Therefore, this research is only focus on the export side. Also, it is not possible to know how much measurement error is introduced into the data. Third, the possibility of under-reporting because of the *entrepôt* trade treatment where products can be exported or imported without paying import duties. An example is Singapore as *entrepôt* for Indonesia.

The international trade data based on the value reported by reporting countries: for example export data based on data recorded by the exporting country. There is evidence that the value reported by exporting countries does not always match the value quoted by the partner (importing) countries. This discrepancy is not only caused by CIF (cost-insurance-freight) –FOB (free-on-board) differences, but also by other factors such as transportation cost, different goods classifications, time lags in recording and exchange rate differences (Yeats 1978, 1995). However it is generally belief that the value recorded by importing countries is more reliable than value recorded by exporting countries. Also developed country data quality is generally higher, especially the U.S.

Data used for macro level analysis cover 98 countries, with share of export of manufactured goods is higher than 0.01%, recorded in COMTRADE database for period 1988-2007. This chosen period coincides with SITC Rev.3 and the fact that the global production networks emerged in the last two decades and data for 2008 – 2009 are liable to have been affected by the global financial crisis. The list of countries is provided in Appendix 2.3.

2.4.2 Firm level analysis

Firm level analysis is conducted to determine the relation between firm characteristics and its decision to participate in the global production network, either through export or import, or both export and import. This research utilizes a rich database, namely the annual manufacturing survey of medium-and-large scale establishments (*Statistik Industri,* or SI) conducted by the Indonesian Central Board of Statistics (*Badan Pusat Statistik)*. The survey covers all manufacturing establishment with 20 or more employees. This survey is also accompanied by a census which is conducted every ten years, carried out in the years ending with 6.

SI data are considered as one of the best by developing countries standards and it has a long time series that enables panel data analysis. The data covers a wide range of information on the establishments including some basic information (ISIC classification, number of employee, ownership, location, year of starting production), production (gross output, value added, share of exported output), material costs (domestic and imported materials) and various types of expenses (wages, energy).

However, there are some limitations of the data. First, the data does not provide information on whether the establishment is a single plant or a part of a multi-plant firm. Therefore the number of enterprises can be overestimated in the case where a plant is part of a multi-plant firm is considered as a single firm. Second, it does not have information which is relevant to the firm's heterogeneity, such as information on the type of worker based on their education level or skill, and number of working hours which is important to measure labour productivity more accurately.

This research the covers period 1990 – 2007 which includes the crisis period (between 1997 – 2000). Because of the concern about data quality during the crisis period, the analysis will focus on the pre- and post-crisis periods, i.e. 1990 – 1996 and 2001 – 2007. However, the crisis and all period estimations are also conducted for comparison.

The industry classification for the survey was changed in the year 2000 from *Klasifikasi Lapangan Usaha Indonesia (KLUI)* 1990 to *Klasifikasi Baku Lapangan Usaha Indonesia (KBLI)* 2000. *KLUI* 1990 is based on ISIC rev.2 while *KLBI* 2000 is based on ISIC rev.3. Since this research covers period 1990 – 2007, both *KLUI 1990* and *KLBI 2000* are used. A concordance table between ISIC (International Standard Industrial Classification) Revision 2 and 3 is provided by BPS.

The firm-level analysis is conducted as the continuation from the macro-level analysis therefore the consistency between these two analyses is important. The macro-level analysis uses the trade data which is based on the Standard International Trade Classification (SITC), while the firm-level analysis uses the *Statistik Industri* which is based on the International Standard Industrial Classification (ISIC). For consistency between the macro-level and firm-level analyses, the concordance between SITC Revision 3 and ISIC Revision 2 provided by IEDB (International Economic Data Bank) is used for sectors covered in this research, i.e. electronics and automotive sectors. The concordance is conducted at the four-digit level. The complete list of concordances between KLUI 1990 and KBLI 2000 and between SITC Revision 3 and ISIC Revision 2 and 3 for the electronics and automotive industries is provided in Appendices 5.1 and 5.2.

2.5 Concluding Remarks

This chapter is a survey of the theory that explains the global production networks. It covers three main strains of literature: product fragmentation theory, agglomeration theory and the new theory of firms and international trade. The first two theories provide the basis for a macro level analysis which aims to determine factors affecting a country's participation in the global production networks. The last theory will be used on the firm level analysis on Indonesia case studies to determine the relationship between firm characteristics and the decision to participate in the global production networks.

Based on the fragmentation theory by Jones and Kierzkowski (1990), there are three contributory factors that enable product fragmentation. First is the development in production technology that enabled slicing of the production process into different tasks with different factor proportion characteristics; second is trade liberalization and third is the advancement in communications and transportation that have contributed to a decline in the cost of service links. However, traditional theory is still relevant in the global production networks since the principle of specialization according to comparative advantage is still a basis for a decision on the location of production blocks. The service link costs are not just communications and transportation costs but also include trade and investment costs. Openness of trade and FDI policies, especially in developing countries, is an important factor determining participation in the global production networks. Since the 'just-in-time' technology developed by the Japanese production networks has proven effective in holding down production costs, infrastructure development is obviously a crucial prerequisite for global production network participation.

The second part of the literature survey is on the theory of firm and international trade. Although both the old trade theory (Ricardian and Heckscher-Ohlin theories) and the new trade theory (Krugman) include firms in the analysis, they do not specifically discuss an individual firm's decisions on export and import. This lacuna has led to the development of heterogeneous firm trade theories such as Roberts and Tybout (1997), Bernard *et al.* (2003) and Melitz (2003). With the existence of fixed costs, which are referred to as sunk-costs, a firm that has a productivity level below the zero-profit productivity cut-off will make a negative profit and choose to exit from the industry. A firm with a productivity level between the zero-profit cut-off and the export productivity cut-off will stay in the industry but will only serve the domestic market. A firm with a productivity cut-off above the export productivity cut-off will stay in the industry and serve both the domestic and export markets. The productivity of a firm depends on characteristics such as size, age, ownership, location and factor intensity.

Two research questions are to be answered in this research. The first question is on the determinants of a country's participation in global production networks and the second is why Indonesia has been left behind.

This research covers global production networks which involves transactions between parent firms and both foreign affiliates and unaffiliated suppliers across national borders. It does not include local production networks which involves firms located in the same country. Analysis will be conducted at two levels, macroeconomic and firm level analyses. Macroeconomic analysis tries to answer the first question on the determinants of a country's participation in global production networks and thereby to explore why Indonesia lags behind other countries.

The firm level analysis examines whether differences in firm characteristics influence a firm's decision to export in the electronics and automotive sectors in Indonesia.

Macroeconomic analysis employs the trade data of 98 countries with an export share of manufactured goods higher than 0.01% for the period 1988 – 2007. Participation in global production network is measured by the real value of parts and components exports. Firm level analysis utilizes a rich data on Indonesia's small-and-medium manufactures with 20 or more employees. The period covered in the firm level analysis is 1990 – 2007 and because of the concern about data quality during the crisis period (1997 – 2000), the analysis will focus on the pre- and post-crisis periods.

Appendix

Appendix 2.1: List of Parts and Components in Electronics Sector

SITC3	ISIC2	ISIC3	Description
1. Consumer Electronics			
77111	3831	3110	Liquid dielectric transformers
77119	3831	3110	Other electrical transformers
77125	3831	3110	Other inductors
77129	3831	3110	Parts of the electric power machinery of group 771
77311	3839	3130	Winding wire
77312	3839	3130	Co-axial cable and other co-axial conductors
77313	3839	3190	Ignition wiring sets and other wiring sets of a kind used in vehicles, aircraft or ships
77314	3839	3130	Other electric conductors, for a voltage not exceeding 80 V
77315	3839	3130	Other electric conductors, for a voltage between 80 V and 1,000 V
77317	3839	3130	Other electric conductors, for a voltage exceeding 1,000 V
77318	3620	3130	Optical fibre cables
77322	3610	2610	Electrical insulators of glass
77323	3620	2691	Electrical insulators of ceramics
77324	3560	3190	Electrical insulators of materials other than glass or ceramics
77326	3620	2691	Insulating fittings for electrical machines, appliances or equipment, being fittings wholly of ceramic materials
77328	3560	2520	Insulating fittings for electrical machines, appliances or equipment, being fittings wholly of plastic materials
77329	3610	3190	Insulating fittings for electrical machines, appliances or equipment, being fittings wholly of materials other than ceramics or plastics
77423	3832	3311	X-ray tubes
77429	3832	3311	Other (including parts and accessories)
77549	3833	2930	Parts of electronics shavers and hair clippers
77579	3833	2930	Parts of electronics mechanics for domestic appliances
77589	3833	2930	Parts of the electrothermic appliances of subgroup 775.8
77812	3839	3140	Electric accumulators (storage batteries)
77817	3839	3140	Parts of primary cells and primary batteries
77819	3839	3140	Parts of electric accumulators
77821	3839	3150	Filament lamps (other than flash bulbs, infrared and ultraviolet lamps and sealed-beam lamp units)
77822	3839	3150	Discharge lamps (other than ultraviolet lamps)
77823	3839	3150	Sealed-beam lamp units
77824	3839	3150	Ultraviolet or infrared lamps; arc lamps
77829	3839	3150	Parts of electric filament, discharge of arc lamps
77831	3831	3190	Electrical ignition or starting equipment of a kind used for spark- ignition or compression-ignition internal combustion engines
77833	3831	3190	Parts of the equipment of heading 778.31
77834	3839	3190	Electrical lighting or signalling equipment , windscreen wipers, defrosters and demisters, of a kind used for cycles or motor vehicles
77835	3839	3190	Parts of the equipment of heading 778.34
77848	3823	2922	Parts of electromechanical hand tools
77861	3832	3210	Fixed capacitors designed for use in 50/60 Hz circuits

77862	3832	3210	Tantalum fixed capacitors
77863	3832	3210	Aluminium electrolytic fixed capacitors
77864	3832	3210	Ceramic dielectric fixed capacitors, single layer
77865	3832	3210	Ceramic dielectric fixed capacitors, multilayer
77866	3832	3210	Paper or plastics dielectric fixed capacitors
77867	3832	3210	Other fixed capacitors
77868	3832	3210	Variable or adjustable (pre-set) capacitors
77869	3832	3210	Parts of electrical capacitors
77871	3851	3190	Particle accelerators
77879	3839	3190	Parts of electronic machines with individual functions
77883	3832	3190	Parts of the equipment of heading 778.82
77885	3832	3190	Parts of the equipment of heading 778.84
77886	3839	3190	Carbon electrodes, carbon brushes, lamp carbons, battery carbons and other carbon articles, with or without metal, of a kind used for electrical purposes
77889	3839	3190	Electrical parts of machinery or apparatus, n.e.s.
2. Industrial Electronics			
7523	3825	3000	Digital processing units, whether or not presented with the rest of a system, which may contain in the same housing one or two of the following types of unit: storage units, input units, output units
7526	3825	3000	Input or output units for automatic data-processing machines, whether or not presented with the rest of a system and whether or not containing storage units in the same housing
7529	3825	3000	Data-processing equipment, n.e.s.
7591	3825	3000	Parts and accessories of the photocopying and thermocopying apparatus of subgroup 751.3
75991	3825	3000	Parts and accessories for typewriters, word processor machine
75993	3825	3000	Parts and accessories for office machines
75995	3825	3000	Parts and accessories for the electronic calculating machines
75997	3825	3000	Parts and accessories (other than covers, carrying cases and the like) suitable for use solely or principally with adapter machines and units
76211	3832	3230	Radio-broadcast receivers not capable of operating without an external source of power, of a kind used in motor vehicles (including apparatus capable of receiving radio-telephony or radio-telegraphy) incorporating sound-recording or reproducing apparatus
76212	3832	3230	Radio-broadcast receivers not capable of operating without an external source of power, of a kind used in motor vehicles (including apparatus capable of receiving radio-telephony or radio-telegraphy) not incorporating sound-recording or reproducing apparatus
76281	3832	3230	Other radio-broadcast receivers (including apparatus capable of receiving radio-telephony or radio-telegraphy) incorporating sound-recording or reproducing apparatus
76282	3832	3230	Other radio-broadcast receivers (including apparatus capable of receiving radio-telephony or radio-telegraphy) not incorporating sound-recording or reproducing apparatus but combined with a clock
76289	3832	3230	Other radio-broadcast receivers (including apparatus capable of receiving radio-telephony or radio-telegraphy) not incorporating sound-recording or reproducing apparatus nor with a clock
76432	3832	3220	Transmission apparatus incorporating reception apparatus
76481	3832	3230	Reception apparatus for radio-telephony or radio-telegraphy, n.e.s.

76491	3832	3220	Parts and accessories suitable for use solely or principally with the apparatus of division 76 with the apparatus of subgroup 764.1
76492	3832	3230	Parts and accessories suitable for use solely or principally with the apparatus of division 76 with the apparatus and equipment of subgroup 764.2
76493	3832	3230	Parts and accessories suitable for use solely or principally with the apparatus of division 76 with the apparatus and equipment of groups 761 and 762 and subgroups 764.3 and 764.8
76499	3832	3230	Parts and accessories suitable for use solely or principally with the apparatus of division 76 with the apparatus falling within group 763
3. Electronics Components			
7722	3831	3210	Printed circuits
77231	3831	3210	Fixed carbon resistors, composition- or film-type
77232	3831	3210	Other fixed resistors
77233	3831	3210	Wire-wound variable resistors (including rheostats and potentiometers)
77235	3831	3210	Other variable resistors (including rheostats and potentiometers)
77238	3831	3210	Parts for the electrical resistors of subgroup 772.3
77241	3831	3120	Fuses
77242	3831	3120	Automatic circuit-breakers for a voltage of less than 72.5 kV
77243	3831	3120	Other automatic circuit-breakers
77244	3831	3120	Isolating switches and make-and-break switches
77245	3831	3120	Lightning arresters, voltage limiters and surge suppressors
77249	3831	3120	Other electrical apparatus for switching or protecting electrical circuits, or for making connections to or in electrical circuits
77251	3831	3120	Fuses
77252	3831	3120	Automatic circuit-breakers
77253	3831	3120	Other apparatus for protecting electrical circuits
77254	3831	3120	Relays
77255	3831	3120	Other switches
77257	3831	3120	Lamp-holders
77258	3831	3120	Plugs and sockets
77259	3831	3120	Other electrical apparatus for switching or protecting electrical circuits, or for making connections to or in electrical circuits
77261	3831	3120	Boards, panels (including numerical control panels), consoles, desks, cabinets and other bases, equipped with two or more apparatus of subgroup 772.4 or 772.5, for electrical control or the distribution of electricity (including those incorporating instruments for a voltage not exceeding 1,000 V
77262	3831	3120	Boards, panels (including numerical control panels), consoles, desks, cabinets and other bases, equipped with two or more apparatus of subgroup 772.4 or 772.5, for electrical control or the distribution of electricity (including those incorporating instruments for a voltage exceeding 1,000 V
77281	3831	3120	Boards, panels, consoles, desks, cabinets and other bases for the goods of subgroup 772.6, not equipped with their apparatus
77282	3831	3120	Other parts
77611	3832	3210	Television picture tubes, cathode-ray (including video monitor cathode-ray tubes) for colour TV
77612	3832	3210	Television picture tubes, cathode-ray (including video monitor cathode-ray tubes)for black and white or other monochrome TV
77621	3832	3210	Television camera tubes; image converters and intensifiers; other photocathode tubes
77623	3832	3210	Other cathode-ray tubes

77625	3832	3210	Microwave tubes (excluding grid-controlled tubes)
77627	3832	3210	Other valves and tubes
77629	3832	3210	Parts of the tubes and valves of subgroups 776.1 and 776.2
77631	3832	3210	Diodes, other than photosensitive or light-emitting diodes
77632	3832	3210	Transistors (excluding photosensitive transistors) with a dissipation rate of less than one watt
77633	3832	3210	Transistors (excluding photosensitive transistors) with a dissipation rate of one watt or more
77635	3832	3210	Thyristors, diacs and triacs (excluding photosensitive devices)
77637	3832	3210	Photosensitive semiconductor devices; light-emitting diodes
77639	3832	3210	Other semiconductor devices
77641	3832	3210	Digital monolithic integrated units
77643	3832	3210	Non-digital monolithic integrated units
77645	3832	3210	Hybrid integrated circuits
77681	3832	3210	Piezoelectric crystals, mounted
77688	3832	3210	Parts for diodes, transistors and semiconductors
77689	3832	3210	Parts of the articles of subgroup 776.4

Appendix 2.2: List of Parts and Components in Automotive Sector

SITC3	ISIC2	ISIC3	Description
1.	Auto Parts		
6251	3551	2511	Tyres, pneumatic, new, of a kind used on motor cars (including station wagons and racing cars)
6252	3551	2511	Tyres, pneumatic, new, of a kind used on buses or lorries
62541	3551	2511	Tyres, pneumatic, new, of a kind used on motorcycles and bicycles of a kind used on motorcycles
62591	3551	2511	Inner tubes
66471	3620	2610	Safety glass, consisting of toughened (tempered) or laminated glass of toughened (tempered) glass
66472	3620	2610	Safety glass, consisting of toughened (tempered) or laminated glass of laminated glass
66481	3620	2610	Rear-view mirrors for vehicles
69915	3811	2899	Other mountings, fittings and similar articles suitable for motor vehicles
69941	3819	2899	Springs and leaves for springs, of iron or steel
74315	3829	2912	Compressors of a kind used in refrigerating equipment
7438	3829	2912	Parts for the pumps, compressors, fans and hoods of subgroups 743.1 and 743.4
7481	3829	2913	Transmission shafts (including camshafts and crankshafts) and cranks
74821	3829	2913	Bearing housings, incorporating ball- or roller bearings
74822	3829	2913	Bearing housings, not incorporating ball- or roller bearings; plain shaft bearings
7485	3829	2913	Flywheels and pulleys (including pulley blocks)
7486	3829	2913	Clutches and shaft couplings (including universal joints)
7489	3829	2913	Parts, n.e.s., for the articles of group 748
74443	3829	2915	Other jacks and hoists, hydraulic
74363	3829	2919	Oil or petrol filters for internal combustion engines
74364	3829	2919	Intake air filters for internal combustion engines
74999	3829	2919	Other machinery parts, not containing electrical connectors, insulators, coils, contacts or other electrical features
71651	3831	3110	Electric generating sets with compression-ignition internal combustion piston engines (diesel or semi-diesel engines)
7169	3831	3110	Parts, n.e.s., suitable for use solely or principally with the machines falling within group 716
77812	3839	3140	Electric accumulators (storage batteries)
77821	3839	3150	Filament lamps (other than flash bulbs, infrared and ultraviolet lamps and sealed-beam lamp units)
77823	3839	3150	Sealed-beam lamp units
77833	3831	3190	Parts of the equipment of heading 778.31
77834	3839	3190	Electrical lighting or signalling equipment (excluding articles of subgroup 778.2), windscreen wipers, defrosters and demisters, of a kind used for cycles or motor vehicles
77835	3839	3190	Parts of the equipment of heading 778.34
77313	3839	3190	Ignition wiring sets and other wiring sets of a kind used in vehicles, aircraft or ships
76211	3832	3230	Radio-broadcast receivers not capable of operating without an external source of power, of a kind used in motor vehicles (including apparatus capable of receiving radio-telephony or radio-telegraphy) incorporating sound-recording or reproducing apparatus
76212	3832	3230	Radio-broadcast receivers not capable of operating without an external source of power, of a kind used in motor vehicles (including apparatus capable of receiving radio-telephony or radio-telegraphy) not incorporating sound-recording or reproducing apparatus
76422	3832	3230	Loudspeakers, mounted in their enclosures
76423	3832	3230	Loudspeakers, not mounted in their enclosures

76425	3832	3230	Audio-frequency electric amplifiers
88571	3853	3330	Instrument panel clocks and clocks of a similar type, for vehicles, aircraft, spacecraft or vessels
71391	3829	3430	Parts, n.e.s, for the internal combustion piston engines of subgroups 713.2, 713.3 and 713.8, suitable for use solely or principally with spark-ignition internal combustion piston engines
71392	3829	3430	Parts, n.e.s, for the internal combustion piston engines of subgroups 713.2, 713.3 and 713.8, suitable for use solely or principally with compression-ignition internal combustion piston engines
78431	3843	3430	Bumpers, and parts thereof
78432	3843	3430	Other parts and accessories of bodies (including cabs)
78433	3843	3430	Brakes and servo-brakes and parts thereof
78434	3843	3430	Gearboxes
78435	3843	3430	Drive-axles with differential, whether or not provided with other transmission components
78436	3843	3430	Non-driving axles, and parts thereof
78439	3843	3430	Other parts and accessories
78535	3844	3591	Parts and accessories of motorcycles (including mopeds)
78531	3844	3592	Invalid carriages, whether or not motorized or otherwise mechanically propelled
78536	3844	3592	Parts and accessories of invalid carriages
78537	3844	3592	Parts and accessories of other vehicles of group 785
82112	3320	3610	Seats of a kind used for motor vehicles
62593	3551	9999	Used pneumatic tyre
2. Assembly			
7841	3843	3410	Chassis fitted with engines, for the motor vehicles of groups 722, 781, 782 and 783
71321	3843	3410	Reciprocating piston engines of a cylinder capacity not exceeding 1,000 cc
71322	3843	3410	Reciprocating piston engines of a cylinder capacity exceeding 1,000 cc
71323	3843	3410	Compression-ignition engines (diesel or semi-diesel engines)
3. Car Body Maker			
78421	3843	3420	Bodies (including cabs), for the motor vehicles of groups 781,
78425	3843	3420	Bodies (including cabs), for the motor vehicles of groups 722, 782 and 783

Appendix 2.3: List of Country

1	Argentina	34	Guatemala	67	Philippines
2	Australia	35	Honduras	68	Poland
3	Austria	36	Hungary	69	Portugal
4	Bahamas	37	India	70	Qatar
5	Bahrain	38	Indonesia	71	Rep. of Korea
6	Bangladesh	39	Iran	72	Rep. of Moldova
7	Belarus	40	Ireland	73	Romania
8	Belgium	41	Israel	74	Russian Federation
9	Bosnia Herzegovina	42	Italy	75	Saudi Arabia
10	Botswana	43	Japan	76	Singapore
11	Brazil	44	Jordan	77	Slovakia
12	Bulgaria	45	Kazakhstan	78	Slovenia
13	Cambodia	46	Kenya	79	South Africa
14	Canada	47	Kuwait	80	Spain
15	Chile	48	Latvia	81	Sri Lanka
16	China	49	Lebanon	82	Sweden
17	China, Hong Kong SAR	50	Libya	83	Switzerland
18	China, Macao SAR	51	Lithuania	84	Syria
19	Colombia	52	Luxembourg	85	TFYR of Macedonia
20	Costa Rica	53	Malaysia	86	Thailand
21	Croatia	54	Malta	87	Trinidad and Tobago
22	Cyprus	55	Mauritius	88	Tunisia
23	Czech Rep.	56	Mexico	89	Turkey
24	Denmark	57	Morocco	90	Ukraine
25	Dominican Rep.	58	Netherlands	91	United Arab Emirates
26	Ecuador	59	New Caledonia	92	United Kingdom
27	Egypt	60	New Zealand	93	Uruguay
28	El Salvador	61	Nicaragua	94	USA
29	Estonia	62	Norway	95	Uzbekistan
30	Finland	63	Oman	96	Venezuela
31	France	64	Pakistan	97	Viet Nam
32	Germany	65	Panama	98	Yugoslavia
33	Greece	66	Peru		

Chapter 3: Trends in Global Production Networks

3.1 Introduction

Over the last two decades, trade in parts and components has increased faster than that of manufactured goods. This rapid growth was made possible by technology development and innovations in telecommunications and transportation. These developments enable firms to fragment their production process into smaller segments in which components of production or assemblies can be relocated to different places. Trade and investment liberalization in many developing countries made relocation to other countries possible. This creates global production networks. In addition, these production blocks have a tendency to be concentrated in close proximity to take advantage of a pool of workers with specialized skills, availability of specialized inputs and services and technological spillovers.

This pattern is more apparent in the trade among Asian countries, with a shift from domination by Japan in the early 1980s to several new industrialized countries in Asia (China, Korea, Singapore, Taiwan and Hong Kong). The rapid increase in the parts and components trade happened because these parts and components move back and forward several times across international boundaries during the production process. This condition reflects the rise in the global production networks.

The electronics and automotive industries are the two industries which are the most dynamic, largest and fastest growing industries in the world. In fact, the electronics industry has become an engine of export growth in some Asian countries. However the development of the automotive industry in Asia has not been as rapid as the electronics industry. Both industries are well fragmented in their production processes and this fragmentation allows more countries with different levels of income and technology to participate in the production network by specializing in their niche markets.

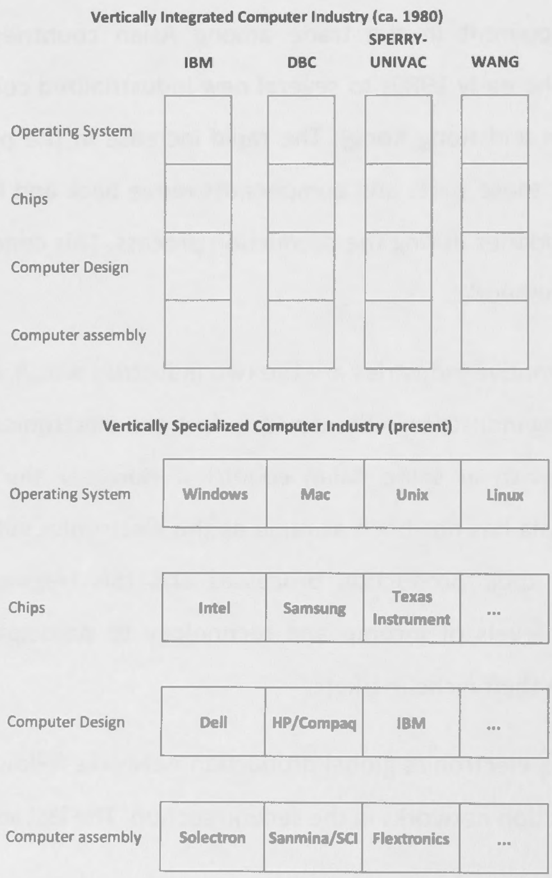
The first section discusses electronics global production networks followed by a discussion on automotive global production networks in the second section. The last section concludes.

3.2 Electronics Global Production Network

The electronics industry is one of the largest and fastest growing industries and it leads the global production networks in developing countries. The development of the electronics industry in Asia was triggered by the product fragmentation implemented by the US and Japanese firms as a response to the change in technology and the competitive environment. Following arguments put by Lall *et al.* (2004), the electronics industry has some characteristics which accelerate its production network development.

First, the electronics industry has discrete production processes with different scale, skill and technology requirements.[3] This type of production process is known as a modular production network (Sturgeon, 2002). Prior to 1980s, most of the electronics products were produced in a vertically integrated system where large firms produced most of the parts and components within their company boundaries and sometimes within one country. This condition restricted the firms' ability to expand their size when the technology changed since they would have to design and produce new parts and components for the new technology while still producing the old one. With the modular production system, firms can fragment the production process and relocate some of the production process to other locations and/or to different ownership. It transforms the electronics industry from a vertically integrated one to a vertically specialized industry, as illustrated in Figure 3.1 for the computer industry (Gangnes and Assche, 2004).

Figure 3.1: Vertically Integrated and Vertically Specialized Industry



Source: Gangnes and Assche (2004)

Second, some of the production stages in the electronics industry are very labour intensive. Therefore many Japanese and the US electronics firms decided to relocate their production

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[3] Electronics sector is defined as products under SITC 75, 76 and 77. A detailed classification is provided in Appendix 2.1.

stages to low-labour- cost countries such as those in Asia. However, relocation to a distant location requires greater transportation and coordination costs; therefore the saving from labour costs should be greater than the additional transportation and coordination costs. Another attraction of Asian countries is their large and growing pool of highly skilled engineers. Third, some of the labour intensive processes in the electronics industry are accompanied by a relatively simple and stable technology and this can be done in low-wage countries which usually have low technology and skills. The electronics industry production process covers a range of technology and skill levels, and this enables a country to upgrade its electronics industry from labour intensive to technology intensive products. Finally, the electronics industry has a relatively small, and light, parts and components therefore the value-to-weight ratio of the product is relatively high and it is still economical to relocate to a distant location which has a low-labour cost advantage.

East Asia is a favourable choice for the US and Japanese firms because of several factors. The first factor is the Asian experience of having produced the consumer electronics industry during the late 1960s. This experience equipped Asian countries with some basic technological capacities. In addition, Asian countries provide abundant low cost labour which is relatively skilled. Asia also provides a large market which made it easier for firms to reach economies of scale. Compared to other developing countries, Asian countries have relatively stable political and conducive economic conditions with a more open and friendly environment for foreign investment, along with export oriented policies and low tariff barriers. These factors are supported by global development in transportation and communications such as cheaper and more reliable shipping and air freight, as well as a lower and more sophisticated internet and international phone connection. This situation lowers the service cost which is crucial to the development of production networks.

In empirical works, one measure of the intensity of production networks is trade flows of parts and components between countries. Adopting Athukorala (2011) electronics parts and components sector is classified further into three subsectors namely consumer electronics, industrial electronics and electronics components. The analysis will be conducted at aggregate level (total parts and components for the electronics industry) over four regions, i.e. East Asia, North America, Europe and other region. The East Asia region comprises of Japan, China, NIEs (Hong Kong, Taiwan, South Korea and Singapore) and ASEAN 4 (Indonesia, Malaysia, the Philippines, and Thailand). The North America region consists of the US, Canada and Mexico, while European region is represented by 15 countries (EU-15): Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, and United Kingdom.

3.2.1 Development of the Electronics Industry in Asia

The electronics production network in Asia is critical for the development of the Japanese and US electronics industry. The development of the Asian electronics industry occurred in stages. During the early stage, the US electronics companies relocated their production to Japan to take advantage of low labour costs and relatively skilled labour. In the 1970s and 1980s, with the rise in wage costs, shortage of labour and the appreciation of the Japanese yen, Japanese electronics firms had to relocate their production process to other Asian countries with lower wages such as Taiwan, South Korea, Singapore and Hong Kong, which are known as Asian NIEs. US and European firms followed as a part of their global strategy to remain competitive (Austria, 2008). With the increase of labour cost in these countries in the 1990s, electronics firms expanded their networks to other Asian countries such as Malaysia, Thailand, Indonesia, the Philippines and later to Vietnam and China.

Henderson (1989) was the first author who showed an international division of labour in electronics, especially on the semiconductor industry. At the top of the hierarchy, MNCs from the US, Japan and Europe use highly automated production systems and carry out the core R&D for next-generation products. Following these developed countries, the NIEs utilize a highly automated production technology but with less research and development (R&D) input, focusing generally on simple products and components. Beneath them, come the second-tier of NIEs, such as Malaysia and Thailand, and then the emerging countries such as the Philippines, Indonesia, China and Vietnam which conduct most labour-intensive production (Hobday, 2001, p. 16).

NIEs and ASEAN countries took different paths to develop their production networks. In South Korea, the government had extensive direct involvement in the general affairs of the *chaebol* (major conglomerates) during the 1960s and 1970s that gave way to firm-led 'corporate governance' during the 1980s and 1990s as the *chaebol* grew in stature and capability (Hobday, 2001, p. 20). However, there is little evidence that government intervention in the form of a technology support program or initiatives contributed to the export success of the *chaebol.* The *chaebol* have been capable of developing sufficient industrial strength and market knowledge to make and execute strategic decisions independently of government. At the general economic level, the government has provided macroeconomic stability for much of the period since the 1960s as well as incentives for export-led development. Moreover, Korea's geographic proximity and colonial and industrial links to Japan, made Japan a role model for Korean companies and policy makers. Another key success of Korean industrialization is the policies on trade, human resource development and technology (Kim, 2005).

In Taiwan, development of the electronics industry was dominated by the informal sector as well as its close connection with MNCs. Taiwan took advantage of overseas Chinese entrepreneurs, and had less government intervention.[4] Small and medium sized enterprises (SME) dominate almost 98 percent of the Taiwanese economy with their efficiency in assets utilization, strong innovation capacity and increased research and development (R&D) expenditures. For semiconductors, the main technology institute, the Industrial and Technology Research Institute (ITRI), has succeeded in spinning off highly successful exporting firms. However some former SMEs have grown large enough to produce semiconductors by themselves, or in partnership with foreign companies, and not requiring assistance from the government. Therefore, Taiwan's success is mainly firm-led and driven initially by traders and SMEs and by some of the large family groups which diversified into new export areas. The government supported firms with a sound educational system, macroeconomic stability and policies to support export growth. Currently, Taiwan's companies have been successful in expanding their companies abroad by making major investments mainly in the US, Malaysia and China. Two Taiwanese leading electronics companies are Inventec and Acer.

Singapore took a different pathway and became a flexible and effective location for CEM (Contract Electronics Manufacturing), the new shape of the division of labour in the electronics industry. Previously, outsourcing took place in the form of OEM (Original Equipment Manufacturing), where local companies produce products with exact specifications from the buyer (usually large international companies). Then the products are marketed through the buyer's own distributional channel under their own brand name. OEM helps newcomers with technological transfer and to attain economies of scale. The buyers also provide advice on capital equipment, training for management, engineers and technicians. Meanwhile, CEM firms are usually large-scale firms, with highly automated manufacturing production systems and responsible for process innovation, leaving product design and marketing to MNCs. With a highly automated manufacturing process, CEM requires a very large capital investment and skilled engineers, as well as control over a supply chain of specialist materials and equipment suppliers. Singapore, with its special geographic location became an effective location for CEM, especially for new products and prototype designs. Singapore has the role as a hub for the dynamic South East Asian region. The Singapore-Johor-Riau Growth Triangle serves to facilitate integration of high-end activities in high-cost Singapore with low-end activities in low-cost Johor and Riau (Vind and Fold, 2007).

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[4] Informal sector is defined as self-exploited employees, home-working female labour, casual labour, illegal foreign labour and imported subcontracting labour (Chou and Kirkby, 1998).

Governments in ASEAN countries such as Malaysia and Thailand support the development of the electronics production networks by providing infrastructure and incentives, including tax-free holidays and the establishment of free trade zones. These policies do encourage foreign investment, but the free trade zones led the electronics industries to disconnect from the local economy, with a little backward linkage to domestic firms. Most foreign investments in Malaysia and Thailand are from the US, Japan and Taiwan.

The electronics industry became Malaysia's leading manufacturing employment and export generator by 1980. This industry emerged following the relocation of MNCs that subsequently began to dominate electronics manufacturing in Malaysia from 1972 as semiconductor assembly expanded to this country with National Semiconductor as the first. With a small domestic market, it is difficult for the import substituting industry to create employment therefore from 1972 export-oriented industry became a primary driver of manufacturing industry in Malaysia (Rasiah, 2010). Before the free-trade zones were opened in 1981, the earlier export-oriented initiatives following the Investment Act of 1968 and the launching of the New Economic Policy in 1971 did not successfully attract foreign investment. Penang Island became a manufacturing hub specializing in electronics and electrical machinery. Penang acquired manufacturing capabilities because of a concentration of MNCs in the electronics industry operating in the city's industrial parks. The pull factors of Penang are that the quality of the workforce is at least on a par with that of neighbouring counties, incentives and overhead costs are competitive, local suppliers of components and support services are experienced and reliable, and the logistic arrangements are efficient (Yusuf and Nabeshima, 2009). As the focus of the Malaysian government shifted towards local heavy industries, foreign investment in the electronics sector declined during the period 1979 – 1985 and resulted in a slowdown of employment growth in electronics manufacturing. This slowdown urged the government to take counter-cyclical measures including reviving generous incentives for export-oriented firms, depreciation of the ringgit and further liberalization of ownership in export-oriented manufacturing. With relocation from Japan, Taiwan, South Korea and Singapore in 1985, foreign ownership in these industries increased again in the period 1985 – 1990. However, from 1993, foreign investment fell gradually and local firms focusing on contract manufacturing and consumer electronics using labour largely from Bangladesh and Indonesia have begun substituting production in the electronics industry. Owing to serious labour shortages in Malaysia and the emergence of more attractive manufacturing sites for labour-intensive operations in China, Vietnam and Philippines, foreign investment continued to decline.

The next stage occurred in China and the Philippines in order to take advantage of low labour cost. The Philippines and China showed a remarkable growth which is far above the world's annual growth rate, while other countries showed a slower growth rate and Indonesia had a negative growth rate of imports which was mainly caused by the financial crisis in 1997, followed by political instability afterwards. The Philippines has benefited from FDI from the US, Japan and Taiwan. Firms in the Philippines began with integrated circuit packaging and assembly of consumer goods. The development of the new high-technology manufacturing zone in Subic Bay with support from the Taiwanese government in providing infrastructure is one major factor in the fast development of the Philippines electronics industries.

China on the other hand, put in place a constrained open door policy for foreign direct investment. Companies benefited from the low-cost technical workforce provided by the universities and many public sector technology institutes. China started with unskilled labour-intensive sectors but quickly began to developed ambitious plans to upgrade its industry to skilled-labour intensive sectors and even technology intensive sectors. Chinese firms began with sub-contracting for medium-sized firms from Hong Kong and gradually became part of the overseas Chinese network, based on family and clan linkages in many countries.

Since 2000, Indonesia and Vietnam began to engage in the production networks. Vietnam's low cost labour is a factor that attracts foreign investment. However Vietnam suffers from too many taxes, cumbersome procedures and standards policies, and poor human resources and under developed local management skills. Rapid growth in the electronics sectors was driven by the telecommunications sectors and computer parts, and then mainly through MNC subsidiaries.

The electronics sector in Indonesia began in the 1970s with only a simple assembly process. Government's policies aimed to develop the sector have not been successful, and have resulted in an industrial development biased towards the production of consumer electronics to serve the domestic market. The close down of two semiconductors firms in the late 1980s and another in early 2000 created a pessimistic perspective of the Indonesian electronics sector. In addition to slow and costly bureaucratic procedures, and an unfriendly business environment, the condition of the Indonesian labour market hampered the development of this sector. Indonesia has a low absorptive capacity to be able to fully comprehend and master technology transfer from foreign direct investment. More detailed discussion policies towards Indonesia's electronics industry will be discussed in Chapter 4 and its development will be discussed in Chapter 7.

3.2.2 *Trends and Mapping of the Electronics Sector*

As explained in the previous chapter, a country's participation in the global production networks is measured by its parts and components export. World trade in parts and components increased substantially from the period 1988 to 2007, from around $153 billion in 1988 to more than $1.5 trillion in 2006, and dropped to $1.1 trillion in 2007. There was a significant drop in 2001 because of the dotcom crisis which drove a drop in the international electronics market (see Appendix 3.1). As depicted in Table 3.1 the annual growth of parts and components trade is much higher than that of the production. This reflects the higher intensity of the electronics production networks in the world, as parts and components move back and forward across borders during the production process.

Table 3.1: Value and Annual Growth of Production and Trade of Electronics Parts and Components

Year	Value ($ million)		Annual Growth (%)	
	Production	Trade	Production	Trade
1990	173,967	276,043		
1995	279,345	620,885	9.93	17.60
2000	409,443	1,052,213	7.95	11.13
2005	388,651	1,371,743	-1.04	5.45

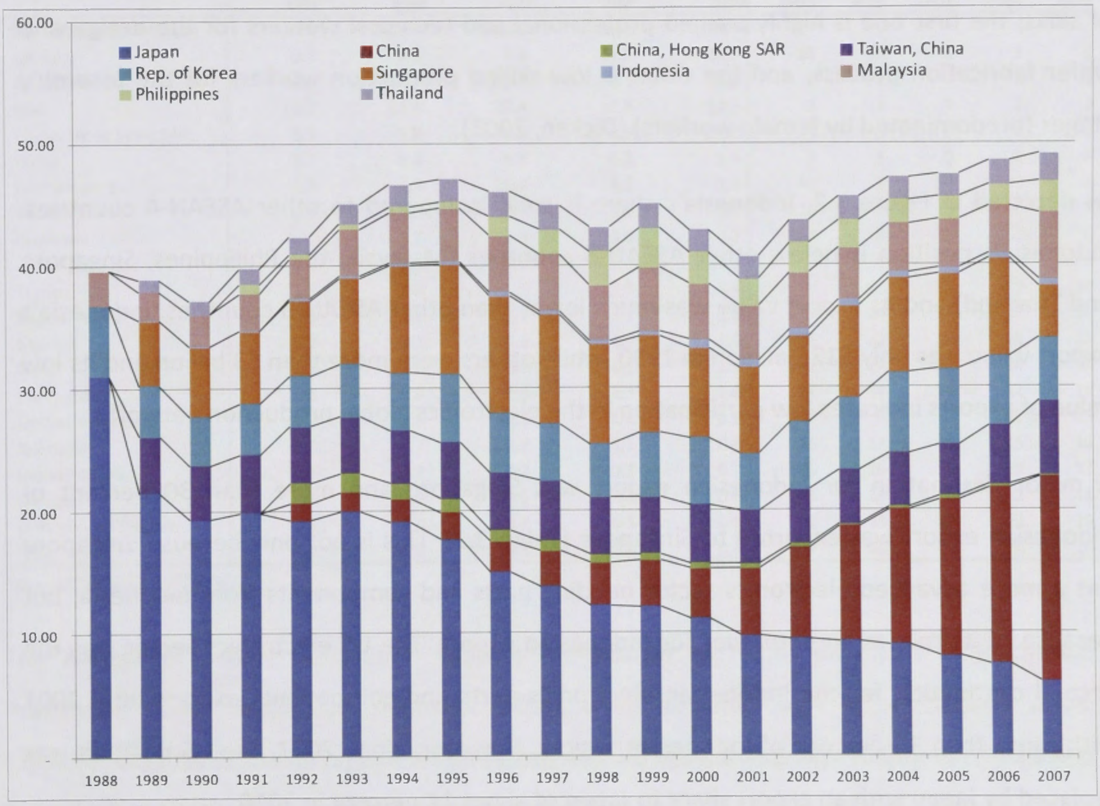
Source: Production data from Yearbook of World Electronics Data
Trade data from UN-COMTRADE

Although the latest data available are for 2010, this research only covers until 2007 because data for 2008 – 2009 are liable to have been affected by the global financial crisis. There is a change in the trends in the trade of electronics parts and components. The domination of Japan, North America and EU-15 declined over time as the share of East Asian countries increased significantly. According to Austria (2008), three factors could explain the declining role of US trade. First, most American electronics MNCs have established their subsidiaries in East Asian countries and making this region as their production base and export platform. Thus, instead of exporting the parts and components to the US and then re-exporting to other countries, the MNCs now export directly from the region to their markets. Second, the intra-Asia trade increased over time as second-tier suppliers in the East Asian countries were sourcing their parts and components from the NIEs (first-tier suppliers). Third, Mexico and China have become significant trading partners of the US and China could have displaced the ASEAN role in the US markets.

Figure 3.2 presents the share of East Asian countries' export of parts and components to world export. Among the East Asian countries (China, NIEs and ASEAN-4), the share of NIEs and China increased remarkably. Amighini (2005) explains that China has successfully upgraded its ICT products from assembly of imported goods into the manufacture of high technology intermediate goods. As a result, import dependence has declined and the domestic value added of exports has increased. The vertical specialization in China's ICT industry has enabled China to rapidly diversify its exports of consumption goods and switch its comparative advantages along the production process from unskilled labour-intensive assembly to more advanced processing activities.

Among NIEs, Singapore and South Korea were the two major Asian exporting countries of electronics parts and components. Singapore, with its flexible and effective location for CEM (Contract Electronics Manufacturing) became the third largest exporter of electronics parts and components in 1995 and 2000 and the fifth largest in 2007. It also became a hub of ASEAN and NIEs countries in the electronics global production network. Meanwhile, South Korea, with its major conglomerates (*chaebol)* and heavy government intervention, has maintained its export share at around 5-6 percent during the period 1995-2007.

Figure 3.2: Share of East Asian Countries Electronics Parts and Components Export to World Export, 1988 - 2007



Source: UN-Comtrade

ASEAN-4's export shares are relatively stable over time. Among ASEAN countries, Malaysia was the largest exporter followed by the Philippines and Thailand, while Indonesia was a laggard. Malaysia's export share during 1995-2007 was relatively stable at 6 percent but its growth rate continued to slow down over this period, similar to Thailand and the Philippines with an export share around 2-3 percent for each of these countries. Indonesia's participation in the electronics global production network was very limited compared to other ASEAN countries. Its export share was less than 1 percent.

The characteristics of the electronics parts and components are the main cause of the relatively low intra region trade. With relatively small and light parts the value-to-weight ratio is relatively high and it is still economical to trade many parts and components from a distant location and in fact, most of it air freight.

One consideration that is important in the manufacturing of semiconductors is the quality of the products, which depends heavily on the cleanliness of the environment for wafer fabrication production. One approach is to create 'mini-environments' which are, in effect, sealed containers to ensure that as the wafer travels through the factory from one processing step to another during its production cycle, it never comes into contact with the 'dirty' factory environment. The very high cost of creating such environments makes the semiconductors industry a very capital intensive one. In addition, this semiconductors industry needs two types of skills; the first one is highly trained professional and technical workers for the design and wafer fabrication process, and the other is low-skilled production workers for the assembly stages (predominated by female workers) (Dicken, 2003).

As depicted in Figure 3.2, Indonesia's share is small compared to other ASEAN-4 countries. Indonesia's position is below other ASEAN-5 countries (Malaysia, the Philippines, Singapore and Thailand) and its export value was much lower than other ASEAN-5 countries. Indonesia's export value was only $122 million in 1990, while others were more than $3 billion and its low value of exports indicates low participation in the electronics global production networks.

A major destination for Indonesian export was Singapore and more than 30 percent of Indonesian export was exported to Singapore (Table 3.2). This is not only because Singapore has a more advanced electronics sector needing parts and components from Indonesia, but because of its role as an *éntprépot* for Indonesian export. The US electronics sector was the second destination for the Indonesian electronics parts and components exports until 2001 with more than 17 percent of Indonesian export. However, since 2007, the US position was replaced by Japan with an export share to Japan of about 14 percent in 2010.

Table 3.2: Indonesia and Malaysia: Major Export Partners, 1990 – 2010

Indonesia: Major Export Partners

Export Partner	Export Share (%)					Rank				
	1990	1996	2001	2007	2010	1990	1996	2001	2007	2010
Total Export ($ million)	**122**	**2,239**	**5,491**	**6,214**	**7,064**					
Singapore	27.0	30.6	31.0	35.4	33.7	1	1	1	1	1
Japan	9.8	12.8	14.1	16.7	13.6	4	3	3	2	2
USA	16.9	17.5	16.8	7.0	6.9	2	2	2	3	3
Philippines	0.2	0.5	1.2	1.1	5.8	30	22	16	15	4
China, Hong Kong SAR	4.9	4.2	3.0	4.1	5.6	5	5	5	5	5
China	-	0.2	1.6	5.2	4.3	93	26	12	4	6
Malaysia	0.6	5.3	5.3	4.0	3.8	17	4	4	6	7
France	0.7	2.4	1.4	2.2	2.6	16	9	14	9	8
Thailand	0.8	3.1	2.8	2.5	2.5	14	6	6	8	9
India	0.2	0.1	0.2	0.6	1.7	31	38	30	24	10
Germany	11.4	2.8	2.0	1.2	1.6	3	7	8	14	11
United Kingdom	0.4	2.4	1.9	0.9	1.4	20	8	9	18	12
Australia	3.3	0.9	1.1	1.4	1.2	8	17	17	12	13
Other Asia, nes	2.6	0.8	1.3	0.9	1.1	10	19	15	16	14
United Arab Emirates	3.7	1.4	1.6	2.5	1.1	7	13	13	7	15
Czech Rep.	-	0.0	0.0	0.7	1.1	103	93	52	21	16
Rep. of Korea	0.4	1.3	1.9	1.3	1.1	19	14	10	13	17
Viet Nam	0.1	0.1	0.2	1.9	1.0	48	31	33	10	18
Netherlands	2.7	2.0	2.8	1.7	0.8	9	10	7	11	19
Brazil	0.2	0.2	0.5	0.8	0.7	27	27	21	19	20

Malaysia: Major Export Partners

Export Partner	Export Share (%)					Rank				
	1990	1996	2001	2007	2010	1990	1996	2001	2007	2010
Total Export ($ million)	**7,083**	**30,087**	**40,205**	**62,802**	**63,399**					
China	0.2	0.5	4.6	11.5	19.3	18	19	6	3	1
Singapore	27.0	27.7	21.7	18.1	16.2	2	1	2	2	2
USA	32.2	24.4	23.4	18.8	12.2	1	2	1	1	3
China, Hong Kong SAR	6.5	5.8	5.5	8.9	11.6	4	4	5	4	4
Japan	9.7	8.4	9.4	6.3	5.5	3	3	3	6	5
Netherlands	0.8	4.3	6.4	6.6	5.2	12	7	4	5	6
Thailand	1.1	3.5	3.7	5.2	5.0	10	9	8	7	7
Germany	-	3.7	2.9	3.5	4.3	164	8	10	8	8
Other Asia, nes	1.6	5.5	4.5	2.6	3.1	8	5	7	9	9
France	1.5	1.0	1.5	2.2	2.4	9	11	13	10	10
Rep. of Korea	2.3	1.2	2.7	2.1	2.2	7	10	11	11	11
Mexico	0.2	0.3	1.3	1.4	1.8	16	22	14	13	12
India	0.0	0.2	0.7	1.1	1.7	32	24	17	16	13
Philippines	0.5	0.9	1.6	1.3	1.0	14	14	12	14	14
United Kingdom	6.3	4.7	2.9	1.4	0.9	6	6	9	12	15
Australia	0.3	0.7	1.2	1.1	0.8	15	17	15	15	16
Indonesia	0.1	0.7	0.7	0.7	0.7	25	16	16	17	17
Canada	0.6	0.6	0.5	0.5	0.6	13	18	19	21	18
United Arab Emirates	0.1	0.3	0.3	0.5	0.5	22	23	22	22	19
Italy	0.2	0.5	0.2	0.3	0.4	17	20	25	26	20

Source: UN-COMTRADE

The change of export destination reflects the change of major principals in Indonesia. Previously, many Indonesian electronics firms were affiliated with US electronics firms. However after 2001, many Japanese companies started networking with Indonesian firms and it resulted in a higher export share directed to Japan.

In contrast, Malaysia's major export partners were more diverse. In 2010, $63 billion of Malaysia's exports were directed to China (19 percent), Singapore (16 percent), the US (12 percent) and Hong Kong (12 percent). This greater variation of Malaysia's export destinations implied Malaysia participated more in global production networks.

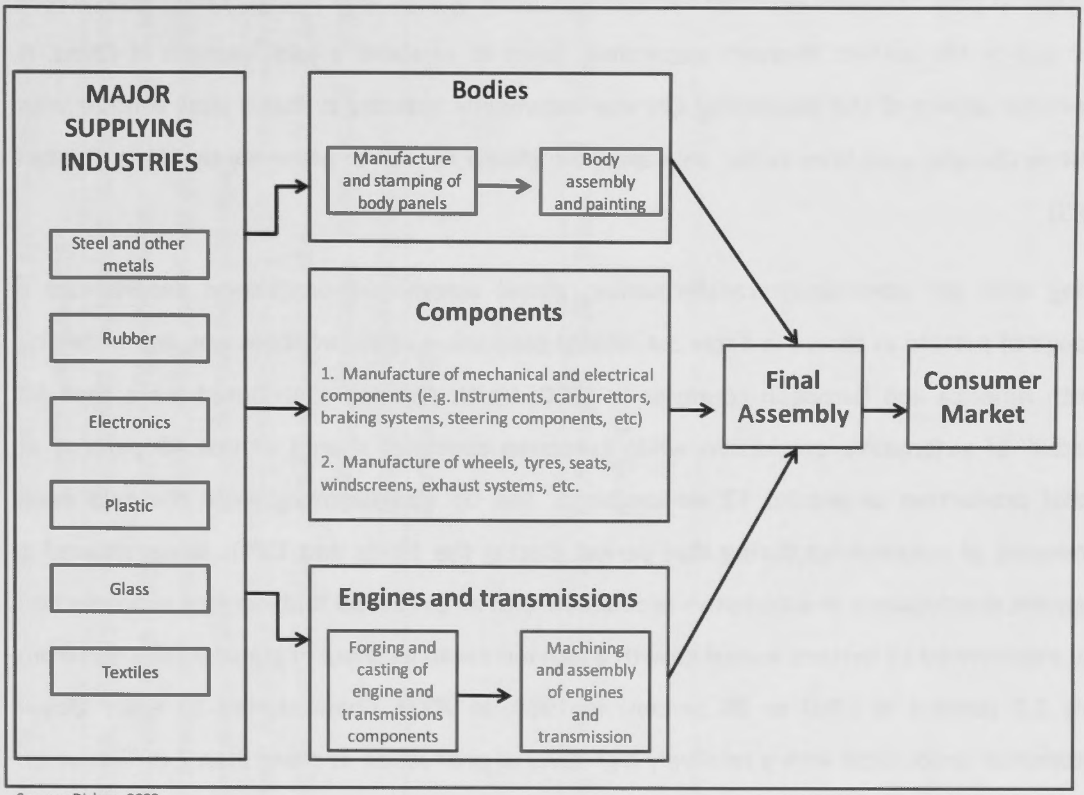
It can be concluded that the electronics sector has a discrete production process with different scale, skill and technology requirements. It varies from a simple assembling process which requires unskilled labour to the sophisticated high technology production process which requires very skilled labour. The electronics parts and components are usually small and light so that it is possible to transport them using air freight instead of sea or land transportation modes. This type of transportation save transportation time and with the high value-to-weight ratio of the parts and components, it is still economical to transport to distant locations. With the technological development, the fragmented products become more similar and useful in a range of industries. An example is the use of computer chips not only in computers but also in other electrical goods such as toasters, laser devices and other products. Therefore it is easier for the electronics sector to achieve economies of scale. Government intervention in the electronics sector is not as intense as in the automotive sector and the trade and investment barriers in the electronics sector are also either lower or do not exist.

3.3 Automotive Global Production Networks

The automotive industry is one of the biggest in the world and employs more than eight million people making vehicles directly, and more than forty million people indirectly through related manufacture and services sectors. In principle, the automotive industry is an assembly industry, where more than a thousand parts and components are produced by independent industries. Dicken (2003) categorized the major processes in the automotive industry prior to the final assembly process into the manufacture of bodies, of components and of engines (as shown in Figure 3.3).

The automotive industry has experienced a transformation from its inception in the late 19^{th} century, when France and Germany were the largest automotive producers but with small domestic markets (Simarmata, 1997). The first transformation began at the beginning of the 20th century with the introduction of Fordist mass production in the US. Fordist mass production is a moving assembly line developed by Henry Ford in 1913. During the 1920s the US car production contributed 84 percent of world car production and in 1929 it started to export 10 percent of its production, which accounted for 35 percent of the world market. The expansion of the US production urged the European governments to protect their domestic car producers and promote their national automotive industries.

Figure 3.3: Production chain in the automotive industry



Source: Dicken, 2003

The second transformation occurred at the end of 1950s with the implementation of the General Agreement of Tariff and Trade (GATT). The significant reduction in tariffs integrated the markets and enabled European automotive producers to expand their markets with their specialization on small cars which were energy-efficient. At the beginning of the 1980s the US's domination of the world's automotive producers started to decline, while European production increased.

The third transformation occurred in the 1970s when Japan started to penetrate the world market with their new lean production system. This new system enabled Japan to produce automobiles more efficiently compared to the US and Europe, with far fewer employees and a "just-in-time" system compared to the "just-in-case" system operating in the US. The expansion of the Japanese automotive industry threatened domestic production in the US and Europe and prompted the US and European governments to apply interventionist policies such as import quotas, tariffs and Voluntary Export Restriction (VER). The differences between craft production, Fordist mass production and Japanese lean production is summarized in Table 3.3.

The fourth transformation occurred in the late 1990s when Western automobile firms began to establish operations in China because China is potentially the mega-market for automobiles in East Asia. In 2010, China was the largest automobiles producer in the world. The Chinese automobile industry consists of a small number of state corporation groups together with a number of joint ventures between members of these groups and foreign firms. Volkswagen was one of the earliest Western automobile firms to establish a joint venture in China. A significant aspect of the developing Chinese automobile industry is that a joint venture with existing Chinese auto firms is the only available choice for FDI in assembly by MNCs (Dicken 2003).

Along with the continuous transformation, global automotive production experienced a change of pattern as shown in Table 3.4. Global production of automobiles was dominated by North America and European countries in 1960. North America contributed more than 50 percent of automotive production while European countries shared almost 40 percent of global production or around 13 million units. The US and Germany were the two main producers of automobiles during that period. During the 1970s and 1980s Japan showed a dramatic development in automotive production with an almost 55 fold increase in production and experienced 15 percent annual growth which increased its share of global production from only 1.3 percent in 1960 to 28 percent in 1989. In 2000, China started to enter global automotive production with a relatively high level of production at more than 2 million units. This lowered the dominance of Germany, the US and Japan. Automobile production reached its highest annual growth during the period 1989-2000, with almost 5 percent growth per annum. In 2000, Canada, South Korea and Malaysia experienced higher growth compared to other countries. This reflects the spread of technology from the US and Japan to surrounding countries.

However, after the Asian financial crisis in 1998, the growth of automotive production slowed down, with only 2.6 percent annual growth in 2000-2005 and even lower growth in 2005-2010. But Asian countries still experienced positive and relatively high growth. In 2005, Asian countries contributed 30 percent of global production of autos, with the highest growth occurring in China and Thailand (22 percent each). In 2010, the Asian share of global automotive production increased further to almost 50 percent, with China and Japan the main contributors.

Table 3.3: Comparison between craft production, Fordist mass production and Japanese lean production

Characteristics	Craft Production	Fordist Mass Production	Japanese Lean Production
Technology	Simple, but flexible tools and equipment using un-standardized components	Complex, but rigid single-purpose machinery using standardized component. Heavy time and cost penalties involved in switching to new products	Highly flexible methods of production using modular component systems. Relatively easy to switch to new products
Labour Force	Highly skilled workers in most aspects of professional production	Very narrowly skilled workers design products but production itself performed by unskilled/ semi skilled "interchangeable" workers. Each performs a very simple task repetitively and in a predefined time and sequence	Multi-skilled, polyvalent workers operate in teams. Responsibilities include several manufacturing operations plus responsibility for simple maintenance and repair
Supplier relationships	Very close contract between customer and supplier. Most suppliers located within a single city.	Distant relationship with suppliers, both functionally and geographically. Large inventories held at assembly plant 'just in case' of disruption of supply	Very close relationship with a functionally tiered system of suppliers. Use a 'just in time' delivery systems encourages geographical proximity between customers and suppliers
Production volume	Relatively slow	Extremely high	Extremely high
Product variety	Extremely wide – each product customized to specific requirements	A narrow range of standardized designs with only minor product modifications	Increasingly wide range of differentiated products

Source: Dicken (2003), table 4.2

In contrast with the electronics industry, although the automotive industry has discrete processes it requires considerable local technological capabilities in order to be efficient. The automotive industry has an extremely concentrated firm structure, with a small number of giant companies dominating global production as depicted in Table 3.5. The top 20 manufacturers contribute almost 90 percent of global automotive production. General Motors (GM) dominated until 2007 and in 2008 Toyota replaced GM's position as the top producer. Of the 20 top manufacturers, six are Japanese firms, three are German, the US and Chinese, and two are French, while the rest are Indian, Italian and Korean firms.

An important characteristic of the auto parts is that there are few fully generic parts and components which can be used in a wide variety of final products without extensive customization such as in the electronics industry. This characteristic limits auto parts firms in reaching economies of scale in production and economies of scope in design. The relationship between auto parts suppliers and car assemblers are typically captive and relational. Many components are larger and heavier than electronics parts and components therefore relocation to close proximity is preferable to a more distant location. This condition leads to agglomeration in the industry.

Surgeon *et al.* (2008) argue that the dispersion of the automotive industry has a nested geographical and organizational structure. Global integration occurred through buyer-supplier relationships, especially between car makers and their largest suppliers. Production tends to organize regionally or nationally, where parts and components which are bulky and heavy tend to locate in close proximity with the assembler to ensure on-time delivery and to save transportation costs. Meanwhile smaller, lighter and standardized parts and components can be located at a distance to take advantage of lower labour cost and economies of scale. Vehicle development is concentrated in a few design centres. As a result, local, national and regional production networks in the automotive industry are nested within the global organization and structures of the largest car maker firms.

Table 3.4: Car production by country, 1960 - 2010

Country	1960 Production (000 units)	1960 World share (%)	1989 Production (000 units)	1989 World share (%)	2000 Production (000 units)	2000 World share (%)	2005 Production (000 units)	2005 World share (%)	2010 Production (000 units)	2010 World share (%)
EU	**5,092**	**39.17**	**13,267**	**37.42**	**15,761**	**27.00**	**15,587**	**24.17**	**12,990**	**16.74**
France	1,175	9.04	3,409	9.62	3,348	5.74	3,666	5.68	2,228	2.87
Germany	1,817	13.98	4,564	12.87	5,527	9.47	5,570	8.64	5,906	7.61
Italy	596	4.58	1,972	5.56	1,738	2.98	1,142	1.77	857	1.10
Spain	43	0.33	1,639	4.62	3,033	5.20	3,012	4.67	2,388	3.08
Sweden	108	0.83	384	1.08	301	0.52	340	0.53	217	0.28
UK	1,353	10.41	1,299	3.66	1,814	3.11	1,857	2.88	1,393	1.80
North America	**6,998**	**53.83**	**7,807**	**22.02**	**15,761**	**27.00**	**14,701**	**22.79**	**9,832**	**12.67**
Canada	323	2.48	984	2.78	2,962	5.07	2,712	4.20	2,071	2.67
USA	6,675	51.35	6,823	19.24	12,800	21.93	11,989	18.59	7,761	10.00
Asia	**165**	**1.27**	**10,018**	**28.26**	**17,113**	**29.32**	**22,535**	**34.94**	**38,616**	**49.76**
China	..	..	..	..	2,069	3.54	5,234	8.12	18,265	23.53
India	..	..	..	..	801	1.37	1,511	2.34	3,537	4.56
Indonesia	..	..	..	..	293	0.50	408	0.63	705	0.91
Japan	165	1.27	9,052	25.53	10,141	17.37	10,512	16.30	9,626	12.40
Malaysia	..	..	94	0.27	283	0.48	472	0.73	568	0.73
South Korea	..	..	872	2.46	3,115	5.34	3,469	5.38	4,272	5.50
Thailand	..	..	..	..	412	0.71	928	1.44	1,645	2.12
South America	**96**	**0.74**	**1,282**	**3.62**	**3,957**	**6.78**	**4,155**	**6.44**	**6,710**	**8.65**
Argentina	30	0.23	112	0.32	340	0.58	260	0.40	717	0.92
Brazil	38	0.29	731	2.06	1,682	2.88	2,317	3.59	3,648	4.70
Mexico	28	0.22	439	1.24	1,936	3.32	1,577	2.45	2,345	3.02
ROW	**648**	**4.98**	**3,081**	**8.69**	**5,781**	**9.90**	**7,519**	**11.66**	**9,462**	**12.19**
Total	**12,999**	**100.00**	**35,455**	**100.00**	**58,374**	**100.00**	**64,496**	**100.00**	**77,610**	**100.00**

Notes: .. : data not available, negligible shares

Source: 1960 and 1989 data: Dicken (2003)

2000, 2005 and 2010 data: International Organization of Motor Vehicle Manufacturers (OICA)

Table 3.5: World automotive production by manufacturer, 1998 – 2010

	Group	Country Head Quarter	1998 Unit ('000)	1998 %	1998 Rank	2003 Unit ('000)	2003 %	2003 Rank	2008 Unit ('000)	2008 %	2008 Rank	2010 Unit ('000)	2010 %	2010 Rank
1	Toyota	Japan	5,210	9.8	3	6,241	8.0	3	9,238	13.3	1	8,557	12.3	1
2	GM	US	7,582	14.3	1	8,186	10.5	1	8,282	11.9	2	8,476	12.2	2
3	Volkswagen	Germany	4,809	9.1	4	5,024	6.5	4	6,437	9.3	3	7,341	10.6	3
4	Hyundai	Korea	899	1.7	15	2,697	3.5	9	2,777	4.0	8	5,765	8.3	4
5	Ford	US	6,556	12.4	2	6,866	8.8	2	5,407	7.8	4	4,988	7.2	5
6	Nissan	Japan	2,620	4.9	7	2,942	3.8	7	3,395	4.9	6	3,982	5.7	6
7	Honda	Japan	2,328	4.4	8	2,923	3.8	8	3,913	5.6	5	3,643	5.2	7
8	PSA	France	2,247	4.2	10	3,310	4.3	6	3,325	4.8	7	3,606	5.2	8
9	Suzuki	Japan	1,298	2.4	12	1,811	2.3	12	2,624	3.8	9	2,893	4.2	9
10	Renault	France	2,283	4.3	9	2,386	3.1	10	2,417	3.5	11	2,716	3.9	10
11	Fiat	Italy	2,696	5.1	6	2,078	2.7	11	2,524	3.6	10	2,410	3.5	11
12	Daimler AG	Germany	4,512	8.5	5	4,232	5.4	5	2,174	3.1	12	1,940	2.8	12
13	Chrysler	US	merged with Daimler AG			merged with Daimler AG			1,893	2.7	13	1,578	2.3	13
14	BMW	Germany	1,209	2.3	13	1,119	1.4	15	1,440	2.1	14	1,481	2.1	14
15	Mazda	Japan	971	1.8	14	1,153	1.5	14	1,349	1.9	16	1,308	1.9	15
16	Mistubishi	Japan	1,591	3.0	11	1,582	2.0	13	1,309	1.9	17	1,174	1.7	16
17	Chana Automobile	China	N/A	N/A	N/A	N/A	N/A	N/A	531	0.8	23	1,103	1.6	17
18	Tata	India	118	0.2	26	289	0.4	23	798	1.1	19	1,011	1.5	18
19	FAW	China	N/A	N/A	N/A	556	0.7	18	638	0.9	20	896	1.3	19
20	Geely	China	N/A	N/A	N/A	N/A	N/A	N/A	221	0.3	31	802	1.2	20
Sub total			**46,929**	**88.6%**		**53,395**	**68.7%**		**62,891**	**90.4%**		66,218	**95.2%**	
World Production			**52,987**	**100.0%**		**77,744**	**100.0%**		**69,561**	**100.0%**		69,561	**100.0%**	

Source: International Organization of Motor Vehicle Manufacturers (OICA)

There are three large regional clusters in the automotive industry: Europe, North America and Asia. Within a region there is a tendency to shift investment locations to lower operating cost countries, such as Mexico in North America, Spain and Eastern Europe in the European region and to Thailand and China in Asia. Auto parts are more heavily traded within a region compared to the finished goods. Within a country, production and employment are concentrated in a location which provides better infrastructure and which in turn lowers the service link costs.

3.3.1 Development of the Automotive Sector in Asia

In contrast to the electronics industry, East Asia is a far less significant player in the automotive industry (this includes auto parts and final assembly industry), except for Japan and China in recent years. The development of an auto parts industry in Southeast Asian countries follows a pattern suggested by Odaka (1983) where technologically less developed SMEs emerge in maintenance and repair services of imported machineries in an almost evolutionary manner. The development of these replacement goods happens in five stages. First, once the industry is established the machinery and equipment in the industry require both periodic and emergency maintenance and repair. Initially the foreign experts in the factory operation carry this out, and the task is later transferred to local technicians. Next, the manufacture of replacement machines and parts is progressively transferred outside the factory for cost saving reasons, usually on an *ad hoc* basis. At the next stage, once the industry reaches a certain level of production size, some producers begin to specialize in the manufacture of replacement goods (REM). At the fourth stage, following such development, a marketing network is established for a variety of replacement machine products, while the emergence and growth of the replacement market itself contributes to the rise of a number of new machinery industries, usually requiring relatively unsophisticated technologies. Finally, local SMEs are established to engage in the domestic production of the machinery that was previously imported (OEM).

The automotive industry in Asia is dominated by Japanese firms and the US firms face a challenge to build a presence in Asia in order to be well-positioned to take advantage of a potentially fastest-growing market for cars over the following decades. Japanese firms assemble their cars in several countries in Asia such as Thailand, Malaysia, the Philippines, Indonesia, Taiwan and China. In Thailand and Indonesia, Japanese cars dominate the production and market share. Thailand is considered a major hub of automotive production for regional and global markets. Japanese firms have more than 90 percent of the market share in Thailand, while Toyota alone controls almost 30 percent of the production (Dicken, 2003). The domination of Japanese cars is even stronger in Indonesia than in Thailand. Almost 100 percent of car production and market share in Indonesia is a Japanese brand with Toyota alone accounting for almost 40 percent of the market share. Japanese companies increased their focus on Asian markets by designing cars specifically tailored to each market and not just versions of the existing models. For example, Toyota and Honda introduced completely new models in the late 1990s based on a very different approach to producing cost-efficient cars for a low-income market. In order to localize production as much as possible, engineers in both companies focused on what local companies could produce cheaply and then designed a car with those components in mind. A more detailed analysis of Indonesia's automotive industry is provided in Chapter 8.

In contrast to Thailand, which is a major hub of automotive production in Asia, China is considered potentially the most important because of its huge domestic market. Both Japanese and European car makers increased their investment in China to take advantage of this potential; however US firms find entry to the Chinese market more difficult. The Chinese government imposes very strict FDI policies where foreign investors can only invest in China in the form of a joint venture with existing Chinese firms. The Chinese automotive industry consists of a small number of state corporation groups and joint ventures between members of these groups and foreign firms. In 2010, China became the top car producer with total car production of 18.3 million units, replacing Japan's production of 9.6 million units. Although China has its domestic brands, most production is of foreign brands. The production of parts grew quickly in the 1990s. Major producers are linked to state, provincial or municipal conglomerates. Joint ventures from Taiwan are usually more efficient and produce acceptable quality, but they still have a relatively low level of sophistication (tyres, batteries, radio, steering wheels, lights, piston rings, brakes, crank shafts). Meanwhile, Japanese firms are criticized because they often provide dated technology although they do pass along quality control and on-time delivery to local firms.

Korea is the third next top car producer in Asia after Japan and China. The development of the automotive industry in Korea has been supported by highly interventionist trade and industrial policies. Imports of cars were prohibited until the 1990s and the government provides subsidised loans, tax incentives for investments and export subsidies for the automotive industry. Korea has a large auto parts industry to support both OEM and REM. The development of auto parts in Korea is supported by a strong national innovation system, along with engineering and metal working skills, and backward linkages with the steel industry. After the financial crisis in 1998 which resulted in the bankruptcy of four out of five domestic assemblers, many small auto parts firms had to exit the industry because of debt and cash flow problems. The crisis also forced some conglomerates to divest their firms and this paved the way for foreign investors to acquire significant shareholdings in Korean component producers.

Malaysia's automotive industry is dominated by a national car program which was a result of government disappointment with the slow progress of local automotive firms, as well as a desire to develop a heavy industry to reduce dependence on commodity exports. The government gives trade protection to the automotive industry through high tariffs on cars, various non-tariff barriers and local content requirements. It also deferred the implementation of the ASEAN Free Trade Agreement (AFTA) for the automotive industry from 2000 to 2005. Another objective of the national car program is to increase the participation of ethnic Malays in the automotive industry which had been dominated by Chinese entrepreneurs previously. With the protection from the government, two national cars, the Proton and the Perodua, successfully captured more than 90 percent of domestic car sales. However, overall car production volume is still too small, which makes auto parts firms less internationally competitive because they cannot reach economies of scale. Consequently, the auto parts industry in Malaysia remains small scale, inefficient and lacking in technological competencies. Although the government aims to increase the value added of the automotive industry, the trend of this value added of the automotive industry in general is declining because of the higher import content for the auto parts industry. The shortage of skilled labour is also profound in the automotive industry because many locally trained engineers are more likely to work in the electronics industry which receives generous investment incentives from the government.

While Malaysia's national car is a disaster, Thailand has been successful in becoming a major regional hub for automotive production for regional and global markets. This rapid development is the result of a combination between a change in global automotive sector and the favourable policy environment set by the Thailand government. Similar to other developing countries, Thailand adopted an import substitution policy during the 1960s-1980s and then switched to an export oriented policy in the early 1990s (Kohpaiboon, 2009).

In early 1960 Thailand implemented an import substitution policy by imposing high import tariffs of 60 percent, 40 percent and 20 percent of CBU on passenger cars, vans and pick-up trucks, respectively. Meanwhile the import tariff for CKD is half of the CBU for each category. With the intention to develop domestic industry, the Thai government announced an Investment Promotion Policy and established a Board of Investment (BOI) to approve foreign investment projects and provide investment promotion measures. Investment incentives for foreign investors include income tax breaks and equal treatment for foreign and domestic investors. The imposition of import tariffs encouraged multinational car makers to set up assembly plants in Thailand and by the late 1960s there were six Japanese car makers, three European carmakers and two major US carmakers with assembly plants in Thailand.

In 1969 the government set up an Automotive Development Committee (ADC) (which consists of officials from the BOI, Ministry of Industry, Ministry of Finance, Ministry of Commerce and Bank of Thailand and representatives of the Automotive sector Club and Association of Thai Industries) as a response to growing concern on the failure of creating backward linkages with the local parts and component industry. In 1977, the government revised the Investment Promotion Policy and limited foreign ownership to 49 percent in the domestic-market (firm sells more than 70 percent of output to domestic market) joint venture. However a foreign investor has an option to set up business without approval from the BOI but is not eligible for any investment incentives provided by the BOI.

In 1983, the government introduced the idea of a Thai vehicle with the intention to increase local content drastically to 70 percent and then 100 percent in the following ten years. This idea faced strong rejection from the industry, so the government compromised and changed the LCR target to 54 points based on two ways classification; account A is "a must" list and account B is an "optional" list if parts in account A are not available domestically. Most parts in Account A had been procured domestically by car makers therefore there was little resistance from the industry. Another policy is to develop a "one-ton diesel engine project" involving three selected firms (Siam Toyota Manufacturing, Isuzu Engine Manufacturing and Thai Automotive sector – Nissan affiliated) to produce diesel engines for a one-ton pick-up truck subject to specific local content and export performance requirements. This plan was based on an intensive consultation with the relevant private sector stake holder and therefore did not come as a surprise unlike the National Car Project in Indonesia. The choice of a one-ton diesel engine project was also based on an assessment of domestic demand where this type of vehicle had the largest domestic demand because of its popularity as a multi-purpose vehicle among farmers and urban vendors. With large domestic demand and a potential export market, this type of engine can easily reach economies of scale.

In 1988, the Thailand economy experienced unprecedented growth and the automotive demand surged and domestic industry could not accommodate it. In response, the government revoked the limitation on the number of models and makers for each car assembler in 1990. In 1991 the import ban for CBU was also lifted and since then the import trade regime for automotive has remained free. With the signing of Trade Related Investment Measures (TRIM) under the WTO in 1998, the LCR was abolished and the limitation of 49% foreign ownership in the domestic-market joint venture was lifted. This significantly changed the Thailand automotive sector from a highly protected industry to a more liberalized industry. As a result, Japanese and US carmakers (Mitsubishi, Toyota, Auto Alliance – joint venture between Ford and Mazda, GM and Isuzu) decided to make Thailand their production base for the regional market. Thailand enjoys the first mover advantage of liberalizing its automotive sector.

The Local Content Requirement (LCR) policy successfully developed parts manufacturers in Thailand. Before the implementation of LCR in 1975 there were only 20 parts manufactures. This increased rapidly to 180 in the 1980s and by 2008 there were 700 first tier firms and 1,100 second tier and third-tiers firms in the Thai auto parts industry. LCR also encouraged the development of production clusters in Rayong and Chonburi provinces since parts producers tended to locate closer to their customers in order to meet the just in time requirement. In the beginning, automotive and auto parts firms were concentrated in industrial estates (IE) located in Bangkok and central areas such as Samut Prakan province. In the late 1980s, the Thai government established regional IEs in the northern region and eastern provinces in line with a rural area development program.

With the removal of the foreign ownership limitation in 1998, many foreign parts suppliers increased their equity shares, in some cases acquiring full ownership. As a result, foreign companies brought the latest technology to Thailand with better managerial practices and close supervision of assembly/production by bringing in foreign technicians and managers. These foreign companies took full control of the OEM market while domestic parts manufacturers are responsible for after market or replacement of parts and components.

Less domination of Japanese carmakers in Thailand compared to Indonesia affects the relationship between supplier and carmakers. With domination by Japanese carmakers, parts suppliers are usually attached to one carmaker making it difficult for parts suppliers to reach economies of scale. Meanwhile, US carmakers are heavily reliant on price bid competition amongst parts suppliers worldwide and this changed other carmakers behaviour in Thailand. A parts supplier can now supply to more than one carmaker so that is easier for them to obtain economics of scale.

During the 1980s, automotive production in Thailand grew at 10 percent annually and had reached more than 500,000 units in 1996. With the financial crises in 1997-1998 production declined sharply but increased again and reached the pre-crisis level in 2002. In 2005, the production was more than 1 million units and continued to increase to 1.6 million units in 2010 (see Table 3.4). The rapid production increase was driven by export oriented policies. Japanese carmakers dominated the production share in Thailand with 80% of output while US carmakers accounted around 7.5 percent of production.

Until the end of the 1990s the Thai automotive sector was mainly for the domestic market with export less than 5 percent of total sales. Exports of cars increased substantially during 2000-2008 with a fivefold increase from 153 thousand to 838 thousand units) which accounted for 60 percent of production. Parts and components accounted for three fourth of total automobile exports in the 1990s but then declining to about one fifth of total exports in 2008. Thai export is dominated by a one-ton pick-up although its share declines from 74.6 percent in 1999 to 42.6 percent in 2007. Export destination also experienced dramatic change with a higher market share to ASEAN countries.

3.3.2 Trends and Mapping of the Automotive Sector

World's auto parts trade increased from \$109 billion in 1988 to almost \$680 billion in 2007, with an annual growth of 8.7 percent which reflects the higher intensity of global production networks in the automotive industry (see Appendix 3.3). The world auto parts trade is dominated by the EU-15 and North American countries with no significant change in the proportion of exporters.

East Asian countries contribute less significantly in the auto parts trade compared to the electronics parts and components trade. Their share in the world auto parts trade is around 21-23 percent for the period 1988-2007, which is much lower than the share in the electronics parts and components trade (around 50 percent). Among East Asian countries, Japan, China, South Korea and Thailand are the major players in the auto parts trade. Japan's role is declining over time with a decline in export share from 18 percent in 1989 to 9 percent in 2007, although it is still the largest exporter of auto parts in Asia. Meanwhile China's export share increased from a low 0.6 percent in 1992 to more than 7 percent in 2007. Other countries in Asia which experienced an increase in export share are South Korea, Thailand and Indonesia. South Korea's share increased from 1.5 percent in 1989 to 3 percent in 2007, while Thailand increased from only 0.2 percent in 1999 to 1.5 percent in 2007. Meanwhile, Indonesia's export shares are relatively modest.

As can be seen in Appendix 3.4, Indonesia's car production is less than that of Thailand and Malaysia until 2010 when its car production exceeded that of Malaysia. Thailand shows an impressive increase in car production moving from being the 19th largest car producer country in 2000 to 14th until 2009 and then to 12th in 2010. Meanwhile in 2010 Indonesia is 21st and Malaysia 22nd.

For the last twenty years, the value of the auto parts trade has increased fourfold, from around \$165 billion in 1990 to \$680 billion 2010. As depicted in Appendix 3.5, Japan was the largest exporter of auto parts in Asia during this period, with an increase in export value from around

$27 billion in 1990 to more than $61 billion in 2008. Indonesia's position in the export of auto parts was 9th throughout the period, with a substantial increase from only $112 million in 1990 to almost $3.5 billion in 2008. Thailand also experienced a substantial increase in its export value from $312 million in 1990 to almost $10 billion in 2008. This impressive performance makes Thailand one of the major hubs in the automotive production network.

As expected, the major export destination countries for Indonesia and Thailand are Japan and the USA, followed by other ASEAN. As shown in Table 3.6, the destination for Indonesia's exports has changed from 1990 to 2010. In the 1990s, the major destination was Singapore, not because Singapore has car assembler firms but because Indonesia used Singapore as an *entrepôt* for export to other countries. However, since 2001, the main destination of Indonesian export has been Japan and the USA, followed by other ASEAN countries such as Thailand, Malaysia, Singapore and the Philippines.

In comparison, Thailand's major export destinations are Japan and the USA. In the 1990s, the first destination was the USA but from 2001 Japan replaced the US as Thailand's first export destination, followed by other ASEAN countries such as Malaysia and Indonesia. In addition, Thailand also exports auto parts to more distant countries such as India and Brazil. Considering the size and weight of auto parts compared to electronics parts and components, export of parts to relatively distant countries reflects the importance of Thailand as a hub in the regional and global automotive production networks.

The increased intensity of intra Asian trade reflects the higher degree of global production network in Asian countries.

3.4 Concluding Remarks

This chapter surveyed the development of global production networks of two categories of industry namely electronics and automotive, which are the most dynamic, largest and fastest growing industries. Both industries are fragmented in their production processes and this fragmentation allows more countries with different levels of income and technology to participate in the production network by specializing in their niche markets. However, there are some distinct differences between these two industries.

Table 3.6: Indonesia and Thailand: Major Export Partners, 1990 - 2007

Indonesia: Major Export Partners

Export Partner	Export Share					Rank				
	1990	1996	2001	2007	2010	1990	1996	2001	2007	2010
Total Export (US$ billion)	**113**	**791**	**1,496**	**3,589**	**4,854**					
Japan	7.9	12.5	18.2	23.8	19.4	4	2	1	1	1
USA	6.8	11.7	14.8	12.1	13.3	5	3	2	2	2
Thailand	2.0	1.4	5.2	10.1	13.0	12	17	6	3	3
Malaysia	8.4	4.0	6.4	6.7	8.0	3	6	5	5	4
Singapore	18.4	19.1	12.1	6.8	5.6	1	1	3	4	5
Philippines	0.8	4.0	4.7	3.3	5.6	24	7	7	6	6
Australia	4.0	2.9	2.0	2.7	3.1	6	10	12	10	7
Brazil	0.3	0.1	0.9	1.6	2.6	39	57	18	14	8
Viet Nam	0.2	0.6	0.7	2.7	2.6	42	23	21	9	9
United Kingdom	1.6	3.5	1.8	3.3	2.5	15	9	13	7	10
United Arab Emirates	2.4	3.9	2.7	2.8	1.9	11	8	9	8	11
China	0.0	0.3	0.3	2.5	1.8	70	35	34	12	12
Saudi Arabia	12.9	4.2	2.6	2.6	1.7	2	5	10	11	13
India	0.1	0.1	0.3	0.8	1.5	45	60	31	20	14
Germany	2.8	2.5	2.1	1.2	1.4	10	12	11	16	15
Other Asia, nes	1.1	2.7	3.3	2.1	1.2	18	11	8	13	16
South Africa	-	-	0.4	1.0	1.1	184	194	26	18	17
Netherlands	1.3	2.1	1.6	1.1	0.9	17	14	14	17	18
Italy	0.9	1.5	1.1	1.2	0.7	22	16	16	15	19
Egypt	1.5	0.6	0.5	0.7	0.7	16	22	23	21	20

Thailand: Major Export Partners

Export Partner	Export Share					Rank				
	1990	1996	2001	2007	2010	1990	1996	2001	2007	2010
Total Export (US$ billion)	**314**	**1,166**	**2,185**	**10,109**	**13,749**					
Japan	10.8	13.6	20.6	16.3	13.3	2	2	1	1	1
USA	37.5	24.9	10.6	9.4	12.7	1	1	2	2	2
Indonesia	2.1	3.0	5.9	9.1	10.0	9	7	4	3	3
Malaysia	4.8	5.6	6.7	8.0	8.3	5	5	3	4	4
India	0.1	0.2	2.7	3.7	5.5	43	51	8	9	5
Viet Nam	0.1	2.0	5.2	4.1	4.8	38	9	5	6	6
Brazil	0.0	0.2	0.7	2.2	3.8	92	41	28	12	7
Philippines	0.2	3.5	4.1	4.0	3.7	27	6	6	7	8
Australia	7.1	1.9	2.2	3.7	3.2	4	11	14	8	9
South Africa	-	-	2.3	4.4	3.0	202	211	12	5	10
China	0.1	0.4	3.2	1.8	2.3	39	28	7	14	11
Belgium	-	-	2.4	2.8	1.9	123	172	11	10	12
Other Asia, nes	1.9	1.8	2.0	1.3	1.8	11	13	15	20	13
Pakistan	0.7	1.1	0.9	1.4	1.6	18	20	26	19	14
United Kingdom	1.6	1.7	1.8	2.1	1.6	12	15	17	13	15
United Arab Emirates	0.5	1.9	1.2	1.6	1.5	23	10	22	16	16
Netherlands	0.5	1.5	1.7	1.7	1.5	22	16	18	15	17
Cambodia	0.0	1.8	1.5	1.4	1.4	110	14	20	17	18
Singapore	9.1	5.9	2.6	2.3	1.3	3	4	10	11	19
Argentina	-	0.1	0.1	1.4	1.1	116	54	46	18	20

Source: UN-COMTRADE (http://COMTRADE.un.org)

The different growth in the trade of electronics parts and components and auto parts is due to their different characteristics. The electronics sector has a discrete production process with different scale, skill and technology requirements. It varies from a simple assembling process with requires unskilled labour to the sophisticated high technology production process which requires very skilled labour. The electronics parts and components are usually small and light and it is therefore possible to transport them using air freight instead of sea or land transportation modes. This type of transportation saves transportation time and with the high value-to-weight ratio of the parts and components, it is still economical to transport it to distant locations. With technological development, the fragmented products become more similar and useful in a range of industries. An example is the use of computer chips not only in computers but also in other electrical goods such as toasters, laser devices and other products. Therefore it is easier for the electronics sector to achieve economies of scale. The government intervention in the electronics sector is not as intense as in the automotive sector and the trade and investment barriers in the electronics sector are also lower or do not exist.

The automotive sector also has a discrete production process, but it has a narrow range of standardized parts which can only be used by specific types, therefore it is more difficult for the auto parts producers to reach economies of scale. The component makers in the automotive sector are usually technologically more advanced compared to the electronics sector, while the assembly process is labour intensive. In contrast to electronics parts and components, auto parts are heavier and larger and it therefore less economical to trade to distant locations. Since vehicle development is concentrated in a few design centres, the automotive production networks are nested within the global organization and structure of the largest car maker firms. This leads to a higher degree of agglomeration compared to the electronics sector. Auto parts are less traded compared to the electronics sector with more intense government's intervention. The local content requirements for domestic production of automotive and tariffs on final products remained relatively high until recently.

The electronics global production network is more dispersed than the automotive production network and this is reflected in the mapping of East Asian trade of electronics parts and components and auto parts. Intra-regional trade in East Asia is lower in the electronics parts and components compared to the auto parts. Dependence on developed countries such as North America and the EU-15 is declining, while China is becoming a major partner for East Asian countries.

There is an increase of trade intensity between intra Asian countries compared to trade between Asian countries and other countries. In the 1970s and 1980s the Asian parts and components trade was dominated by Japan and the US, but the pattern has changed in the last two decades with the share of developing East Asian countries accounting for more than 80 percent of the regional trade. The rise of China has been the dominant factor behind this structural change.

The policy toward the electronics and automotive sector in Asian countries affects participation in the global production networks. In the electronics sector, the government support in terms of providing a sound education system and incentives for the private sectors engaging in research and development activities such as in Taiwan and Korea are successful in development of this sector. In the automotive sector, the Thailand automotive sector has grown rapidly in the last twenty years and became a major hub for automotive production for regional and global market. This rapid development is a result of a combination between a change in the global automotive sector and the favourable policy environment set by the Thailand government. Meanwhile, heavy government protection in the automotive sector as in the Malaysia is not successful because the overall car production is still too small, which makes auto parts firms less internationally competitive because they cannot reach economies of scale. Consequently, the Malaysian auto parts industry remains small scale, inefficient and lacking in the technological competencies.

For exports of electronics parts and components, Indonesia's position is below all ASEAN-5 countries (Malaysia, the Philippines, Singapore and Thailand) and its export value was much lower than other ASEAN-5 countries. Indonesia's export value was only \$122 million in 1990, while the others were more than \$3 billion. Although Indonesia was at the 9th position, its low value of exports indicates low participation in the electronics global production networks. In the automotive sector, Indonesia's export of auto parts position was 9th for the period 1990 - 2010, with a substantial increase from only \$112 billion in 1990 to almost \$5 trillion in 2010. Thailand also experienced a substantial increase in its export value from \$312 billion in 1990 to almost \$14 trillion in 2010.

Appendix

Appendix 3.1: Export of Electronics Parts and Components ($million), 1988 – 2007

Year	ASEAN4	China	Japan	NIE	EU15	North America	Other	World
1988	4,404	N/A	47,697	8,880	78,973	5,251	8,654	153,860
1989	8,004	N/A	51,308	33,622	85,210	50,445	10,535	239,125
1990	10,357	N/A	53,076	39,111	102,415	58,190	12,893	276,043
1991	15,538	N/A	59,735	44,693	106,692	62,375	12,557	301,590
1992	18,264	5,013	67,204	58,022	113,320	73,068	16,026	350,917
1993	23,273	6,109	76,705	67,628	114,549	80,427	17,314	386,005
1994	31,979	9,152	91,567	92,044	139,500	96,758	20,997	481,996
1995	43,433	13,799	109,123	125,896	183,672	117,183	27,779	620,885
1996	55,783	15,905	97,284	130,884	194,053	125,441	31,971	651,320
1997	63,854	20,619	98,166	138,525	212,207	145,125	36,788	715,285
1998	68,712	24,710	87,465	128,561	220,396	144,911	42,902	717,656
1999	86,081	29,899	95,887	145,764	238,453	161,111	37,212	794,407
2000	101,991	42,584	116,797	189,771	268,469	193,874	138,726	1,052,213
2001	83,318	49,631	88,820	150,201	251,553	159,118	131,535	914,176
2002	87,958	67,921	87,320	159,321	249,471	139,994	129,663	921,648
2003	93,606	96,960	96,150	186,649	270,248	141,883	152,955	1,038,451
2004	103,138	137,597	111,715	235,418	318,019	148,655	192,566	1,247,109
2005	112,301	174,062	110,409	253,249	350,744	152,381	218,598	1,371,743
2006	125,510	223,452	115,720	292,992	399,693	166,966	237,765	1,562,098
2007	124,619	190,302	68,811	178,703	258,809	120,670	203,931	1,145,843

Source: UN-Comtrade

Notes: - *ASEAN 4: Indonesia, Malaysia, Thailand, and Philippines*
- *NIEs: Singapore, Taiwan, Hong Kong, Korea*
- *EU – 15: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, and United Kingdom*
- *North America: US, Canada and Mexico*

Appendix 3.2: East Asian Countries Export of Electronics Parts and Components ($million), 1988 – 2007

Year	Japan	China	Hong Kong SAR	Taiwan	Rep. of Korea	Singapore	Indonesia	Malaysia	Philippines	Thailand	World
1988	47,697	N/A	N/A	N/A	8,880	N/A	N/A	4,404	N/A	-	153,860
1989	51,308	N/A	N/A	11,027	9,907	12,688	70	5,588	N/A	2,346	239,125
1990	53,076	N/A	N/A	12,314	11,035	15,762	122	7,083	N/A	3,153	276,043
1991	59,735	N/A	N/A	14,285	12,712	17,696	259	9,083	2,255	3,940	301,590
1992	67,204	5,013	5,693	16,315	14,549	21,464	649	11,320	1,399	4,897	350,917
1993	76,705	6,109	5,969	17,877	16,647	27,136	763	14,611	1,760	6,138	386,005
1994	91,567	9,152	6,133	20,911	22,827	42,174	1,087	19,833	2,352	8,707	481,996
1995	109,123	13,799	6,929	28,652	34,521	55,794	1,673	26,944	3,151	11,665	620,885
1996	97,284	15,905	6,013	30,563	31,885	62,423	2,239	30,087	10,280	13,177	651,320
1997	98,166	20,619	6,143	35,127	32,858	64,397	2,141	33,146	14,571	13,996	715,285
1998	87,465	24,710	4,931	33,635	31,181	58,813	1,955	32,656	19,677	14,425	717,656
1999	95,887	29,899	4,294	36,785	41,957	62,729	2,857	41,706	25,688	15,829	794,407
2000	116,797	42,584	4,843	50,121	57,429	77,378	6,912	48,437	27,309	19,333	1,052,213
2001	88,820	49,631	3,617	39,604	42,504	64,477	5,491	40,205	20,816	16,806	914,176
2002	87,320	67,921	2,718	41,112	50,423	65,067	5,338	42,574	22,848	17,197	921,648
2003	96,150	96,960	1,954	45,583	61,550	77,562	5,544	44,399	23,409	20,253	1,038,451
2004	111,715	137,597	2,324	54,692	81,796	96,606	6,267	50,042	24,140	22,690	1,247,109
2005	110,409	174,062	4,217	57,853	84,839	106,340	7,088	54,907	24,941	25,364	1,371,743
2006	115,720	223,452	4,322	75,380	88,282	125,008	6,761	61,267	26,864	30,618	1,562,098
2007	68,811	190,302	1,105	69,834	59,113	48,651	6,214	62,802	29,578	26,025	1,145,843

Source: UN-Comtrade

Appendix 3.3: Export of Auto Parts ($million), 1988 - 2007

Year	ASEAN4	China	EU15	Japan	NIE	North America	Other	World
1988	179	-	40,692	24,091	2,134	10,056	32,023	109,177
1989	608	-	42,736	26,121	3,508	33,576	35,380	141,929
1990	754	-	52,298	27,632	3,900	38,158	41,988	164,730
1991	1,298	-	85,264	29,068	4,112	38,048	10,004	167,795
1992	1,870	1,165	94,144	32,388	6,768	46,478	13,688	196,502
1993	2,704	1,398	72,144	37,347	8,088	53,504	14,452	189,636
1994	3,774	1,938	86,134	43,050	9,451	59,813	16,492	220,653
1995	4,164	2,883	105,241	47,742	11,303	64,921	21,850	258,105
1996	4,315	3,311	114,570	42,757	12,252	69,920	24,887	272,013
1997	4,614	3,940	113,283	38,952	12,754	80,228	28,154	281,925
1998	4,879	4,339	123,097	33,825	11,094	82,851	32,517	292,601
1999	5,779	5,280	131,085	38,452	10,854	91,657	25,283	308,391
2000	6,990	7,082	128,556	43,298	11,857	99,250	28,322	325,355
2001	6,477	7,763	127,524	37,560	11,134	93,183	31,139	314,779
2002	7,236	10,153	141,450	39,719	12,461	95,647	35,924	342,590
2003	8,690	13,682	173,097	45,207	16,386	95,498	47,537	400,095
2004	11,727	20,295	207,087	52,397	20,544	104,629	60,958	477,637
2005	14,188	27,713	221,090	55,710	25,169	112,957	72,969	529,796
2006	16,318	36,034	242,730	56,179	27,857	119,848	84,614	583,581
2007	19,495	48,309	284,783	61,527	32,651	124,804	108,146	679,716

Source: UN-COMTRADE

Appendix 3.4: Rank of Car Production (unit), 2000 – 2010

Rank	2000	2005	2007	2009	2010
1	USA	USA	Japan	**China**	**China**
2	Japan	Japan	USA	Japan	Japan
3	Germany	Germany	**China**	USA	USA
4	France	**China**	Germany	Germany	Germany
5	South Korea	South Korea	South Korea	South Korea	South Korea
6	Spain	France	France	Brazil	Brazil
7	Canada	Spain	Brazil	India	India
8	**China**	Canada	Spain	Spain	Spain
9	Mexico	Brazil	Canada	France	Mexico
10	UK	UK	India	Mexico	France
11	Italy	Mexico	Mexico	Canada	Canada
12	Brazil	India	UK	UK	**Thailand**
13	Russia	Russia	Russia	Czech Rep.	Iran
14	Belgium	**Thailand**	**Thailand**	**Thailand**	Russia
15	India	Italy	Italy	Poland	UK
16	Poland	Belgium	Turkey	Turkey	Turkey
17	Czech Rep.	Turkey	Iran	Italy	Czech Rep.
18	Turkey	Iran	Czech Rep.	Iran	Poland
19	**Thailand**	Poland	Belgium	Russia	Italy
20	Taiwan	Czech Rep.	Poland	Belgium	Argentina
21	South Africa	**Malaysia**	Others	Argentina	**Indonesia**
22	Australia	South Africa	Slovakia	**Malaysia**	**Malaysia**
23	Argentina	Others	Argentina	**Indonesia**	Slovakia
24	Sweden	**Indonesia**	South Africa	Slovakia	South Africa
25	**Indonesia**	Taiwan	**Malaysia**	Supplementary	Romania
26	**Malaysia**	Australia	**Indonesia**	South Africa	Belgium
27	Iran	Sweden	Ukraine	Romania	Taiwan

Notes: production includes cars and commercial cars

Source: OICA (http://www.oica.net)

Appendix 3.5: East Asian Countries' Export of Auto Parts ($ million), 1988 - 2008

Year	Japan	China	Hong Kong	South Korea	Singapore	Indonesia	Malaysia	Philippines	Thailand	World
1988	24,091	-	-	2,134	-	-	179	-	-	109,177
1989	26,121	-	-	2,197	1,311	90	259	-	259	141,929
1990	27,632	-	-	2,460	1,440	112	331	-	312	164,730
1991	29,068	-	-	2,494	1,618	184	513	255	346	167,795
1992	32,388	1,165	2,161	2,763	1,844	315	691	370	495	196,502
1993	37,347	1,398	2,998	2,887	2,202	423	843	463	975	189,636
1994	43,050	1,938	3,468	3,297	2,686	500	1,125	719	1,429	220,653
1995	47,742	2,883	4,441	3,798	3,064	710	1,286	800	1,367	258,105
1996	42,757	3,311	4,661	4,407	3,184	880	1,249	897	1,289	272,013
1997	38,952	3,940	5,066	4,683	3,005	903	1,323	1,005	1,384	281,925
1998	33,825	4,339	4,277	4,540	2,277	860	1,432	953	1,633	292,601
1999	38,452	5,280	3,552	5,062	2,240	1,045	1,751	1,200	1,783	308,391
2000	43,298	7,082	4,014	5,460	2,382	1,473	1,736	1,434	2,347	325,355
2001	37,560	7,763	3,415	5,564	2,156	1,546	1,360	1,383	2,187	314,779
2002	39,719	10,153	3,706	6,362	2,392	1,706	1,405	1,567	2,557	342,590
2003	45,207	13,682	4,058	8,515	3,813	1,881	1,695	1,727	3,386	400,095
2004	52,397	20,295	4,597	11,233	4,714	2,487	2,245	2,236	4,758	477,637
2005	55,710	27,713	5,252	14,592	5,325	3,074	2,299	2,395	6,420	529,796
2006	56,179	36,034	5,144	16,971	5,742	3,526	2,376	2,549	7,867	583,581
2007	61,527	48,309	5,512	20,475	6,665	3,508	3,006	3,030	9,951	679,716

Source: UN-COMTRADE

Chapter 4: Overview of Indonesian Economy

4.1 Introduction

Indonesia is the fourth most populous country in the world and the largest economy in Southeast Asia. Its economic development has varied over time. From independence in 1945 until the advent of the New Order Era in 1966, Indonesia underwent a structural retrogression with GDP per capita hardly rising and the share of the labour intensive or traditional sector in total output increasing, while the share of the modern capital intensive sectors declined (Booth, 1998). It was different to neighbours such as Thailand and the Philippines where the manufacturing sectors were far more dynamic. In the early 1990s, The World Bank classified Indonesia as one of the seven East Asian miracle economies because of its rapid growth since 1967. However, the Asian crisis in 1997-1998 hit Indonesia hard, especially as it was followed by domestic political turmoil and resulted in a contraction of GDP per capita by almost 14 percent in 1998. Although Indonesia has now recovered to its pre-crisis level, the country has in effect lost a decade of growth (Hill and Shiraishi, 2007).

To provide a backdrop for further analysis on the reasons why Indonesia lags behind other ASEAN countries in participation in global production networks, this chapter surveys Indonesian trade, industrial and investment policies and its economic development. The first section discusses economic development which includes economic growth, international trade, investment, labour market and infrastructure conditions. The second section surveys the trade, industrial and investment policies which changed over time to respond to a change in economic dynamics. Since the beginning of the new order era in 1966, the economic policy and development in Indonesia can be categorized into six periods. The third part discusses historical development and policy regime in the electronics sector, followed by the forth part on historical development and policy regime in the automotive sector. The last section concludes.

4.2 Economic Development

From independence in 1945 until 1967, Indonesia experienced a structural retrogression where the labour intensive or traditional sector share of total output increased while the share of the modern capital intensive sector declined. Rapid industrial growth and catch up took place during the New Order era (1966-1998) and in the early 1990s. The World Bank considered Indonesia to be one of the seven Asian "Miracle" economies in the late 1980s and early 1990s. Indonesia was also considered to be an industrial late starter due to muddled economic policies and relative resource endowment which resulted in a distinct development path (Bird and Hill, 2006). The windfall revenue from the oil boom in the 1970s allowed Indonesia to minimize the "Dutch disease" effect by using oil revenue to finance large investments in infrastructure, agriculture and state enterprise sectors. As discussed before, the rapid economic growth stopped abruptly in 1997-1998 as a result of the Asian Financial Crisis (AFC) and the following domestic political turmoil which resulted in a change of regime.

4.2.1 *Economic Growth*

As shown in Figure 4.1, Indonesia's real GDP per capita has increased from $193 in 1967 to $1,144 in 2010 (or $3,879 in PPP constant 2005 international $). Following a sharp decline in 1998 with an almost 14 percent contraction, it took seven years to return to its pre-crisis level of $875.

Figure 4.1 shows the economic growth can be classified into five periods. The first is the stabilization period (1967-1972) with average annual growth of 4.6 percent. The second period is the oil boom (1973-1981) when the economy grew by 5.5 percent on average. The third is the major deregulation period (1982-1996) with 5 percent annual growth. The financial crisis hit Indonesia severely in the fourth period (1997-2001) and resulted in negative average annual growth of -1.1 percent. The fifth is the recovery and post Soeharto period (2002 – current) with slower growth of 4.2 percent on average.

Figure 4.1: Economic Development – Per Capita Real GDP, 1967 – 2010

Source: World Bank, WDI website (http://data.worldbank.org/indicator)

Indonesia's economy is mainly consumption driven as shown in Table 4.1, with consumption contributing almost 60 percent of total GDP after 1982. This is comparable with other Southeast Asian countries (ADB, ILO and IDB, 2010). The contribution of investment, both domestic and foreign, reached its highest contribution after the major deregulation period because of a conducive business environment.

Indonesia's economy has undergone a significant structural change over this period. The agriculture sector, dominant before the oil boom period with a contribution 45.5 percent, became less dominant and its contribution has continued to decline in recent years to 14 percent. In contrast, the industry sector's contribution was only 19 percent in the stabilization period but it has contributed the most in recent years increasing to 46 percent. After the financial crisis, the service sector became more important with an increase in contribution to 40 percent.

Table 4.1: Annual Average Real GDP Growth and Share in GDP by Expenditure and Sectors, 1967-2010

Period	GDP per capita		Average Share in GDP by Expenditure (%)					Average Share in GDP by Sectors (%)		
	Growth Rate	GDP per Capita	Consump-tion	Goverment Exp	Invest-ment	Export	Imports	Agricul-ture	Industry	Services
1967-1972	4.6	226.2	81.9	7.5	9.8	10.2	-9.4	45.5	18.5	36.0
1973-1981	5.5	335.7	78.6	7.7	15.0	15.6	-16.9	29.1	35.4	35.5
1982-1996	5.0	575.3	59.4	10.1	27.0	25.4	-21.9	20.7	38.9	40.5
1997-2001	-1.1	787.6	58.7	8.6	30.6	26.5	-24.4	16.9	45.1	38.0
2001-2010	4.2	965.9	63.8	7.0	23.8	34.6	-29.3	14.4	46.2	39.4

Source: World Bank, WDI website (http://data.worldbank.org/indicator)

4.2.2 International Trade

International trade is becoming more important for the Indonesian economy with an increasing contribution in GDP (Appendix 4.1 for annual data). Export's contribution in GDP increased from 27 percent in 2001 to 30 percent in 2010.

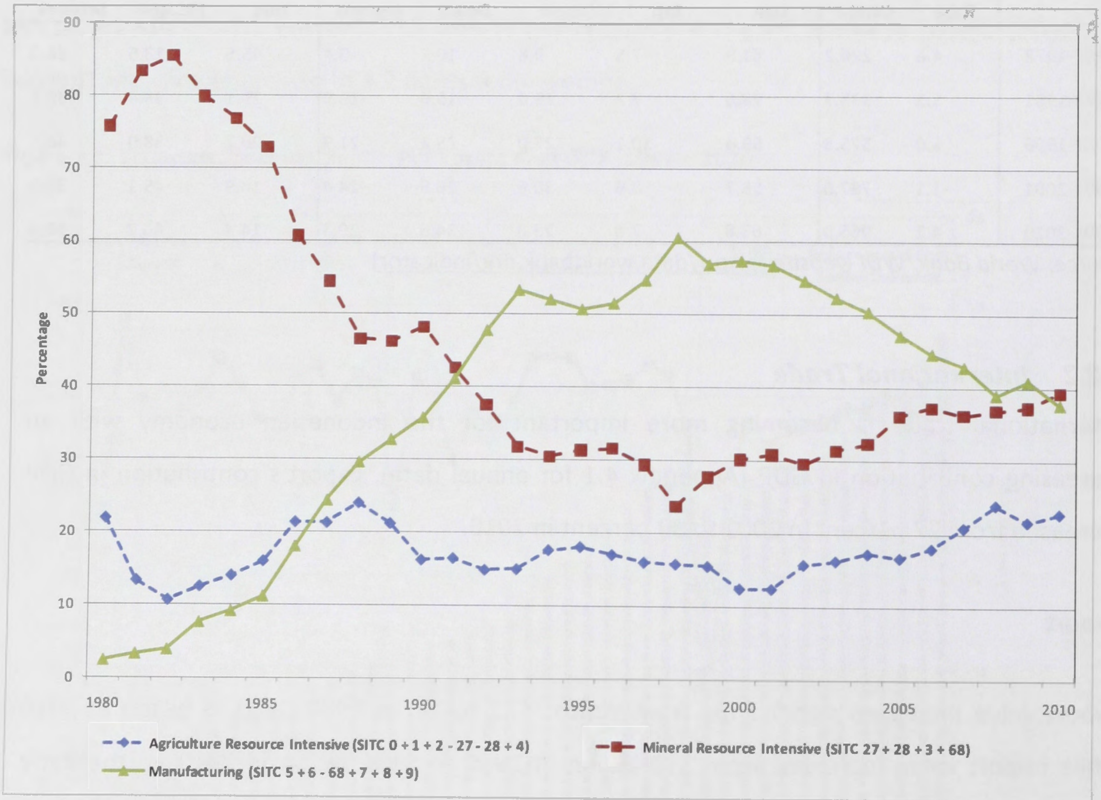
Export

Export value increased significantly from almost $22 billion in 1980 to $158 billion in 2010 while import value increased from $10 billion in 1980 to $136 billion in 2010. In the early 1980s, Indonesia's exports were dominated by mineral resource intensive (MRI) products, especially oil and gas because of the oil boom. Until 1986, the share of MRI in total exports was more than 60 percent, with a highest share of 86 percent in 1982 (Figure 4.2). After 1987, the share declined to less than 50 percent because of the falling world oil price. However, the share of mineral resource intensive export began to increase after the AFC reaching 41 percent in 2009 mainly as a result of the increase export of coal (Figure 4.3).

The share of Agricultural Resource Intensive (ARI) products in exports has been relatively stable. Its highest share was during 1986-1989 when the oil price declined. Since 2006, the ARI share has increased significantly because of the sharp increase in the export of vegetable oil and fats, especially palm oil.

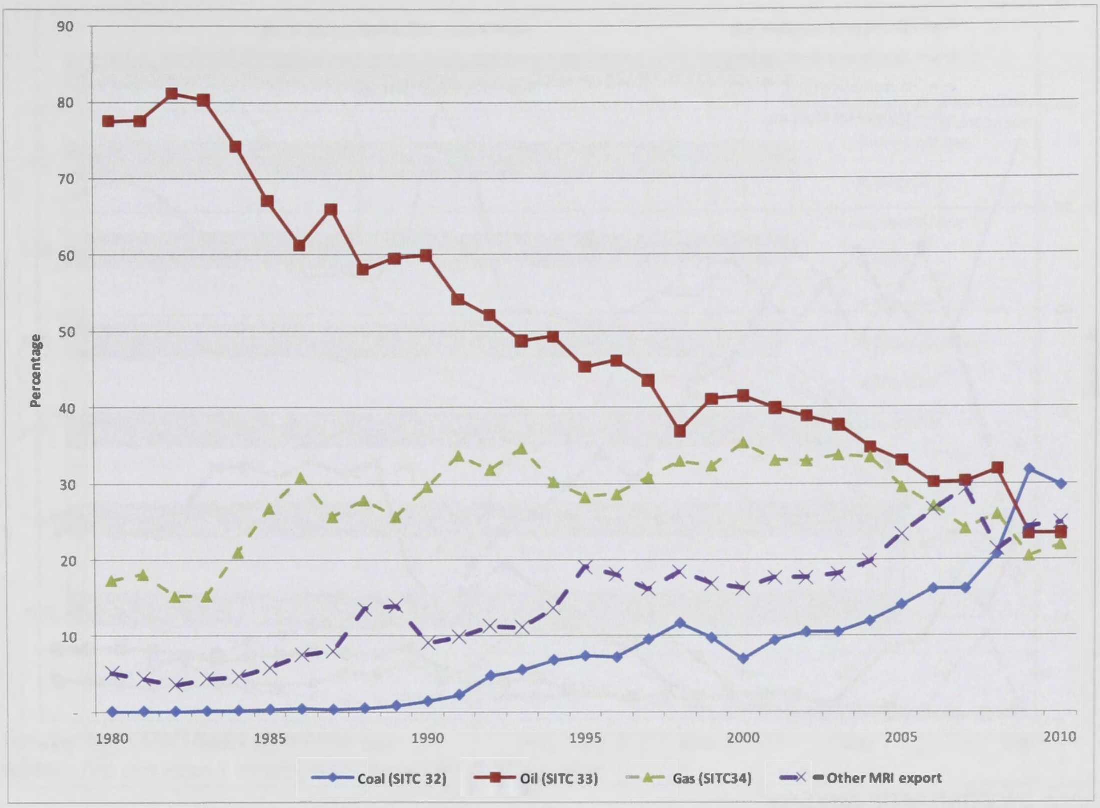
The export of manufacturing products became important since the late 1980s in response to the introduction of deregulation packages to improve Indonesia's investment climate for domestic and foreign investors as well as the series of trade reforms to reduce the country's anti-export bias, especially the introduction of a duty exemption and the drawback scheme in May 1986. . The manufacturing export share increased from only 2.4 percent in 1980 to more than 50 percent in the 1990s. After the financial crisis, the manufacturing sector share continued to decline and it contributed less than 40 percent in 2010 (Appendix 4.2).

Figure 4.2: Indonesia: Share of Exports by Factor Intensity, 1980 - 2010



Source: UN-COMTRADE database

Figure 4.3: Indonesia: Share of Mineral Resource Intensive Export, 1980 – 2010

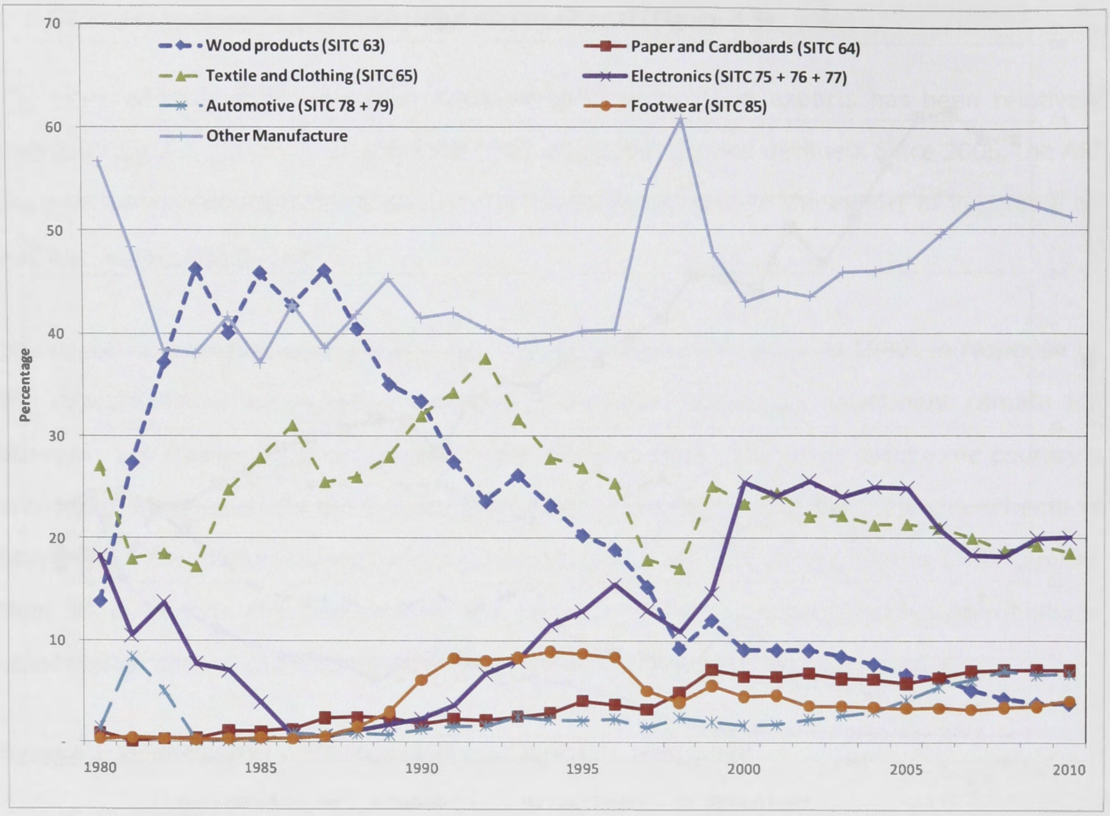


Source: UN-COMTRADE database

There has been a change in export composition among manufacturing products as shown in Figure 4.4. Immediately before the AFC, unskilled labour intensive sectors, such as textiles and clothing, wood products and footwear, dominated manufacturing export. Textiles and clothing expanded rapidly until 1992 with wood products relatively stable until 1992 before experiencing a sharp increase in 1993 followed by a rapid decline because of change in regulation from export ban to high export tariff on timber. Footwear experienced stable export growth until 1996 when its contribution also declined. The slower growth in unskilled labour intensive products was caused by the declining competitiveness of the Indonesian labour intensive sector as a result of the increasing labour costs compared with other ASEAN countries such as Vietnam and Cambodia. On the other hand, electronics and telecommunications exports experienced high growth until 1996.

After the AFC, there was a brief resurgence in manufacturing exports that was not sustained (Thee, 2009). Automotive products continued to contribute to manufacturing exports although with modest increase. This continued increase in the automotive export share is closely related to increasing automotive regional production networks.

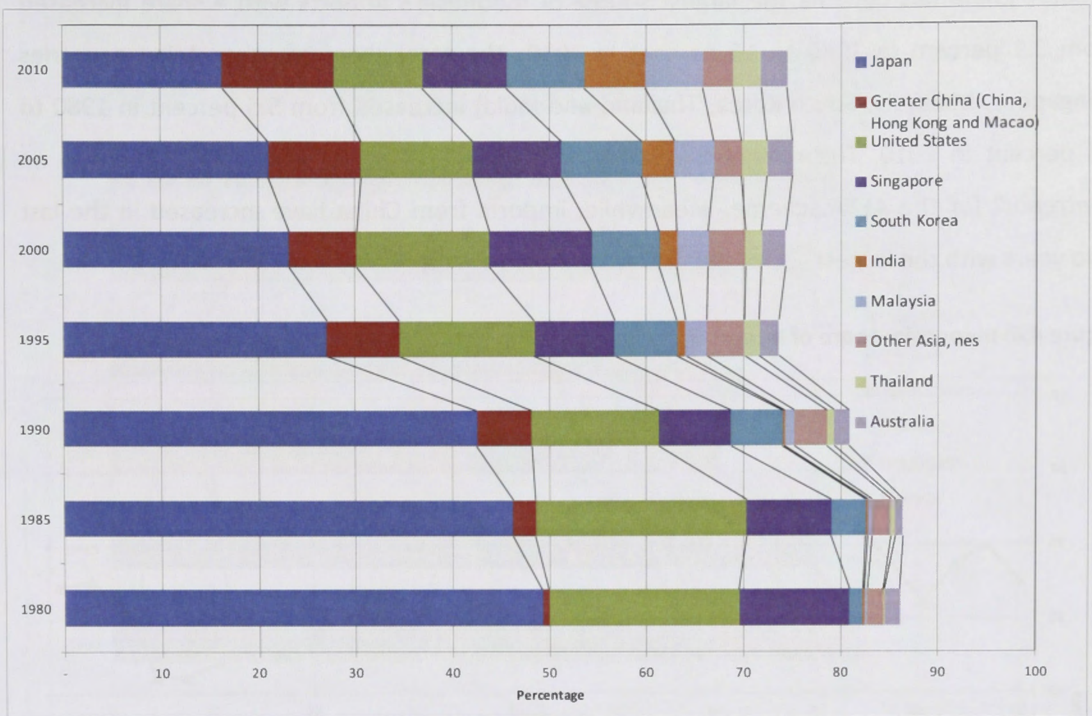
Figure 4.4: Indonesia: Share of Manufacturing Export, 1980 – 2010



Source: UN-COMTRADE database

The destination of exports also experienced significant change after the AFC (Figure 4.5). Before the AFC, Japan and the US were the two major export destination countries with a total share of more than 40 percent of total exports. Although Japan is still the largest export destination, its share declined from 50 percent in 1980 to only 16 percent in 2010. Meanwhile, Greater China (China, Hong Kong and Macao) became more important for Indonesian exports. The export share to Greater China increased from less than 1 percent in 1980 to 11 percent in 2010. Exports to Singapore declined in 2010 while exports to other Asian countries (South Korea, Malaysia, Thailand and Other Asia) increased from 4 percent in 1980 to 23 percent in 2010. This change in export destination is consistent with the higher intensity of the regional production networks in Asia where the role of Thailand and Malaysia as centres of regional production networks has become more significant.

Figure 4.5: Composition of Major Indonesia's Exports Destination (percent), 1980 - 2010



Source: UN-COMTRADE database
Notes: Top ten export destinations based on 2010 exports

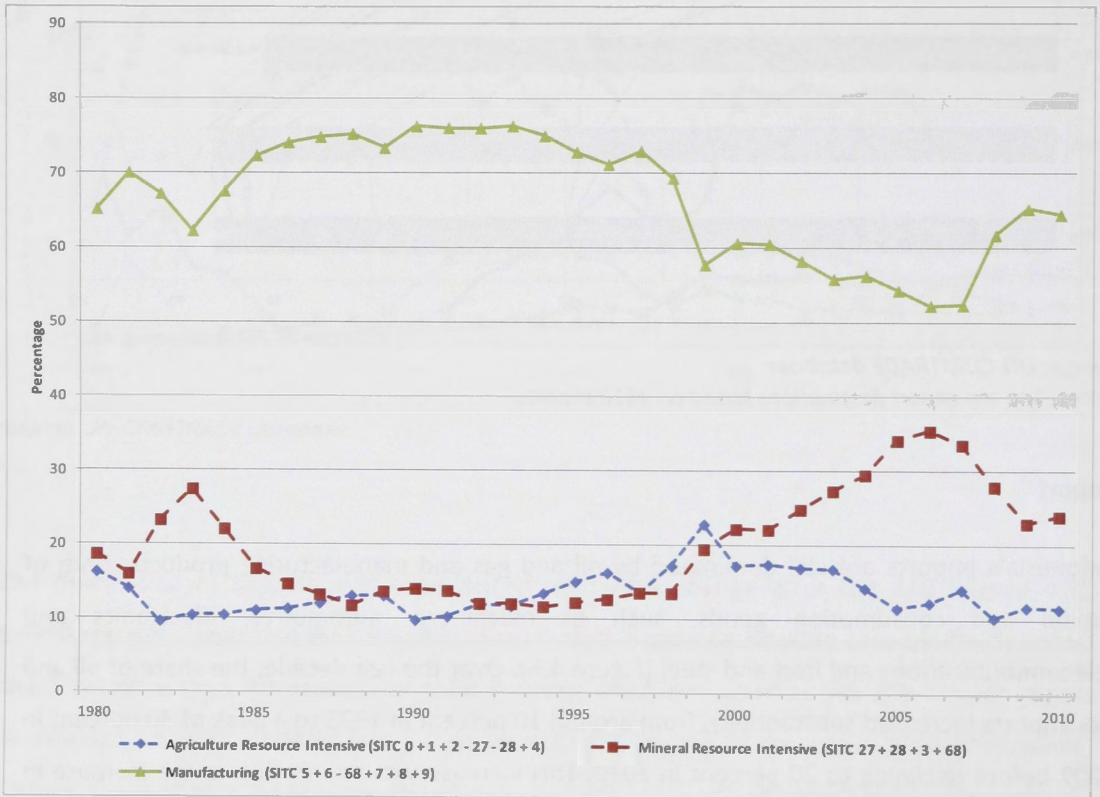
Import

Indonesia's imports are still dominated by oil and gas and manufacturing products, both of capital and consumption goods, such as machinery, automotive, electronics and telecommunications and iron and steel (Figure 4.6). Over the last decade, the share of oil and gas imports increased substantially, from around 10 percent in 1998 to a peak of 30 percent in 2007 before declining to 20 percent in 2010. This increase was mainly due to the increase in world oil prices which reached their highest point in 2007 because of the Iraq war as well as the high economic growth in Asia and Indonesia's switch from being a net exporter to a net importer of oil.

Machinery dominated manufacturing imports until 2007 but for the last three years was replaced by electrical and telecommunications equipment imports. Automotive imports, including auto parts, have also experienced an increasing share since 2007. The increase in these imports reflects the increase in Indonesian participation in the regional/global production network in the electronics and automotive industry.

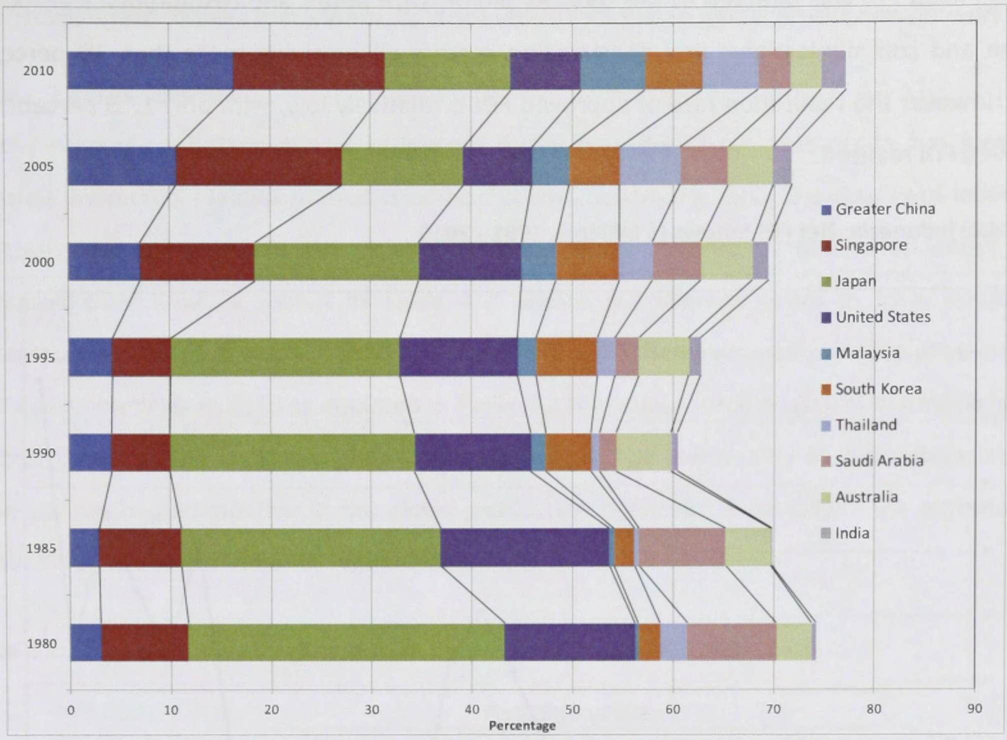
The composition of import sourcing countries has changed since the AFC. Japan and USA were the major import sourcing countries with a share of more than 40 percent in 1986, but this has declined to less than 20 percent in 2010. The main source of imports then moved to Asian countries such as Singapore, Greater China, South Korea, Thailand and Malaysia (Figure 4.7). Greater China has become the largest source of Indonesia's imports with a share increased from 3.1 percent in 1980 to 16 percent in 2010. The total share of other Asian countries (Singapore, Malaysia, South Korea, Thailand and India) increased from 5.5 percent in 1980 to 17 percent in 2010. The role of Singapore in Indonesian imports is very important as an "*entrepôt*" for the AFTA scheme. Meanwhile, imports from China have increased in the last two years with the largest sector being electronics parts and components.

Figure 4.6: Indonesia: Share of Import by Factor Intensity, 1980 - 2010



Source: UN-COMTRADE database

Figure 4.7: Composition of Major Indonesia's Import Source (percent), 1980, 2010



Source: UN-COMTRADE database

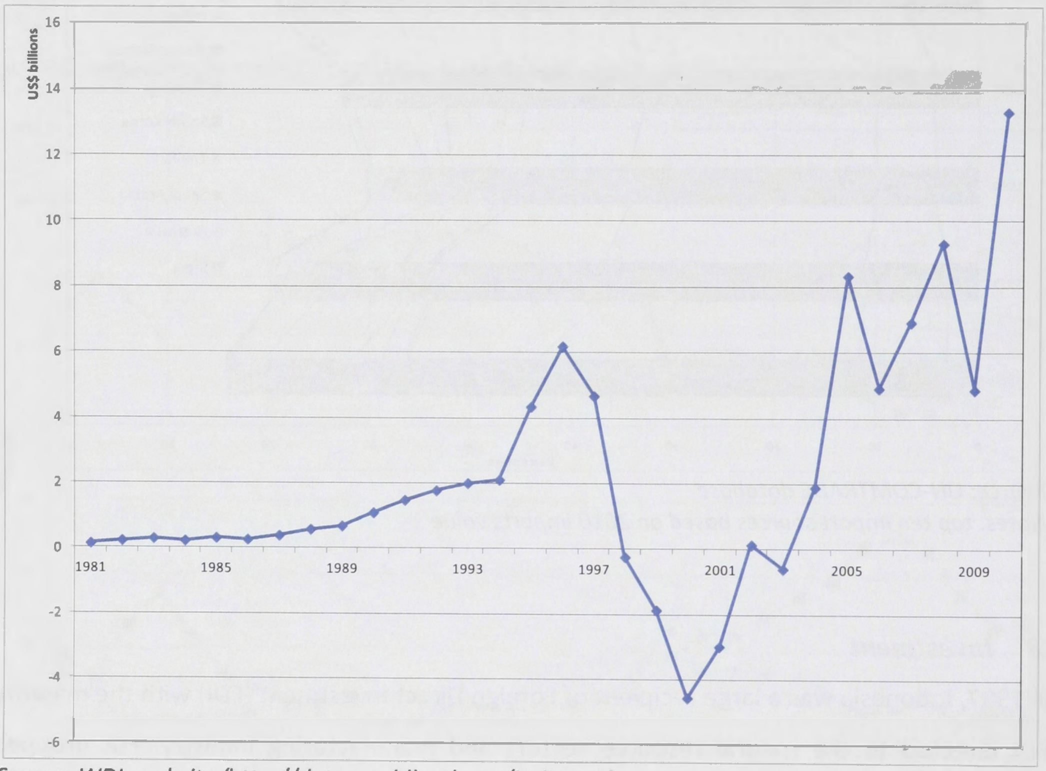
Notes: top ten import sources based on 2010 imports value

4.2.3 Investment

Until 1997, Indonesia was a large recipient of Foreign Direct Investment (FDI) with the majority of FDI directed to the natural resource sectors and manufacturing industry. FDI dropped significantly during the AFC period and began to pick up again in 2004. Before the mid 1980s most of the FDI for the manufacturing sector was concentrated in import substitution industries. The more liberal investment climate after the 1980s economic reforms saw FDI concentration shift to export orientated manufacturing and the services sectors. However the AFC resulted in negative FDI inflows because of the political disturbances that followed in 1998 which raised uncertainty about investing in Indonesia. There were several "horror stories" in the press on the FDI following the AFC. These included Cemex's (the huge Mexican cement company) difficulties acquiring Semen Gresik; the protracted saga of the Canadian insurance company Manulife; Standard Chartered Bank's aborted takeover of Bank Bali; a footwear exporter moving to Vietnam; Sony electronics moving to Malaysia; and many more (Bird and Hill, 2006).

There was a change in the approved FDI pattern in Indonesia after the AFC as described by Khaliq and Noy (2007). During 1997-1999, more than 70 percent of FDI was directed to manufacturing sectors, in particular paper and printing, the chemical and the pharmaceutical industries, and the food industries all received more than 10 percent each. In contrast, after the AFC, most FDI was directed to the services sector, with hotels and restaurants; transport, storage and communications; and construction sectors all receiving more than 10 percent each. However the realization rate of approved FDI is relatively low, with only 17.5 percent of approved FDI realized.

Figure 4.8: Indonesia: Net FDI Inflows ($ billions), 1981 - 2010



*Source: WDI website (*http://data.worldbank.org/indicator*)*

The nature of FDI has also changed since the AFC. Prior to the AFC, most FDI in the form of greenfield investments in sectors such as manufacturing. After the AFC most FDI has been in the form of expansion, mergers and acquisitions (M&A) which is consistent with Lipsey's fire-sale FDI behaviour following a crisis where there is excess capacity and assets prices fall drastically because of real exchange depreciation. Examples of success stories of the FDI fire-sale in Indonesia are two major cement producers, Indocement and Semen Cibinong that are now foreign controlled, Unilever has bought several local brands in the consumer market and the modern retail sector has been opened to FDI with French firm Carrefour, Korean firm Lotte Mart and Malaysia firm Giant opening many outlets since late 1998 (Bird and Hill, 2006).

In general, the structure of FDI in Indonesia is different from other Asian countries (Lipsey and Sjöholm, 2010). Most FDI in Indonesia is in sectors where alternative locations are few, such as mining and raw materials, and there has only been a low inflow of FDI in machinery and electronics which implies that Indonesia is not very attractive to global production networks.

4.2.4 Labour Market

Labour market conditions are an important factor considered by investors in the location decision. Indonesia's labour market condition is not challenging. First, the quality of labour is relatively low compared to the neighbouring countries. Indonesia's quality of labour has increased over time as shown in Table 4.2, where the average years of total schooling increased from only 1.6 years in 1960 to 6.1 years in 2010. However, compared to other South East Asian countries in 2010 as depicted in Table 4.3 the labour force quality in Indonesia is the second lowest of ten countries with Cambodia lowest. The low quality of Indonesia's labour force constrains participation in the global production networks, especially in the automotive sector since this sector requires higher skills.

Table 4.2: Indonesia: Education Completion Rate by Level (Age 15+), 1960 – 2010

Year	Average years			
	Total Schooling	Primary Schooling	Secondary Schooling	Tertiary Schooling
1960	1.6	1.4	0.1	0.00
1965	2.2	1.9	0.2	0.01
1970	2.8	2.5	0.3	0.01
1975	3.2	2.7	0.4	0.02
1985	3.9	3.0	0.9	0.05
1980	4.0	3.2	0.8	0.02
1990	4.1	2.9	1.2	0.05
2000	4.3	3.0	1.3	0.06
1995	4.5	3.4	1.1	0.06
2005	5.6	4.2	1.3	0.07
2010	6.1	4.5	1.6	0.08

Source: Barro-Lee dataset, WDI website (http://data.worldbank.org/indicator)

In addition to the low labour force quality in Indonesia, labour market policies are less flexible compared to its neighbours. Before the AFC, the Indonesian labour market was more or less in accord with "East Asian norms" (Manning, 1998), where rapid economic growth generated rising real wages with a lag. There was movement of labour from the informal and agricultural sectors to the formal and non-agricultural sectors. Minimum wages existed with rates below the formal levels and they were not enforced systematically.

Table 4.3: Education Completion Rate by Level in East Asian countries (15 and over), 2005 and 2010

Year 2005	Average years Primary Schooling	Secondary Schooling	Tertiary Schooling	Total Schooling	Population aged 15-64 (1000s)
Indonesia	4.2	1.3	0.1	5.6	150,283
Vietnam	4.1	1.5	0.1	5.7	55,039
Cambodia	5.0	0.9	0.0	5.9	8,058
Thailand	5.0	1.5	0.3	6.8	46,417
China	4.9	2.5	0.2	7.6	919,989
Singapore	5.0	2.9	0.5	8.5	3,069
Philippines	5.4	2.3	1.0	8.6	50,878
Malaysia	5.2	4.1	0.3	9.7	16,572
Hong Kong SAR, China	5.0	4.4	0.4	9.9	5,012

Year 2010	Average years Primary Schooling	Secondary Schooling	Tertiary Schooling	Total Schooling	Population ages 15-64 (1000s)
Cambodia	5.1	0.9	0.0	6.0	9,090
Indonesia	4.5	1.6	0.1	6.1	161,699
Vietnam	4.3	2.0	0.2	6.4	61,200
Thailand	5.1	1.9	0.5	7.5	48,785
China	5.0	2.9	0.3	8.2	968,336
Philippines	5.5	2.5	1.0	9.0	56,816
Singapore	5.2	3.4	0.6	9.1	3,736
Malaysia	5.3	4.4	0.4	10.1	18,431
Hong Kong SAR, China	5.2	4.7	0.5	10.4	5,354

Source: Barro-Lee dataset, WDI website (http://data.worldbank.org/indicator)

After the AFC, there was a rapid change in Indonesian labour market policies with two major labour market effects (Bird and Hill, 2006). The first was the sharp fall in real wages in 1998, by more than any other crisis-affected economy. This was a result of the unregulated nature of the market and implies the major impact of the crisis was on price (i.e. real wages) and not on quantity (i.e. unemployment). This condition ameliorated the impact of the crisis on the labour force (Manning, 2000). The second effect was pressure from the pro-labour movement which strengthened after the AFC. The constraints on trade unions were largely removed and the government strongly supported worker entitlements and wage claims. Minimum wages are determined at the sub-provincial level and this situation resulted in a significant increase of 90 percent in just three years (1999-2002). This encouraged workers to expect continuing increases and this led to uncertainty for business, especially when the increase in minimum wages was not accompanied by an increase in labour productivity.

Other regulations also increased labour market rigidities compared to neighbouring countries. The hiring and firing regulations of the 2003 Labour Law discourage firms from formally hiring more workers. For example, the severance pay entitlement has been increased and it is now the highest among the East Asian countries. There is also a requirement to convert contract workers into permanent workers. This discourages firms in the labour-intensive sector which usually hire contract workers seasonally, based on work load. Conversion from contract workers to permanent workers also implies that firms have to bear expensive costs related to the hiring and firing of workers. With the rigidities in the labour market, based on the Doing Business Survey 2009, the Indonesian position in the Employing Workers Index is the second most rigid compared to the other nine countries in East Asia as depicted in Table 4.4 below. Besides the rigidity of hours index and rigidity of employment index, Indonesia is lowest in the difficulty of firing index and firing cost, and second lowest in the difficulty in hiring index.

Table 4.4: Rank of Employing Workers Indicators in some selected Asian countries, 2009

Economy	Ease of Doing Business Rank	Employing Workers					
		Rank	Difficulty of Hiring Index	Rigidity of Hours Index	Difficulty of Firing Index	Rigidity of Employment Index	Firing costs (weeks of wages)
Singapore	1	1	0	0	0	0	4
Hong Kong	4	20	0	0	0	0	62
Malaysia	20	48	0	0	30	10	75
Thailand	13	56	33	20	0	18	54
Vietnam	92	90	11	20	40	24	87
China	83	111	11	20	50	27	91
Philippines	140	126	56	20	30	35	91
Cambodia	135	134	44	60	30	45	39
Indonesia	129	157	61	0	60	40	108
Taiwan	61	159	78	40	40	53	91

World Bank (2009); the website of World Bank http://www.doingbusiness.org/

4.2.5 Infrastructure

One factor that affects the location decision of production blocks in global production networks is the service link cost, which is the cost of connecting all the production blocks efficiently. Infrastructure and institutional quality are two examples of service links, and they will be considered briefly.

During the Soeharto era, there was a massive expansion of physical infrastructure, including roads, ports, airports, irrigation and telecommunications. However, the decentralization to regional governments in 2001 caused a sharp decline in public investment in physical infrastructure. As of 2011, there is no clear coordination arrangement and division of authority between central and local governments in the provision of public infrastructure. The government expects substantial private participation in the provision of infrastructure. However, without a conducive investment climate for these long-term projects the private sector will continue to be reluctant to participate.

Both domestic and foreign investors hold the view that the condition of infrastructure in Indonesia is poor. A survey by Japanese affiliates ranks underdeveloped infrastructure as the most important barrier to investment in the Indonesian manufacturing sector and the third most important barriers to investment in services sector (JETRO, 2009). Meanwhile a survey by Regional Autonomy Watch reveals 27 percent of surveyed firms have identified infrastructure as the most important local constraint on their business activities (KPPOD, 2007). Common problems raised by investors are road congestion, electricity supply which has not kept pace with growing demand and poor quality in port logistics.

Based on the Logistic Performance Index (LPI) conducted by The World Bank every two years, Indonesia's position on infrastructure condition has worsened over time. In 2006, Indonesia was 42nd out of 149 countries, and by 2010, Indonesia's position has dropped to 72nd out of 163 countries. The low quality of infrastructure in Indonesia, especially related to trade processing has influenced Indonesia's competitiveness in attracting global production networks. Comparison with other East Asian countries (i.e. China, Malaysia, Thailand, Philippines, Vietnam and Cambodia) shows that Indonesia is second lowest and only above Cambodia for the overall logistic performance index.

The quality of a country's institutions (which includes the legal system) plays a critical role in attracting business. Institutions in Indonesia are relatively weak and complex with highly corrupt systems. Based on the Doing Business Survey conducted every year since 2004 by the World Bank, Indonesia's has position dropped from 126th in 2010 to 129th in 2011 out of 180 countries. Although the survey has been conducted since 2004, the overall rank is only available since 2010. As evaluated in the Doing Business Survey, Indonesia's position is low in several aspects, such as Starting a Business (155th position), Enforcing Contracts (154th), and Closing a Business (142nd). Although Indonesia has shown some improvement in several aspects in the Doing Business Survey as depicted in Table 4.5, it is still behind most other ASEAN countries. In 2011, the time required to complete all procedures in starting a business was 46 days in Indonesia, 17 and 32 days in Malaysia and Thailand respectively and 38 days in the Philippines. Contract enforcement is the most expensive in Indonesia compared to other ASEAN countries, as the cost is higher than the claim itself (122.7 percent of claim), while the cost in other ASEAN countries is less than 32 percent, except for Cambodia which is 102.7 percent of the claim

Table 4.5: Ease of Doing Business in Indonesia, 2004 – 2011

Year		2004	2005	2006	2007	2008	2009	2010	2011
Ease of Doing Business Rank		..	..	..	..	..	..	115	121
Starting a Business	Rank	..	..	..	..	..	..	159	155
	Procedures (number)	12	12	12	12	12	11	9	9
	Time (days)	168	151	151	97	105	76	60	47
	Cost (% of income per capita)	136.7	130.7	101.7	86.7	80	77.9	26	22.3
	Paid-in Min. Capital (% of income per capita)	69.1	62.8	48.9	41.7	38.4	74.2	59.7	53.1
Enforcing Contracts	Rank	..	..	..	..	..	..	153	154
	Procedures (number)	40	40	40	40	40	40	40	40
	Time (days)	570	570	570	570	570	570	570	570
	Cost (% of claim)	122.7	122.7	122.7	122.7	122.7	122.7	122.7	122.7
Closing a Business	Rank	..	..	..	..	..	..	141	142
	Recovery rate (cents on the dollar)	9.9	10.6	13.1	11.8	12.6	13.7	13.7	13.2
	Time (years)	6	6	5.5	5.5	5.5	5.5	5.5	5.5
	Cost (% of estate)	18	18	18	18	18	18	18	18

Source: World Bank (2009) - Doing Business – http://www.doingbusiness.or

Table 4.6: Ease of Doing Business in Selected ASEAN countries, 2011

Economy		Brunei Darussalam	Cambodia	Indonesia	Lao PDR	Malaysia	Philippines	Thailand	Vietnam
Ease of Doing Business Rank (Rank)		**112**	**147**	**121**	**171**	**21**	**148**	**19**	**78**
Starting a Business	Rank	**133**	**170**	**155**	**93**	**113**	**156**	**95**	**100**
	Procedures (number)	15	9	9	7	9	15	7	9
	Time (days)	105	85	47	100	17	38	32	44
	Cost (% of income per capita)	13.5	128.3	22.3	11.3	17.5	30.3	5.6	12.1
	Paid-in Min. Capital (% of income per capita)	0	37	53.1	0	0	6	0	0
Enforcing Contracts	Rank	**159**	**142**	**154**	**110**	**59**	**118**	**25**	**31**
	Procedures (number)	58	44	40	42	30	37	36	34
	Time (days)	540	401	570	443	585	842	479	295
	Cost (% of claim)	36.6	102.7	122.7	31.6	27.5	26	12.3	28.5
Closing a Business	Rank	**42**	**183**	**142**	**183**	**55**	**153**	**46**	**124**
	Recovery rate (cents in the dollar)	47.2	0	13.2	0	39.8	4.5	43.5	18.6
	Time (years)	2.5	no practice	5.5	no practice	2.3	5.7	2.7	5
	Cost (% of estate)	4	no practice	18	no practice	15	38	36	15

Source: World Bank (2009) - Doing Business – http://www.doingbusiness.org

In addition to complex and cumbersome processes in doing business, corruption is a serious problem in Indonesia. Corruption was actually more predictable during the Soeharto era than after the reformation era (1998 onwards) where the link between corruption and results became weaker and more uncertain. Transparency International publishes a Corruption Perceptions Index every year. This calculates the degree to which corruption is perceived to exist among public officials and politicians. Corruption is defined as the abuse of entrusted power for private gain. In 2010, Indonesia was ranked 110th from 178 countries below its neighbouring countries such as Singapore (1st), Malaysia (56th), Thailand (78th), while the Philippines was 134th. The uncertainty caused by the serious corruption in Indonesia discourages foreign investment, especially in "footloose" sectors where investment can easily be relocated to other countries. This is one explanation for the low investment in manufacturing sectors that has hampered Indonesian participation in the global production networks.

4.3 Trade, Industrial and Investment Policies

For the first twenty years following independence in 1945, it was difficult to implement any economic development policy owing to political struggles. The major changes in trade policies began in 1967, at the beginning of the new order period with a substantial liberalization in trade and the capital account (Pangestu, 1996). Since then, economic policy and development in Indonesia can be categorized into several periods. The first is 1967-1970, when Indonesia was still in a rehabilitation and stabilization period; followed by the oil boom period in 1974-1981, when Indonesia adopted an inward looking import substitution regime; between 1983 – 1996 there was major deregulation when Indonesia shifted to an outward looking export promotion regime and underwent major economic liberalization as a response to a fall in the oil price. The Asian financial crisis in 1997 – 1998 hit Indonesia severely and resulted in economic reforms under the IMF during 1998 – 2003. After the first free and fair parliamentary (1999) and presidential elections (2004), Indonesia continued to conduct prudent macroeconomic policies and maintain open economic policies.

4.3.1 Stabilization Period, 1967 -1972

By 1966 Indonesia had hyperinflation reaching 636 percent and was disengaged from the international community when it withdrew from the United Nations, the IMF and The World Bank. Physical infrastructure was in very bad condition because most was from the colonial era with little investment since. In 1967, the new government under Soeharto focused on an economic policy to reduce inflation, re-establish ties with the international community and rehabilitate the physical infrastructure. The government introduced orthodox monetary and fiscal policies and an open commercial policy. To increase domestic production, tariffs on some products were increased in 1968 and as a result there was an increase in production of several products, notably textile products. The government unified the multiple exchange rate system in 1970, and the rupiah was devalued in 1971.

The Foreign Investment Law was introduced in 1967 to restore investor confidence and encourage private investment in priority sectors. There were no restrictions on foreign equity and employment of expatriates and 100 percent foreign ownership was allowed. The only restriction on foreign investors was that they were not allowed to distribute their own products domestically. This law also included a package of incentives, such as, tax holidays, import duty and sales tax exemptions on machinery and equipment, accelerated depreciation, guaranteed reparation of capital and profits, and provision to carry forward losses. This law reflected the dilemma that on one hand, Indonesia needed foreign linkages to obtain capital, technology and markets to accelerate economic development, but on the other hand, it feared "foreign domination" in the economy.

Nevertheless, these policies were successful in attracting investment from both domestic and foreign investors. In 1967, 22 foreign owned companies (*PMA- Penanaman Modal Asing)* were approved, and in 1970, 177 PMA projects were approved with approximately 37 percent of them were 100 percent foreign-owned projects (Hill, 1988). This resulted in high GDP growth of 10 percent which was considered to be the beginning of the recovery process (Pangestu, 1996, p. 27).

4.3.2 Oil Boom Period: 1974 – 1981

An increase in world oil prices in the second half of 1973 provided massive windfall revenue for the Indonesian economy. During this period, Indonesia experienced sustained economic growth at an average annual rate of 7.4 percent and the inflation rate was high but mostly relatively steady at below 20 percent. The liberal investment regimes of the previous period were initially maintained but became more restricted in response to the perceived growing domination of the Japanese over the Indonesian economy. There was a resurgence of a nationalist economic agenda. In January 1974 an anti-Japanese protest occurred and triggered the announcement of a new foreign investment regulation. This new regulation stated that all new foreign investment should be in the form of joint ventures; Indonesian equity should be increased to a majority shareholding of 51 percent within a certain period of time; the number of sectors closed to foreign investment was extended; tax incentives were reduced; and the number of foreign personnel restricted (Pangestu, 1996).

Trade policies were also more restricted with higher tariffs and more Non-Tariff Barriers (NTBs) to accommodate the government's plan to embark on an ambitious programme of heavy industrialization. Trade and industrial policies during this period were directed to foster industrialization patterns through protection of domestic industries. Indonesia adopted inward looking policies through an import substitution strategy beginning with consumer goods then expanding to intermediate and capital goods.

There were some efforts to liberalize the trade regime during the oil boom period. In April 1979, there were 50 percent tariff reductions on thousand of goods and services, as well as, a 50 percent reduction in import sales taxes. In 1981, in accordance with the GATT and Tokyo

Round negotiations, there was another 50 percent reduction in import sales taxes on a substantial number of commodities for domestic production.

In 1977, administrative procedures for investment were simplified with the establishment of "one stop service" and the introduction of a Priority Investment List (*Daftar Skala Prioritas – DSP)* by BKPM.[5] The *DSP* was published annually with the intention of providing more transparency for investors. However, since it was not comprehensive or accurate it was open to misinterpretation. Furthermore, the DSP regulated production capacity and the number of licences given based on this and there was no consistent criteria and calculation as to whether a sector was closed or open.

In 1978, the government undertook 50 percent devaluation to offset the Dutch disease effects which is a decline in relative price of non oil tradables to non tradables. With the second increase in the oil price in 1979, the government's enthusiasm to improve the investment climate declined and the more restricted investment priority list was announced, and trade, industrial and investment liberalization waned.

As a result, the 1978 devaluation was not successful because it was not followed by the much needed deregulation in the real sector. There were no policies to reduce the exporting cost therefore there was no substantial increase in export. Unfortunately, this confirmed policy makers' doubts about the benefits of trade and investment liberalization.

4.3.3 Major Deregulation Period: 1983 - 1996

Oil prices began to decline in 1982 and revenue from this sector began to contract, which resulting in slower economic growth. This was coupled with the worldwide recession which had adverse effects on Indonesian traditional exports. In response, the government shifted its inward looking import substitution policy to an outward looking export orientation policy. This began with economic stabilization policies, which included exchange rate management, monetary and financial policies, fiscal policy and trade policy and other macroeconomic regulatory policies (Kuncoro and Resosudarmo, 2004).

At the same time, protection pressure remained. As a result, the more restrictive trade regime using non-tariff barriers was also implemented. A quantitative restriction on imports under

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[5] *BKPM (Badan Koordinasi Penanaman Modal)* – Investment Coordination Board was established in 1973 and it has discretionary authority to approve both foreign and domestic investment.

the approved importers systems (*Tata Niaga Impor)* was announced and nine goods[6] were restricted for import only to approved importers. General importers (*importir umum)* were approved to import goods falling in certain categories. The government could limit the number of approved general importers to bona fide importers who satisfied several requirements. During the period 1982 – 1986, these there were many licences issued of this type (Pangestu, 1996). As these licences were extended to more industries; it became obvious that politically connected business interests were the prime beneficiaries. Nevertheless, even approved importers were sometimes subject to restrictions on the amount and type of goods they could import.

After the end of the oil boom era in 1982, the Indonesian government responded by devaluating the rupiah in March 1983 by 50 percent for budgetary reasons and to improve the non-oil sector. Since most of government revenue came from taxes on petroleum corporations, the decline in oil price decreased the availability of government revenue from this sector. Therefore the government took austerity measures and increased revenue from non-oil sectors. The austerity measures were undertaken by reductions in government spending and the prevention of "leakages", while the increase in revenue from non-oil sectors was conducted through mobilization of domestic funds from the financial sector, improved tax collection and increased non-oil exports (Pangestu, 1996 pp. 11).

Trade Liberalization

Two major trade reforms were undertaken in 1985. First, in March 1985, there was a reduction in tariffs across the board as well as the number of tariff categories. The range of tariffs was reduced from 0-225 percent to 0-60 percent and most tariff rates ranged from 5 to 35 percent. The numbers of tariff levels were also reduced from 25 to 11. Although tariff rates were reduced, NTBs in the form of import bans, explicit quotas and import licensing remained and in this way the problems faced by a high-cost and inefficient industrial sector were exacerbated.

In April 1985, the government undertook a bold customs cleanup and improvement of shipping regulations by disbanding the corrupt and inefficient national customs service and replacing it with a private Swiss surveying company, *Société Générale de Surveilance* (SGS). This policy aimed to simplify customs procedures at the point of importation. The inter-island transportation sector was also deregulated by reducing documentation, rationalizing port fees and allowing foreign carriers to operate.

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[6] The nine goods were electrical and electronics goods, chemical products, metal industry products, machinery and spare parts, heavy equipment and spare parts, motor vehicles, textiles, agricultural products, and food beverages and fresh fruits.

In order to a supportive trade regime by reducing its 'anti-export bias', a successful export promotion policy also requires an equally supportive exchange rate policy by keeping its real effective exchange rate at a competitive level. In September 1986, the government undertook a 50 percent devaluation to increase non-oil export and reduce balance of payment (BOP) deficit. Unlike the 1978 and 1983 devaluations, this devaluation was considered successful in term of increasing non-oil exports. The devaluation was followed by series of deregulations which resulted in competitive real exchange rates and an increase in confidence that the government was serious about improving producers' regulatory environment (Pangestu, 1996, p. 19).

Following the devaluation, in October 1986 and January 1987 the government announced a trade policy package that indicated a trend towards using tariff protection instead of non-tariff barriers (Pangestu, 1987). The October package included a change in import procedures - 321 items previously imported only under the approved importer licensing system were removed or relaxed. Tariff reductions were effected on inputs that were not produced domestically but were important to local production to offset increased costs due to the devaluation. The second part of the October package was a change in import duties on 306 items. About half of these changes were increases in tariffs to offset any fall in protection resulting from the removal or relaxation of licences.

The January 1987 package relaxed import procedures in the textiles and iron and steel sectors with 88 items in the textile sector, and 11 items in the iron and steel sector reclassified into the general importer category. The other sectors affected were the machinery, electrical machinery and motor vehicles sectors where 43 items had their tariffs reduced and 12 had them removed. The significant development in these sectors was that manufacturers no longer needed a new licence to produce similar products. Furthermore, producers were now able to import from more than one source and could sell their product freely. However, several sectors remained highly regulated, such as some pharmaceutical products, plastics, hides and leather, iron and steel, mineral and agriculture.

In November 1988, the government announced another trade policy package, which included a relaxation of the total exclusion of foreign companies from domestic trading. Foreign companies could engage in the wholesale trading of their own product through joint ventures set up solely for this purpose (Simandjuntak, 1989). Furthermore, some of the restrictive import licences previously left untouched was also liberalized.

A substantial trade liberalization package was announced in May 1990. This was the first reform of the tariff schedule since 1985 (Conroy and Drake, 1990). It included the removal of a number of NTBs and specific deregulation on pharmaceuticals, fisheries and agriculture. This regulation removed or relaxed 371 industrial items and the unweighted average tariff rate declined from 25 percent-30 percent to 20 percent. From a total 9,250 tariff classifications, tariff levels were lowered in 2,481 cases. 387 new tariff items were introduced to replace the import embargos, many on electronic goods or components. The principal impact of tariff reductions was at the 60 percent level (1,351 items reduced to 31) and at the 50 percent level (formerly 585 items, now 82). Imports of final electronics goods and footwear previously levied at 60 percent were lowered to 40 percent. However 224 items, with 100 of them in the manufacturing sector, now had higher levies.

In June 1991, there was a further removal of NTBs, a reduction in import tariffs and reopening of several business areas to new domestic and foreign investors. Several major features of the reform included outright import bans for cold-rolled steel coils, abolition of an export quota system for palm oil and copra, introduction of an import quota system for built-up commercial vehicles, and reopening car component manufacture to new investors (Nasution, 1991).

Further tariff reductions were announced in July 1992, June and October 1993, and May 1995. One important policy in June 1993 was a long awaited liberalization of the automotive industry where the import ban was lifted, although the importation of automobiles was still subject to a 200 percent import tariff plus 100 percent surcharge. This policy was aimed more at encouraging the domestic auto parts industry rather than improving Indonesian competitiveness in the international market (Eng, 1993). The May 1995 trade liberalization reaffirmed Indonesia's commitment to fully implementing AFTA with the objective of major tariff cuts by 2003.

Fane and Condon (1996) provide estimates of the real effective rate of protection (RERP) between 1987 – 1995. Whereas, the effective rate of protection (ERP) of a sector is defined as the proportionate increase in its value added per unit due to the complete system of trade policies, the RERP is defined as the corresponding increase in its *real* value added per unit, where real value added is obtained by deflating nominal value added by the nominal wage. The advantage of RERP is that it allows for the effect of protection on the general price level and hence on the exchange rate, whereas ERP does not (Fane and Condon, 1996, p. 35). Their estimation shows that the RERP for manufacturing, excluding oil refining, fell from 66 percent in 1987 to 11 percent in 1995, and from 9 percent to 5 percent for agriculture (Table 4.7). The standard deviation of RERPs for manufacturing, excluding oil refining, fell from 102 percentage points to 39. The reduction in real effective protection was much greater for the manufacturing sector than for agriculture. In the manufacturing sector, the subgroups which accounted for the bulk of the reduction in protection to manufacturing were: food, beverages and tobacco; textiles, clothing and footwear; chemicals; and other manufactures. Most of the fall in protection was directly attributable to trade reform.

Table 4.7: Nominal and Real Effective Protection for Broad Aggregates, 1987-2003

	NRP (percent)			RERP (percent)		
	1987	1995	2003	1987	1995	2003
Agriculture (excluding forestry, fishing & hunting)	14	8	4	9	4	5
Forestry, fishing and hunting	-22	-24	-28	-36	-34	-37
Mining and quarrying (including oil & gas)	0	1	1	-12	-6	-3
Manufacturing (excluding oil refining and LNG)	21	6	3	66	16	11
Manufacturing (including oil refining and LNG)	16	5	1	32	11	9
All tradable	10	3	1	4	0	0
Anti-trade bias	25	16	12	53	28	20
Wage effect	14	8	4	-	-	-

Source: Fane and Condon (1996, p.53).
Notes: 2003 figure is their estimation based on the tariffs and tariff surcharges for 2003, announced in the May 1995 trade liberalization package

The RERP includes non-tariff barriers in the calculation. NTB coverage is often calculated by weighting the individual items subject to NTBs by gross output (Fane and Cordon, 1996, p. 50). Their results show that since the mid 1980s restrictive NTB coverage had been greatly reduced and most of the manufacturing sectors no longer had NTB coverage. The remaining high NTB coverage was in wood products and paper products.

Investment Liberalization

From 1986 to 1993, in line with the effort to improve non-oil exports, the government undertook a gradual liberalization in investment but with a "big bang" in 1994.

In May 1986, a foreign firm which was located in remote areas on high risk ventures (i.e. mostly East Indonesia), with export orientation (i.e. exporting more than 85 percent of production) and involving high technology, could have up to 95 percent ownership. The licence was valid for 30 years and could be extended for another 30 years if the PMA increase their capital for expansion or diversification. The PMA could obtain national treatment if it was at least 75 percent Indonesian owned (state and/or private domestic); or 51 percent of its shares were traded in the capital market; or 51 percent Indonesian owned if at least 20 percent of its shares were traded in the capital market. National treatment means the PMA company can have access to subsidised export credit and borrow from the state banks.

Further liberalization was conducted in December 1987 and investment and capacity licensing requirements were substantially deregulated: renewal was no longer necessary and only expansion of capacity exceeding 30 percent needed approval. A previously "closed" sector could then be opened if an investor was export oriented (exporting more than 85 percent of production).

During the period 1985 – 1988 the *DSP* became more transparent and more sectors were open for foreign investment. Some of the sectors opened were housing estates, hotels and garment manufacturing. Some manufacturing sectors previously considered "strategic" such as chemicals, metallurgic industries and machinery were also opened. A sector still closed was small scale industry for the reason of national security or development policy. The DSP was also more transparent because it included the ISIC categories and no longer listed the production capabilities or the number of licences requirements.

In 1989, the government established the Batam Economic Zone and allowed 100 percent foreign ownership with 5 percent divestment to Indonesian shareholding in five years and no further divestment if the PMA company in Batam exported 100 percent of its products.

By the end of 1989, the pace of liberalization had slowed. In 1992, 100 percent foreign ownership was allowed for certain types of investment, i.e. investment over $50 million, located in East Indonesia and in a bonded zone with all of its production exported. Foreign firms with as little capital as $250,000 could be established with up to 95 percent foreign ownership if they were "labour intensive" (employing at least 50 staff) and export oriented (exporting at least 50 percent of their output). This new regulation gave Indonesia more opportunities to attract foreign investors especially in the oligopolistic industries such as electronics where investors required such arrangements (Hill, 1992).

Foreign investment policies were improved further in October 1993 with more flexible requirements such as on divestment; lower minimum capital to establish a 100 percent foreign-owned company (from $50 thousand to $2 million); special treatment for foreign companies located in industrial and bonded zones; simplified approval processes and shifting the authorization to a lower level of government (from provincial to *kabupaten* level).

In June 1994 there was a major investment deregulation with a substantial relaxation of the divestment requirements for foreign investors. For sectors open to foreign investment, the foreign investor could either form a joint venture with 95 percent ownership and no further divestment thereafter or form a wholly foreign-owned subsidiary with some divestment within 15 years (Pangestu and Azis, 1994).

Other elements of the package were the elimination of minimum investment requirements and the opening up of these nine sectors previously closed to foreign investment: sea ports; production, transmission and distribution of electricity; telecommunications; shipping; civil aviation; drinking water; railways; nuclear power generation; and the mass media. The only requirement was that foreign investors must come in as part of a joint venture. The one sector still closed for foreign investors was domestic distribution and retailing. Foreign investment licences were still given for only 30 years with the renewal to be obtained from the Minister for Investment Coordination. Finally, 100 percent foreign-owned firms could invest in all regions in Indonesia.

In May 1995, the government removed 10 industries from the negative list of closed sectors for 100 percent foreign ownership, while adding new industries into the list including economic infrastructure which was very crucial for investment. It also improved business facilities with a change of permanent business permit to a simpler industrial permit; and waiving customs inspection of the movement of export goods between bonded zones and entrepôrts.

This return to a liberal trade and investment regime during 1983 – 1996, starting with the stabilization policies and followed by resource mobilization, was successful because of the sequencing policies and political will from policy makers. The 1986 devaluation was followed by tight money policies which resulted in low inflation and depreciation of the nominal exchange rate was also accompanied by depreciation in the real exchange rate.

After resource mobilization, the government adopted policies to reduce costs or increase efficiency beginning with reforms in trade policies and then reforms in industrial or investment policies. After these reforms in the trade and industrial sectors, reforms followed in other areas such as transportation and domestic regulations.

4.3.4 Asian Financial Crisis: 1997 – 1998

The 1986-1996 economic boom did not last very long and came to an abrupt end in August 1997 when Indonesia was hit by the Asian financial crisis shortly after Thailand. Indonesia sank into an unprecedented economic crisis in the history that began when Thailand's economic crisis triggered doubts concerning Indonesia's economic stability (Kuncoro and Resosudarmo, 2004). The 35 percent depreciation of the Rupiah in July and August 1997 was unexpected, and the government did not have enough reserves to defend it and so opted to change the exchange rate management to a free floating system. This created a panic among domestic corporations with a large exposure to overseas loans, and also among international investors with Rupiah dominated assets (Hill, 1999). The currency collapsed from Rp.2,300 per USD in June 1997 to Rp. 17,000 per USD in January 1998 and inflation jumped to 78 percent in 1998.

Although not directly related to the financial crisis, the government announced another deregulation package in July 1997, just before the Consultative Group on Indonesia (CGI) meeting. The new package directly affected the financial markets only through a restriction on credit for land purchases. Otherwise most attention centred on the reduction of import tariffs. The July 1997 package brought the share of items subject to tariffs of less than 10 percent down from 63 percent to 56 percent. However, the reduction in the average tariff rate was negligible, and little progress was made in removing non-tariff barriers (Lindblad, 1997, p.13).

The economic crisis was intensified by the December 1997 political crisis with Soeharto's declining health. By January 1998, most of the business empires closely linked to Soeharto and his cronies were bankrupt because they were unable to repay their foreign currency loans (Hill and Shiraishi, 2007, p.125). The economic crisis deepened the social crisis, which manifested itself in increasing unemployment, looting, disturbances, and rising criminality and this reached a peak in May 2008 with widespread anti-China riots. The end result was that Soeharto was force to step down.

Owing to the political instability, the government was powerless to deal with this unprecedented crisis and IMF assistance commenced in October 1997 (at an earlier stage than Thailand or Korea).

4.3.5 Recovery and Post Soeharto Period: 1998 – 2011

In spite of the political difficulties and the unpopularity of the IMF, the agreement was a signal that Indonesia was serious about tackling the entrenched corruption, collusion and nepotism

(Soesastro and Basri, 1998). The agreement between the IMF and Indonesia was different to agreements with other countries such as Korea and Thailand, because it included measures for the real sectors, which are not usually included in an IMF package. These measures were proposed by Indonesia to increase the credibility of the agreement and to take into account the expectations of the general public and international markets. The structural adjustment in this package included several trade liberalization programs both on the export and import side, as well as domestic trade, and was to be implemented within a three year period. The structural program included (i) a gradual reduction of import tariffs including those on chemical products, iron and steel and fisheries products by the year 2003, (ii) a reduction of barriers to export, including export taxes which were to be implemented in stages, (iii) trade deregulation for various commodities such as wheat and wheat flour, soybeans and garlic which were to be imported freely, and (iv) the local content program for automobiles, which provided special tariffs for producers who achieved high local content, were to be eliminated by the year 2000

In January 1998, the second agreement was signed in the form of a Letter of Intent with more detailed information available to the public. The LOI include both macroeconomic stability and a microeconomics program. Trade liberalization was still a priority in the LOI with the removal of the monopoly of BULOG on importation of sugar and for wheat flour distribution; elimination of the Clove Marketing Board (*Badan Penyangga Produksi Cengkeh - BPPC*) monopoly for cloves, and abolition of marketing restrictions on cement, paper and plywood. Special privileges for the National Car Program were also eliminated. Import tariffs for food products were reduced to a maximum 5 percent along with abolition of local content for dairy products to ensure domestic food security for lower income groups. From 1 February 1998, export taxes on a wide range of products such as leather, cork, ores and waste aluminium were to be abolished, and export taxes on sawn timber, rattan and minerals were to be reduced to a maximum of 10 percent. Other export restrictions such as quotas were set to be eliminated by the end of year 2001. Export restrictions on palm oil were removed, to ensure adequate domestic supplies. In addition, formal and informal barriers on investment in palm oil plantations were to be eliminated by February 1998 and all restrictions on foreign investment in wholesale and retailing trade were to be lifted by March 1998.

Under the LOI, several economic laws were enacted covering bankruptcy (1998); banking and financial sector rehabilitations and reforms; and corporate debt restructuring initiatives (1998) and competition (1999).

On the other hand, there was an increase in protectionist sentiment from 2002 when the Minister of Agriculture urged an increase in the import tariff for sugar, rice and chicken legs to protect domestic producers. However, the Ministry of Finance did not agree since the increase of import tariffs was only an artificial increase in farmers' income at the expense of consumers (Athukorala, 2002). In line with the emergence of the protectionist sentiment the Minister of Industry and Trade issued a number of new regulations and rulings in 2003 on international and domestic trade, such as new restrictive import-licensing arrangements, export bans and licences, controls on domestic trade, proposals for re-regulating modern, large-scale retailing, and support and facilitation of cartel-like arrangements for key export commodities (Ray, 2003). These non-tariff measures covered several commodities such as rice, sugar, textiles and wood products. Non-tariff measures were used because they are under the authority of the Minister of Industry and Trade while tariff measures are under the authority of the Minister of Finance.

There was a plan to switch the then post-shipping inspection mechanism with the pre-shipping inspection mechanism but this would only change the mode of smuggling from administrative smuggling (where importers under-report their import) to physical smuggling (where the importer does not report at all).

Another reason for the rise in protectionism was political since the 2004 election was approaching. With democratization, rural voters are crucial and politicians exploit this factor with appeals to sentimental notions of food sufficiency (Basri and Hill, 2008, p.1404). One vocal protectionist was the head of the Indonesian farmers' association who appeared to use the association to provide a political platform for his populist views. He argued that the government neglected agriculture and that considerably more protection was needed for farmers (Ray, 2003, p.260).

As a consequence of its commitment under the AFTA, Indonesia conducted tariff harmonization in 2004 which resulted in a rise in the unweighted average tariff from 7.2 percent in 2003 to 9.9 percent in 2004. This was caused by an increase in the number of tariff lines from 7,540 in 2003 to 11,163 in 2004.

The government formally started the labour sector "reform" in 1998 by ratifying some of the International Labour Organization (ILO) Conventions and enacting three new laws regarding labour: the Trade Union Law (No.21 of 2000), the Manpower Law (No.13 of 2003), and the Industrial Relations Dispute Settlement Law (No.2 of 2004). The Manpower Law 2003 was a compromise between two previous regulations on labour, the Manpower Law no 25 Of 1997 (enacted under the Soeharto administration) which was subjected to hostile rejection from the labour union as was the Ministerial Decree No. 150 of 2000 (issued during the Abdurrahman Wahid administration) which was a source of intense opposition from employers (MacIntyre and Resosudarmo, 2003). However, there were still complaints from both sides with the enactment of the 2003 Law. Labour unions argued that the contract worker regulation in the Law resulted in less job security for workers. On the other hand, the employers view was that the 2003 Law made it costly to hire and fire workers.

In 1999, Indonesia had its first free and fair parliamentary election. In the new democratic politics, the *Dewan Perwakilan Rakyat* (*DPR)*, the lower house of the parliament, emerged as a new power centre along with the presidency, and electoral politics has assumed a crucial role in organizing the government, although no one party controls the parliament (Hill and Shiraishi, 2007). After the first direct presidential election in 2004, policy formulations in Indonesia changed, with less dependence on international institutions such as the IMF and The World Bank. From 2004 onwards, Indonesia continued to adopt a prudent macroeconomic and open economy policy with a goal to increase participation in the global economy. The intended policy orientation was to accelerate economic growth, promote poverty reduction and job creation through proactive fiscal policies, government expenditure on national welfare (such as education and health) and promotion of investment (though infrastructure development).

With a stronger parliament and no single party controlling parliament, the presidency and cabinet unity has been weakened. The proliferation of political parties and weak party discipline, the absence of coherent ideologies and policy platforms, and low levels of economic literacy have all resulted in a strong inclination towards populist politics, reflecting a general community reluctance to embrace liberal economic policies (Bird, Hill and Cuthberston, 2008, p. 951).

Although Indonesia formally exited the IMF programme in 2003, Indonesia is still committed to continue trade liberalization and in 2005, the government began the tariff harmonization program with the objective of adopting a uniform tariff rate. The program was conducted in two stages. The first stage covered 1,900 tariff lines, mainly affected agriculture commodities, and was implemented in early 2005. The second stage, covered more than 9,000 tariff lines and was completed in February 2006. This new tariff harmonization program specifies a tariff reduction schedule from 2005 to 2020. By 2010, 94 percent of all tariff lines had rates at or below 10 percent. The remaining 6 percent (considered as sensitive items) will have tariffs of 10 percent by 2020. Although the tariffs average was lower, the non-tariff barriers, in terms of import restrictions, proliferated with their number rising by almost 40 percent in just two years (2002 – 2004). The non-tariff barriers are under sectoral ministers, and most of the NTB are for agriculture products.

The first set of policies to improve Indonesian competitiveness was launched in 2006 with investment and infrastructure packages. Unfortunately these packages do not have clear objectives or a monitoring plan. There was little real intention from some parts of government to implement them as well as also a lack of capacity in the bureaucracy (Basri and Patunru, 2006). Meanwhile the implementation of the investment package was delayed because of the slow progress in the completion of several amendments to investment regulations.

In 2007, the government announced another deregulations package which included four sectors: investment, financial, infrastructure, and small and medium enterprises. This package integrated and continued the earlier economic packages, but measures to promote the micro, small and medium enterprises (MSME) sector were included as a major field for the first time. The package aimed to 'empower' MSME by providing better access to financial resources; promoting development of entrepreneurship and human resources; improving market access; and implementing other regulatory reforms that to help such firms (Takii and Ramstetter, 2007). This package had a clear objective and for the purpose of monitoring, the actual outcomes will be examined by an independent external team.

The Investment Law no 25/2007 replaced the 1967 Foreign Investment Law and 1968 Domestic Investment Law. This new law guarantees equal treatment of foreign and domestic firms in sectors open for investment, but not equal opportunity to invest in all sectors. Together with this Investment law, the long-awaited revised Negative List was announced in the attachment. This list specifies 25 closed sectors and 300 industries conditionally open to investment. [7]The closed sector is designed to protect "national interest" while the conditional list is aimed at promoting MSME and it is therefore subject to foreign equity limitation, location requirements or specific licences. The new list is more transparent because the sector is classified at the 5-digit Indonesian Business Classification. It also includes clearer mechanisms for revising the list, making it more difficult to increase the number of protected industries than in the past.

However, there have been many complaints about the rationale for specific restrictions. One specific complaint came from business groups active in transport and logistics, a sector that

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[7] Based on the Presidential Regulation no 76/2007, the establishment of open business line is condition on protection and development of MSE, based on partnership, capital ownership, specified location and special permit.

was considered inefficient, and where foreign ownership limits were tightened from 95 percent to 49 percent. Another complaint was about implementation, since there was no clarity as to whether the new regulation applied to existing foreign firms where ownership restrictions were tightened. If there was a change in foreign ownership shares changed because of recapitalization, it was not clear whether either the old or new regulation applied. Finally, there was no certainty that the negative list will not be more restrictive after its review in 2010.

Indonesia has always preferred unilateral trade reforms, in the context of a preference for a multilateral system of trade negotiations and liberalization. However, in 2008, Indonesia signed its first bilateral agreement, with Japan. This was partly caused by the stalling of the Doha Round and the urge to have a bilateral agreement with major trade partners to compete with other ASEAN countries which already had similar agreements with major trade partners. These bilateral trade agreements, starting with the Indonesia-Japan Economic Partnership Agreement, covered not only trade, but also investment regulation, technical assistance and labour movements.

The previous administrative also signed on to the ASEAN-China Free Trade Agreement (ACFTA) which came into effect in 2010. However, by the time of implementation there were many rejections by the business sector. The current parliament argued that no less than 15 of the 17 sectors included in the agreement needed protection.[8] In contrast with the strong political will during the period 1982–1996, the current parliament has little understanding as to why protectionism diminishes the potential gains from trade (Patunru and von Luebke, 2010).

With a weakened presidency and cabinet unity, the current government has failed to give certainty for current and potential investors that had hoped the new investment law and negative list would provide. Furthermore, the government decision to shift trade negotiation from the multilateral to the bilateral was a regression. Re-negotiation on the ACFTA was a further setback that made Indonesia seems an unreliable economic partner.

4.4 The Electronics Sector: Historical Development and Policy Regime

The electronics sector in Indonesia is relatively new; it had just begun to develop in the 1970s. During the Old Order government (1950-1966) the electronics sector was very under-developed and consisting only of a small number of importers, repairers, service centres and a

[8] The 15 sectors are: textiles and textile products; food and beverages; petrochemicals; agricultural machinery and equipment; footwear; synthetic fibre; electronics; cables and electrical equipment; machinery; steel; automotive components; cosmetics and traditional herbal medicines; furniture; rubber products; and engineering, procurement and construction services.

few assemblers. The first local production, PT. Transistor Radio Mfg Co., produced radios with its brand name Tjawang in the late 1950s. With the introduction of black and white television in 1962, some large companies began assembly operations (Thee and Pangestu, 1998 p.222).

The summary of policies in electronics sector is summarized in Table 4.8 below.

Table 4.8: Policies related to Indonesian Electronics Sector

Year	Policy
1970-1984	Inward Looking Import Substitution Policy
1970s	Negative list for import
Late 1970s	Elimination of differential treatments for importer
1982	Introduction of a sole agency system
1982	Restriction on the import of second hand machineries
1985-now	Outward Looking Export Promotion Policy
1985	Customs reform
1989	Establishment of export processing zone and bonded warehouse – Batam Island
1990	Removal of non-tariff barriers and imposition of import tariffs
1994	Change in Foreign Investment Law: 100 percent of foreign ownership is allowed throughout Indonesia

Inward Looking Import Substitution Policy

The next phase of the electronics sector development was 1970 – 1985 when the government introduced an inward looking, import substitution, policy. During this period, the government provided protection to important domestic industries through quantitative restrictions and tariffs. For the electronics sectors, the government banned importation of completely built up (CBU) television sets and radios and imposed high tariffs on consumer electronic final goods (2-50 percent) and on professional electronic equipment (5-50 percent). This policy was successful in attracting foreign (Japanese and Germany) electronics companies to open assembly centres in Indonesia. As a result, many joint ventures with foreign companies were established, such as National, Sanyo, Sharp, Grundig, Philips and ITT. Until 1973, at least 15 companies were established both as a sole agent (*Agen Tunggal Pemegang Merek – ATPM)* of foreign brands (principals) or as producers of their own local brands. Examples of the *ATPM* were: PT Yasonta, an assembler of Japanese televisions, Sharp; PT Sanyo Industries Indonesia, an assembler of radios, television and household appliances for Sanyo - Japan; PT National Gobel, an assembler of radios, television and household appliances for National - Japan; and PT Asia Electronics Corp, an assembler for German radios and television, Grundig. The local brands were PT Galindra Electrics Ltd, an assembler of radios, televisions, tape recorders of Galindra. Some of these companies still exist (Gabungan Elektronika Indonesia, 1996).

The Indonesian electronics sector was first developed with the Original Equipment Assemblies (OEA) system which took advantage of low labour costs. In this system, semi-knocked down (SKD) components were installed to become a TV set. However, this system was considered as having low value added, therefore the government moved to upgrade the electronics sector from SKD to a completely knockdown (CKD) system by imposing lower import tariffs for CKD components (Negara, 2009). However, while this policy favoured companies linked to the principal, it creates disadvantaged other domestic firms, because CKD kits could only be imported by the principals. As a result, the differential treatment was eliminated in the late 1970s.

In the early 1970s, the government provided a bonded-warehouse status to two major US semiconductor companies: Fairchild in 1973 and National Semiconductor (NSC) in 1974. With this status, firms were able to import inputs duty free as long as the produced goods were exported. Both companies were 100 percent foreign owned and all their semiconductor output was exported. Unfortunately, both companies closed their plants in Indonesia in 1985 because of the downturn in the semiconductor global market. Fairchild's plan to upgrade their technology with automation was rejected by the government because it would have involved reducing the labour force. With the close of these two plants, Indonesian semiconductor exports dropped significantly (Thee and Pangestu, 1998).

Other quantitative restrictions affecting the electronics sector were introduced in the late 1970s and early 1980s. The first was a "negative list" of imports where imports of specific commodities were banned. This localization policy was first introduced to the automotive sector and then gradually extended to other sectors. The objective of this policy was to encourage engineering industries to use local components. The second policy was an import limitation of some electronics products to only approved importers. In 1978, the government introduced a Deletion Program, which had started in the automotive sector in 1976 and then was expanded to other industries. In this program, the government scheduled the gradual deletion of specific components used in the related industries. The objective of this policy was to develop the local parts and components industry to support the electronics sector. In addition, the government invited local companies to invest in component production and PT National Gobel responded by making speakers. Other companies started to make mechanical parts, transformer and cables.

In 1982, a sole agency system for domestic assemblers linked to foreign principals was introduced. Later, importation of used machinery was banned to avoid obsolete machinery. However this policy ended up discouraging the relocation-type investment in which foreign investment relocated some of their production blocks to other countries to take advantage of cheaper labour costs. This ban means that relocation investment to Indonesia became more expensive because investors had to buy new machineries.

The import substitution policy resulted in an electronics sectors biased towards the manufacture of final consumer goods. As a result, consumer electronics goods dominated the electronics sectors especially after the closure of the two semiconductors plants.

Outward Looking Export Promotion Policy

As discussed earlier, with the fall in the international oil price in the 1980s, the government could not continue to finance the expensive import substitution policy and was forced to change from an inward looking import substitution policy to an outward looking export orientation policy.

As a first step to reduce exporting cost, the government simplified customs procedures in 1985 with an appointment of a private Swiss surveying company, *Société Générale de Surveilance* (SGS), to clear goods for import at the point of importation. In 1989, an export-processing zone was established in the industrial estate along with a liberalization of foreign ownership restrictions, although this only applied in certain areas. 100 percent foreign ownership was allowed in the Batam Economic Zone with no divestment requirement if all products were exported (Pangestu, 1996). These policies led to the next phase of electronics sector development, when joint ventures and some domestic firms began to export customer electronics product. One reason why domestic firms began to increase exports was to increase their production capacity in anticipation of sharper competition in the domestic market after export-oriented firms were allowed to sell a certain percentage of their products domestically (Thee and Pangestu, 1998 p. 226).[9]

Unlike the textiles and garment sector, which responded immediately to these policy changes, the electronics sector was a late starter. Rapid growth in the electronics sectors only took place in 1991-92. There were several reasons for this late start. The first was that the Indonesian electronics sector was relatively under-developed and its image was not good owing to the closure of the two US semiconductor plants in the 1980s. Instead, most of the relocation investment from Japan and the US was directed to other ASEAN countries such as Malaysia and Thailand. The second reason was the long period of time required to complete all the investment procedures and set-up operations. The third reason was that deregulation in

[9] Since May 1986, export-oriented firms in export processing zones and a bonded warehouse could sell 15 percent of their products to the domestic market. In 1993, this was increased to 25 percent. The products sold in the domestic market were subject to import duties and sales tax.

this sector only occurred in 1990 with the removal of non-tariff barriers and then replacement them with equivalent tariffs. For the electronics sector, all electronics goods and their main components could be imported under the non-restrictive general importer licence rather than only through an approved importer. The import tariff for final electronics goods reduced from 20-60 percent to 20-40 percent and all surcharges were removed. The import tariffs for components were also lowered from 20-30 percent to 0-5 percent to reduce production costs in downstream industries.

Although there was a 65 percent increase in the electronics production in period 1990-1992, the composition of electronics products continued to be dominated by consumer electronics products. In addition, the low import tariffs were not successfully eliminating the rampant smuggling of electronics products. The different tariff treatments between producers and importers of electronics products, where the producers had to pay 10-30 percent of import tariffs plus 10 percent of value added tax while this was not applied to importers, further hampered development of the electronics sector.

The export promotion policies resulted in a dramatic change in the production and export of the electronics sector, especially in 1992. Consumer electronics still accounted for half of the outputs, followed by industrial electronics and electronics components. A significant percentage of component exports came from Batam as a result of the special economic zone policy.

The 1994 foreign investment law had a positive effect on electronics sector development. Two years after the announcement of this policy, BKPM had already approved 72 mostly export-oriented electronics projects. A number of projects were related to electronic components, including semiconductors.

Until 1996, the prospect of Indonesia receiving an influx of foreign investment was good, since some of the large electronics firms in Japan and other East Asian NIE (New Industrialized Economies) were in the process of relocating investment to South East Asian countries. Several joint venture companies producing components built factories, such as PT Sharp Semiconductor Indonesia, PT NEC Semiconductor Indonesia and PT Panasonic Semiconductor Indonesia, and they produced active components, mainly semiconductor devices and integrated circuits (ICs).

Unfortunately, the 1997 financial crisis shattered this hope with a number of domestic and foreign companies forced to stop operations. In addition to the sudden drop in domestic demand for electronics goods, rampant illegal imports made some producers switch to importers. This was because it was more profitable for them to import Chinese products to sell in the domestic market compared to their own brands.

Although the government has tried to develop the electronics sector, the Indonesian electronics sector has not been successful in joining the global production networks. In addition to the late start of the development of local industries, the closing of two semiconductors factories (Fairchild and NSC) in the 1980s created a pessimistic perspective on Indonesia. A further hit on the Indonesian electronics sector was the closing of Sony Electronics Indonesia in May 2003, after operating locally since 1991 when it relocated its factories to Malaysia and Thailand. There were several reasons for this relocation. The first was the strong labour movement that organized frequent demonstrations demanding higher wages that sometimes ended violently and disturbed the production process. The second reason was the slow and costly bureaucratic procedures not only at the time of establishment but also during ongoing operations. The final reason was a security issue. After the 2002 Bali bombing, many foreign investors felt uncertain about their investment in Indonesia.

The most recent example of Indonesia's low competitiveness compared to Malaysia was the decision by Research in Motion (RIM), a producer of BlackBerry smart phones, to manufacture the BlackBerry in Penang, Malaysia from July 1st 2011. Although Indonesia has a bigger market and lower production costs than Malaysia, the better infrastructure facilities and financial incentives offered by Malaysia are more attractive. Reactions from several Indonesian officials made the Indonesian position even worse, since they threatened to remove the incentives and impose luxury taxes on the Blackberry.

These examples should serve as lessons that it is not difficult for foreign investment to relocate electronics industries to other countries which offer a better business environment. This means Indonesia had once again missed the opportunity to be part of the electronics production networks.

In spite of the government's efforts to provide several policies, development of the electronics sectors has not been successful. Moreover, existing policies, especially the import substitution regime, resulted in industrial development biased toward the production of consumer electronics. In addition to the slow and costly bureaucratic procedures, and unfriendly business environment, the condition of the Indonesian labour market hampered the development of this sector. As argued by Jacob and Szirmai (2007) knowledge spillovers have become significant contributors to labour productivity growth following the liberalization of the Indonesian economy. Unfortunately, Indonesia has a low absorptive capacity, specifically the shortage of adequately trained and skilled local employees to be able to fully comprehend and master technologies transfers (Thee, 2005b). Therefore the electronics sector especially the high technology intensive sector is still lagging compared to Malaysia and the Philippines.

4.5 The Automotive Sector: Historical Development and Policy Regime

The automotive sector in Indonesia began in 1928 with the establishment of PT General Motors in Jakarta, which operated a very simple assembly because automobiles were imported in two-unit packs. The main reason for this simple local assembly was to save transportation costs. The assembly activities in Indonesia gradually increased in the 1950s with importation of completely knocked-down (CKD) packs to increase labour utilization and technical skills as well as saving foreign exchange. However with further decline in government's foreign exchange reserves, by 1961 importation of CKD ceased with the exception of the assembly for government needs financed by government-to-government grants from other countries (Witoelar, 1983).

Policies affecting automotive sector since the 1966 is summarized in Table 4.9 below.

Table 4.9: Policies related to Indonesian Automotive Sector

Year	Policy
1966	Allowing any kind of automobiles importation, from completely build up (CBU), CKD, semi-knocked down (SKD) and even used cars
1969	Regulation on importation and assembly
1969	Long term development program to have full domestic manufacturing capability of various automobile by 1984.
1972	Ban the import of commercial vehicles in CBU to Java and Sumatra
1974	Ban the import of commercial vehicles and passengers cars throughout Indonesia
1974	Change in Foreign Investment Law in which foreign investment is only allowed to have 49 percent share in joint venture
1976	Deletion Program
1983	Extend the deletion program
1992	Change in Foreign Investment Law: 100 percent foreign ownership is allowed but only for investments in certain regions and certain sectors in Indonesia
1993	Replace the Deletion Program with Incentive Program
1994	Change in Foreign Investment Law: 100 percent foreign ownership is allowed throughout Indonesia
1995	Importation of CBU is allowed with very high import tariff
1996	National Car Policy
1999	Tariff reform which reduces CBU and CKD parts import tariff but still remain high

The New Order government under Soeharto in 1966 realized the need to increase the supply of all goods and commodities including automobiles and allowed any kind of automobile importation, not only CKD, but also completely built up (CBU), and semi-knocked down (SKD) and even used cars. This surge of imported goods hampered the development of existing assembly firms. In early 1969, the government gave three options to the motor vehicle business: to be a sole agent, a local, or a general assembler depend in part by the facilities of the companies. A general assembler had to be capable of producing at least 3,000 vehicles per year from CKD condition, a local assembler had to have facilities to assemble at least 1,000 per year and companies without the required facilities should become sole agents.

The government also took a number of steps to rationalise the development of automotive industry. The first step was to separate the importation from assembly by requiring that import sales and assembly must be handled by separate corporate entities. Overseas manufacturers had to appoint sole agents. Assemblers were to undertake assembly on a contract basis for these sole agents. The second was the joint decrees of the Minister of Trade and Industry which announced that after 31 March 1970, brands of motor vehicles for which a sole agent or brandholder had not been approved could not be imported into Indonesia. The third was provisions regarding sole agents. However, because of the limited size of the automotive market in Indonesia, there was not be enough production of any given make and model to keep the assembly equipment fully occupied (Hansen, 1971).

The government decided to make a long term development plan for the industry towards import substitution policy and employment creation. The automotive sector was intended to have full manufacturing capability including the capability to locally produce and assemble all or most components. The government planned to have full domestic manufacturing capability of various automobiles by 1984. To support the development of local manufacturers, the government banned the importation of CBU commercial vehicles to Java and Sumatra in 1972, and the ban was extended to passengers cars throughout Indonesia in 1974.

The open door policy to foreign investment and the protected captive market that was given to foreign investors in the early phase of import substitution attracted numerous foreign investors. This created resentment in nationalist circles especially toward the highly visible Japanese investment and reached a peak during the demonstrations when Prime Minister Tanaka visited Indonesia on 15 January 1974, and became known as the Malari Affair (Pangestu and Sato, 1997). A week after the Malari Affair, President Soeharto announced the principles of foreign investment.

The major government policy supporting development of the auto parts industry was the deletion program announced in 1976. By Minister of Industry Decree no 307/1976, the government scheduled the gradual deletion of specific components from the imported CKD packs used in the assembly of commercial vehicles but not in passenger cars (see Table 4.10). One objective of the deletion program was to stimulate technology transfer from the Japanese auto parts industry to local manufacturers through a stable, durable and intense subcontracting relationship between large car assembling firms and the local auto parts supplier firms. However, in reality, many of the components intended to be made locally were actually assembled from imported parts and components (Thee, 2005a).

Table 4.10: Ministry of Industry Decree No. 307/M/SK/1976: Schedule of the Compulsory Uses of Locally Manufactured Components in the Assembly of Commercial Automobiles in Indonesia

Vehicle	1977	1978	1979	1984
¾ - 1 ton	Paint, tires and storage battery	Glass, seat and seat frame, leaf spring, cabin, wheel rim, shock absorber, load cabin, radiator, muffler, plastic and rubber parts, ornament, bus body, and components (which will be stipulated later)	Chassis, fuel tank, oil and air filter, spark plug, and components (which will be stipulated later)	Engine and transmission, wheel drum, brakes and clutch lining, axle and components (which will be stipulated later)
2 – 2.5 ton	Paint, tires and storage batter	Glass, seat and seat frame, leaf spring, shock absorber, radiator, wheel rim, plastic and rubber parts, ornament, busybody and components (which will be stipulated later)	Load cabin, chassis, cabin, fuel tank, oil and air filter, spark plug, and components (which will be stipulated later)	Engine and transmission, wheel drum, brakes and clutch lining, axle and components (which will be stipulated later)
3.5 – 5 ton	Paint, tires and storage batter	Glass, seat and seat frame, radiator, plastic and rubber parts, ornament, busybody and components (which will be stipulated later)	Cabin, load cabin, wheel rim, shock absorber, leaf spring, fuel tank, oil and air filter, spark plug, and components (which will be stipulated later)	Engine and transmission, chassis, wheel drum, brakes and clutch lining, axle and components (which will be stipulated later)

Source: Witoelar (1983)

The Indonesian automotive market expanded strongly in the early 1970s because of the oil boom and rapid economic growth, with an increase in makes and models from 12 and 21, in 1974 to 42 and 130 in 1976, respectively. By 1980 there were 51 makes and 147 models (Witoelar, 1983). The large number of varieties created a very segmented and small market for the auto parts industry making it unable to achieve economies of scale. In 1981, the government attempted to rationalize the automotive sector by requiring car assemblers to reduce the number of car brands and models to achieve economies of scale (Tarmidi, 2004). The objective was to have a larger market share for each brand and to increase efficiency and lower production costs. However because of strong rejection from vested interests in the sector, this regulation was not implemented effectively.

Another decree was stipulated in 1983 on the compulsory use of locally made components. However this decree was not successful either, due to the lack of technology, capital and skills in technical areas of the small and medium scale manufacturers (Sato, 2001). This made foreign car makers unwilling to invest heavily in local small and medium manufacturers and created shallow, short term and non-exclusive relationships between assemblers and auto parts manufacturers. Therefore the government intention to develop a local auto parts industry was not achieved.

Since the deletion program had little success in fostering development of the auto parts industry in Indonesia, the government terminated the deletion program in 1993 and replaced it with the incentive program. In this program, assemblers were not forced to use locally made auto parts. Instead they would receive an incentive in the form of lower import tariffs for imported parts and components if they increased the use of locally made components (local content). The maximum tariff for imported parts and components was 40 percent but became zero when the local content requirements were achieved or exceeded. Local content was measured by a formula of multiplying the percentage of value added achieved with the given weighted percentage of the component parts. At the same time, AFTA began to have an impact and the trade among ASEAN countries increased. Until 1995, the components were considered local if they used 40 percent locally made sub-components for passenger cars and 20 percent locally made sub-components for commercial cars.

The restriction on foreign investment was lifted in April 1992 and 100 percent foreign ownership was again permitted but in certain areas and with a requirement of divestment after a certain period. In June 1994, the policy on foreign investment became more open, allowing foreign investment throughout Indonesia with no obligatory divestment policy (Aswicahyono and Hill, 1995).

In 1995, the government increased the incentive bar to 60 percent for passenger cars and 40 percent for commercial cars. However the incentive system was not successful either since the local content for passenger cars was only 11 percent (Hale, 2001). In June 1995, the government launched a regulation package allowing import of CBU cars but still with a relatively high import tariff. The import tariff was 125 percent for CBU, 75 percent for CKD and 25 percent for components. This regulation was viewed as a positive step toward less restrictive automotive industry.

In 1996, Soeharto signed a highly controversial decree appointing the Timor Putra Nasional (TPN) company,(owned by his son, as sole manufacturer of the "national car", Timor. TPN did not have one single auto plant. In a joint venture with KIA Motors from Korea, they began to build factories in Indonesia. Meanwhile the cars were produced wholly in Korea and exported to Indonesia as CBUs. As the national car, it received pioneer status exempting it from import duties and luxury sales tax (Tarmidi, 2004). To qualify as a national car assembler, automotive companies had to meet three basic criteria: first, use an Indonesian brand name; second, company shareholders had to be wholly Indonesian and third, had to contribute directly to improving national technology design and engineering capabilities by increasing local content with a schedule of 20 percent in the first year, 40 percent in the second year and 60 percent in the third year in accordance with the import duty incentive of the 1993 regulation. This national car program was heavily criticized by Japan, the US and the EU. They all filed complaints with the WTO which ruled that the program was a violation of WTO rules.

After the financial crises in 1998, Indonesia had to sign a Letter of Intent with the IMF which required rapid liberalization of the market. The Indonesian government introduced a harmonized system under the WTO system in 1999. In this harmonized system, the local content programs were removed and Indonesia signed the "trade-related investment measures" (TRIMS). The protectionist policy toward the automotive sector was replaced by a market liberalization program. The June 1999 tariff reform significantly reduced the import tariff for CBU and CKD imports, but it remained relatively high (Aswicahyono, Basri, and Hill 2000).

In conclusion, a frequent change in policies toward the automotive sector in Indonesia (as summarized in Table 4.9) created uncertainty for both domestic and foreign investment which in turn hampered development of the automotive sector especially auto parts manufacture. Technology transfer from Japanese car makers to domestic small and medium enterprises did not occur as expected. Japanese car makers were reluctant to transfer technology because they were unable to secure majority ownership (Sato, 2001).

4.6 Concluding Remarks

Indonesia's economic development is improving over time with average annual growth around 5 percent during the oil boom and major deregulation periods. Indonesia's growth recovered after the financial crisis, although it took seven years to return to its pre-crisis GDP per capital level. Similar to other Southeast Asian countries, the largest contribution to GDP is private consumption. In the last decade, the contribution of international trade in GDP increased. On a sectoral basis, the contribution of the agriculture sector declined.

Indonesia's exports are dominated by the manufacturing sector although its share has continued to decline since 2000 while the share of agriculture export has continued to increase because of increasing international demand for palm oil. The country composition of Indonesia's exports and imports has changed with a lower share for Japan and the US and an increasing share for Asian countries such as China, South Korea, Malaysia and Thailand. This reflects the increased intra Asian trade which is closely related to the increased intensity of the global production networks.

Although Indonesia has improved its education quality and business environment, its position is still low compared to other ASEAN countries and this has hampered Indonesia's participation in the global production networks.

Trade, industrial and investment policies have changed over time to respond to a change in economic dynamics. During the 1974-1981 oil boom period, the trade and industrial policy operating was inward looking import substitution providing protection to domestic industries. Initially, it applied to consumer goods but was subsequently expanded to intermediate and capital goods. Protection was in the form of high import tariffs and non-tariff barriers such as import restrictions and import sales tax.

With the 1982 decline in oil price, the government did not have the option to maintain the expensive import substitution policy and so shifted trade policy to outward looking export promotion from 1983. It started with economic stabilization policies which included devaluation of the rupiah, tight monetary policy, and mobilisation of domestic funds through better tax collection and improvement of non-oil exports. The government later adopted policies to reduce the high costs economy, starting with trade policies and followed by reforms in industrial and investment policies. The trade reform in this period reduced the real effective rate of protection in the manufacturing sector (excluding oil and gas) from 66 percent in 1987 to 16 percent in 1995. However, protection in the agriculture sector only changed slightly from 9 percent in 1987 to 4 percent in 1995.

Investment policies toward foreign investment have changed from liberal regime in 1967, to a restrictive one in 1974 before liberalizing again in 1994. These policy swings depended on the availability of development funds and nationalist sentiment. When the economy was good, investment policies tended to be more restrictive because the government considered the foreign investment to be a supplement to domestic investment or capital.

The series of deregulations in the period 1983 – 1996 was successful because of sequencing policies and political will from policy makers. Unfortunately, the Asian financial crisis that hit Indonesia severely and contracted the economy by 13.1 percent in 1998 was intensified by the political crisis that resulted in regime change. Since the government was powerless to deal with the unprecedented crisis, in spite of the political difficulties and unpopularity of the IMF, it signed an agreement with the IMF in 1998. Trade liberalization continued under the IMF agreement and several economic laws were also enacted. However, there was an increase in protectionism through non-tariff barriers using the nationalism rationale.

As a result of free and fair parliamentary and presidential elections in 1999 and 2004 new democratic politics complicated the policy making process. Although the government continued to implement trade and investment liberalization after the IMF program ended, it failed to provide certainty to investors. Current and potential investors had hoped the new investment law enacted in 2007 would improve the business environment significantly.

The electronics sector in Indonesia began in 1970s with only a simple assembly process. Government's policies aimed to develop the sector have not been successful, and have resulted in an industrial development biased towards the production of consumer electronics to serve the domestic market. The close down of two semiconductors firms in the late 1980s and another in early 2000 has created a pessimistic perspective of the Indonesian electronics sector. In addition to slow and costly bureaucratic procedures, and an unfriendly business environment, the condition of the Indonesian labour market hampered the development of this sector. Indonesia has a low absorptive capacity to be able to fully comprehend and master technology transfer from foreign direct investment.

The Indonesian automotive sector started back in 1928 with a very simple assembly process and continued to develop with a significant increase in the number of firms. The government always had an intention to develop this into a competitive sector by providing a highly interventionist policy regime. However this policy regime did not give the expected result, and instead made the sector inefficient and uncompetitive. The frequent change in policies towards the automotive sector created uncertainty for both domestic and foreign investment.

Appendix

Appendix 4.1: Real GDP per Capita and Share in GDP by Expenditures and Sectors, 1960 – 2007

Year	GDP per capita		Share in GDP by Expenditure (%)					Share in GDP by Sectors (%)		
	Annual Growth (%)	Constant (2000 US$)	Consump-tion	Goverment Exp	Invest-ment	Export	Imports	Agricul-ture	Industry	Services
1967	-1.4	193.2	77.2	10.4	9.2	15.0	-11.9	51.4	12.7	35.9
1968	9.2	211.0	79.4	10.9	11.9	10.7	-12.9	48.6	15.9	35.5
1969	4.8	221.0	87.1	5.7	6.5	5.8	-5.1	47.0	17.9	35.1
1970	5.4	233.0	82.7	6.5	9.5	10.2	-8.9	44.9	18.7	36.4
1971	4.3	243.1	78.1	6.5	14.1	13.7	-12.4	42.7	20.8	36.5
1972	5.2	255.7	87.0	5.1	7.8	5.5	-5.4	38.4	25.2	36.4
1973	7.1	273.8	94.2	8.0	5.3	13.4	-20.9	38.2	26.5	35.2
1974	5.6	289.1	90.7	6.7	9.3	9.2	-15.9	31.1	34.2	34.7
1975	3.6	299.6	86.3	6.8	10.2	11.4	-14.7	30.2	33.5	36.3
1976	3.5	310.0	84.3	6.7	13.6	9.5	-14.0	29.7	34.1	36.3
1977	6.1	328.8	77.7	8.0	15.8	13.5	-15.0	29.6	34.3	36.2
1978	6.7	350.8	74.2	8.5	18.4	15.0	-16.1	28.1	35.7	36.2
1979	4.6	367.0	68.5	8.3	21.8	17.5	-16.1	27.3	37.7	35.0
1980	6.3	390.0	67.1	9.7	20.8	21.0	-18.6	24.0	41.7	34.3
1981	5.7	412.3	64.0	7.2	19.5	29.8	-20.5	23.4	41.2	35.4
1982	-1.1	407.7	64.3	9.0	23.7	24.0	-21.0	23.9	37.9	38.2
1983	6.1	432.6	63.5	9.4	24.1	24.5	-21.5	22.9	39.8	37.3
1984	4.9	453.9	61.0	9.9	23.4	24.8	-19.2	22.7	39.1	38.2
1985	1.4	460.1	62.3	10.7	23.9	22.9	-19.7	23.2	35.8	40.9
1986	3.9	478.0	57.6	9.5	24.8	30.6	-22.6	24.2	33.7	42.0
1987	3.3	493.9	51.4	10.5	24.1	34.2	-20.2	23.3	36.3	40.4
1988	4.4	515.7	57.2	11.0	26.7	29.0	-24.0	22.5	37.3	40.3
1989	7.2	552.6	59.5	11.5	27.8	25.3	-24.1	21.7	38.3	40.0
1990	7.1	592.1	59.8	10.4	31.3	26.3	-27.9	19.4	39.1	41.5
1991	7.1	634.3	59.5	10.1	26.8	25.6	-22.1	18.3	40.4	41.3
1992	5.5	669.1	59.1	11.2	28.0	22.2	-20.4	18.7	39.6	41.7
1993	5.6	706.5	60.4	11.0	29.5	19.5	-20.5	17.9	39.7	42.4
1994	5.9	748.3	58.8	9.4	30.2	23.9	-22.4	17.3	40.6	42.1
1995	6.8	799.3	59.9	8.5	28.8	23.8	-21.1	17.1	41.8	41.1
1996	6.1	848.2	55.8	8.7	32.6	24.3	-21.4	16.7	43.5	39.9
1997	3.3	876.0	58.9	8.8	30.7	25.3	-23.7	16.1	44.3	39.6
1998	-14.3	750.8	58.4	8.3	31.6	25.8	-24.1	18.1	45.2	36.7
1999	-0.5	746.8	57.8	8.8	30.5	27.9	-25.0	19.6	43.4	37.0
2000	3.6	773.3	58.5	9.0	29.5	26.8	-23.8	15.6	45.9	38.5
2001	2.3	791.1	59.7	8.1	31.1	26.5	-25.4	15.3	46.5	38.3
2002	3.2	816.0	61.6	7.8	31.9	26.3	-27.6	15.5	44.5	40.1
2003	3.5	844.2	62.4	7.6	30.7	25.8	-26.4	15.2	43.7	41.1
2004	3.7	875.7	61.7	6.8	31.8	27.9	-28.1	14.3	44.6	41.0
2005	4.4	914.6	67.8	5.7	16.8	53.0	-43.2	13.1	46.5	40.3
2006	4.3	953.9	73.9	6.6	11.4	35.5	-27.4	13.0	46.9	40.1
2007	5.2	1,003.4	60.7	6.5	22.2	41.0	-30.5	13.7	46.8	39.5
2008	4.9	1,052.4	62.3	6.9	22.5	39.0	-30.8	14.5	48.1	37.5
2009	3.5	1,089.2	65.0	7.3	21.4	32.7	-26.4	15.3	47.7	37.0
2010	5.0	1,143.8	58.9	8.1	25.6	30.5	-23.1	15.3	47.0	37.6

Source: World Bank, WDI website (http://data.worldbank.org/indicator)

Appendix 4.2: Indonesia: Export by Factor Intensity, 1980 – 2010

Year	Total Export ($ billions)	Export Share (%)		
		Agricultural	Mineral	Manufacturing
1980	21.9	21.8	75.8	2.4
1981	22.3	13.3	83.4	3.3
1982	22.3	10.6	85.5	3.9
1983	21.1	12.5	79.9	7.6
1984	21.9	14.0	76.9	9.2
1985	18.6	15.9	72.9	11.2
1986	14.8	21.3	60.7	18.0
1987	17.1	21.2	54.4	24.3
1988	19.2	23.9	46.5	29.6
1989	22.0	21.1	46.2	32.7
1990	25.7	16.2	48.1	35.7
1991	29.1	16.4	42.5	41.1
1992	34.0	14.8	37.4	47.7
1993	36.8	15.0	31.7	53.3
1994	40.1	17.6	30.4	52.0
1995	45.4	18.0	31.3	50.7
1996	49.8	17.0	31.5	51.5
1997	53.4	16.0	29.3	54.7
1998	48.8	15.8	23.7	60.6
1999	48.7	15.5	27.7	56.8
2000	62.1	12.5	30.1	57.4
2001	56.3	12.5	30.8	56.7
2002	57.2	15.8	29.6	54.7
2003	61.1	16.3	31.4	52.3
2004	71.6	17.3	32.3	50.4
2005	85.7	16.7	36.1	47.1
2006	100.8	18.0	37.3	44.6
2007	114.1	20.9	36.3	42.9
2008	137.0	24.0	37.0	39.1
2009	116.5	21.7	37.4	40.9
2010	157.8	22.8	39.4	37.8

Source: UN-COMTRADE database

Notes:

- Agriculture Resource Intensive - SITC 0 + 1 + 2 - 27 - 28 + 4
- Mineral Resource Intensive - SITC 27 + 28 + 3 + 68
- Manufacturing - SITC 5 + 6 - 68 + 7 + 8 + 9

Appendix 4.3: Indonesia Import by Factor Intensity, 1980 - 2010

Year	Total Import ($ billions)	Import Share (%)		
		Agricultural	Mineral	Manufacturing
1980	10.8	16.2	18.6	65.2
1981	13.3	14.0	16.0	70.1
1982	16.9	9.5	23.2	67.2
1983	16.4	10.4	27.4	62.2
1984	13.9	10.4	22.0	67.6
1985	10.3	11.0	16.7	72.3
1986	10.7	11.3	14.6	74.1
1987	12.4	12.0	13.2	74.8
1988	13.2	13.0	11.7	75.3
1989	16.4	13.0	13.6	73.4
1990	21.8	9.7	14.0	76.3
1991	25.9	10.2	13.7	76.1
1992	27.3	12.0	12.0	76.0
1993	28.3	11.7	12.0	76.3
1994	32.0	13.4	11.6	75.0
1995	40.6	15.0	12.2	72.8
1996	42.9	16.2	12.6	71.2
1997	41.7	13.5	13.5	73.0
1998	27.3	17.1	13.5	69.4
1999	24.0	22.8	19.4	57.8
2000	33.2	17.2	22.2	60.7
2001	30.7	17.4	22.1	60.5
2002	31.1	16.9	24.8	58.3
2003	32.3	16.8	27.3	55.9
2004	46.3	14.2	29.5	56.3
2005	57.4	11.5	34.1	54.3
2006	60.7	12.3	35.4	52.3
2007	74.5	14.1	33.5	52.4
2008	129.2	10.3	27.9	61.8
2009	96.8	11.7	23.0	65.3
2010	135.5	11.5	24.0	64.5

Source: UN-COMTRADE database

Notes:

- Agriculture Resource Intensive - SITC 0 + 1 + 2 - 27 - 28 + 4
- Mineral Resource Intensive - SITC 27 + 28 + 3 + 68
- Manufacturing - SITC 5 + 6 - 68 + 7 + 8 + 9

Chapter 5: Determinants of Global Production Network - Analytical Framework

5.1 Introduction

This chapter develops an analytical framework to determine factors affecting a country's participation in global production networks. The analysis is conducted at two levels; the first analysis is at the macroeconomic level and the second one is at the firm level using Indonesia case studies. The macroeconomic level analysis is based on the fragmentation theory developed by Jones and Kierzkowski (1990). There are three contributory factors that enabled product fragmentation. First is the development in production technology that enabled slicing the production process into different tasks with different factor proportion characteristics; second is trade liberalization and third is advancement in communications and transportation that have contributed to a decline in the cost of service links. To the best of the author's knowledge, this study is the first systematic analysis to determine why Indonesia has been left behind in global production network; the author uses a simple pooled regression model with the trade data instead of the more commonly used gravity model.

Meanwhile, the microeconomic level analysis is based on Roberts and Tybout's (1997) model on firm heterogeneity to analyse the implications of firm heterogeneity for international trade. Firm heterogeneity covers firm characteristics such as size, ownership, location, factor intensity and productivity. The Roberts and Tybout's model is applied to Indonesian case studies for the electronics and automotive sectors in order to investigate whether firm heterogeneity affects the participation of Indonesian firms in the global production network. This is the first study on Indonesia on the global production network using the firm level data of which the author is aware.

This chapter is organized as follows. The first part discusses macroeconomic level analysis and the second part discusses firm level analysis. Each part begins with the model specification, providing a theoretical reasoning and a detailed discussion of the variables, followed by data description and estimation model. The final section presents a summary of the models which will be estimated in the following chapters: Chapter 6 on the macroeconomic level analysis, Chapter 7 on the Indonesian electronics case study and Chapter 8 on the Indonesian automotive case study.

5.2 Macroeconomic level analysis

The macroeconomic analysis is based on the Jones and Kierzkowski's (1990) fragmentation theory. Owing to the three contributory factors mentioned earlier, a firm is able to choose to produce in a single production block or in several fragmented production blocks. This decision is based on a combination between marginal production cost and fixed service link costs connecting the production blocks. The aim is to answer two research questions, the first is on the determinants of a country's participation in the global production network; the second question is why Indonesia has been left behind.

This research provides a new contribution to the empirical studies on the global production network. While the existing studies focus on selected countries and groups of countries, this research covers 98 countries with a share of manufactured exports of higher than 0.01 percent, with a longer period from 1988-2007. This benchmark is used to make sure there is no sample selection bias and that all countries in this dataset export parts and components.

The existing empirical studies have separately analysed the determinants of the global production network. Jones *et al.* (2005), Deardorff (2001) and Golub *et al.* (2007) focused on the role of service links in the global production network. The lowering of service link costs promotes fragmentation and the outsourcing of output. The first study uses business telephone charges as a proxy of service link cost. They compare three regions: East Asia, EU 15 and NAFTA for the period 1990-2000. The result supports the theory that the lowering of business telephone charges increases the trade of parts and components. The second study uses an index of service link quality and costs as a proxy of service links. They construct an index consisting of transport, communications, and electric power reliability and costs using data from around 2004. The result also supports the theory that lower service link costs indeed increase the trade of parts and components as well as trade of final goods and FDI inflows.

Other determinants of the global production network are exchange rates and relative wages. Arndt and Huemer (2005) use quarterly data for bilateral trade between the U.S. and Mexico from the first quarter of 1989 to the fourth quarter of 2002 to examine the effect of cross-border production sharing on the sensitivity of trade to the exchange rate and GDP. They found that the sensitivity of exports and imports to the real exchange rate should decline when cross-border fragmentation expands and when the share of trade associated with production networks rises.

Kimura (2005) examines the industrialization performance of Indonesia through a comparative evaluation with other Asian countries. While neighbouring countries actively formulated international production/distribution networks, Indonesia fell behind in utilizing the benefits of globalizing corporate activities. One of the reasons is due to the design of Indonesia's development strategies and "institutions" which does not conform to the globalizing world because the presence of network-forming foreign companies is not large enough to make them influential "actors".

Kimura *et al.* (2007) compares product fragmentation in the European Union and East Asia. The hypothesis is that the European model is dominated by horizontal differentiated products, while the East Asian model is dominated by product fragmentation.

Athukorala and Yamashita (2006) use the gravity model to examine the extent, trends and patterns of the global production network. They found that relative wage differentials are a significant determinant of cross border trade in components (as well as the related final products).

As has been discussed more detailed in Chapter 2, a country's decision to participate in global production network depends not only on the relative cost but also on efficiency of service links.

5.2.1 Model Specification

The empirical model employed in this research is based on Jones and Kierzkowski's (1990) fragmentation theory. The hypothesis is that this participation depends on relative costs as well as service link costs. Relative costs are measured by the labour cost and real exchange rate. The service link costs are measured by the trade cost, infrastructure condition, trade openness and FDI openness.

Labour cost

As suggested by the new trade and fragmentation theory, in vertically differentiated products Falvey (1981) and Falvey and Kierzkowski (1987) suggest that since a higher-quality product requires higher capital-intensity in production, in an open economy the capital-rich country will export high-quality products whereas the labour-rich country will export low-quality products. These models predict that the share of intra-industry trade in the bilateral trade should be greater, the greater the difference in relative factor endowments between the two countries. This implies a positive coefficient for the export model. Alternately, a high-wage country will export high-quality parts and components and then re-import them in the context of an export processing zone, which implies that the coefficients of both the export and import models are positive.

Competitiveness

Traditionally, the appreciation of domestic currency raises the cost of imports and lowers that of exports. However, in the production networks the relationship can be reversed. The response of a country's exports to a change in the exchange rates should decline as the share of imported components of its exports rises. Therefore the relationship between changes in exchange rate (*RER*) and trade will be smaller in the presence of production networks. Moreover, as suggested by Arndt and Huemer (2005), the sensitivity of trade to the exchange rates will decline in line with the more intensive fragmentation trade among countries. Then the exchange rate would not be a significant determinant of the participation in global production networks. A study by Jongwanich (2010) on 8 East and Southeast Asian countries found that a connection between real exchange rate and export performance is weaken in fragmentation trade, while world demand and supply side factors, including FDI, tend to become more crucial in determining export performance.

Service links costs

Fragmentation trade depends significantly on service links which connect the production blocks and ensure that the production blocks interact efficiently. Basically, goods and services are traded among the production blocks both domestically and across borders.

Trade Cost

Trade cost is crucial in determining the flow of goods between countries, especially in the fragmentation trade because of the double trade-cost incidence of exporting components and re-importing them (or vice versa). A broad definition of trade costs includes policy barriers (tariffs and non-tariff barriers), transportation costs (freight and time costs) as well as the cost of communications and other information, enforcement costs, exchange rate costs, administration cost, legal and regulatory costs and local distribution costs. Fragmentation enables low trade cost countries to specialize in export activities that match their factor endowments, while higher trade cost countries use fragmentation as a means of 'import substituting'. Thus, labour abundant countries that have low trade costs import components and export assembled products, while countries with higher trade costs import and assemble components for the local market only. In the latter case fragmentation may reduce trade volumes (Markusen and Venables, 2007). A lower trade cost will increase the trade flows in a country, therefore the expected sign is negative.

Since data for tariff and non-tariff barriers for all countries are not available for the sectoral level, the trade cost considered in this research is the administration burden faced by the exporter and the importer at the port. The number of documents to be signed and the time taken to complete the administration affects the cost of exporting and importing. For the movement of goods in international trade, an improvement in efficiency in logistics and any related trade-enhancing infrastructure at ports is important as it will increase a country's participation in global production network. However in the empirical analysis, there is a possibility of an endogeneity problem between trade cost and trade flows. The higher trade flows make the role of export and import in the GDP more significant and increase the bargaining power of the exporter and the importer to lobby government in order to improve the trade facilitation, and this in turn will result in a decrease in trade costs.

Freight costs

One explanation of the rise in international trade is the decline in the international transportation costs (Hummels, 2007). The decline in the cost is associated with innovations in transportation and telecommunications. The mode of transportation depends on the characteristics of the goods - the bulk commodities such as oil and petroleum products, iron ore, coal, and grains are shipped almost exclusively with ocean cargo. On the other hand, commodities with high value-to-weight ratio will choose air transportation which nowadays is more preferable to ocean transportation because of the sharp decline in the relative cost of air transport.

Some studies found that trade is more sensitive to transportation cost than import tariffs (see for example: Finger and Yeats 1976; Clemens and Williamson 2002; Waters 1970). As there is more trade negotiation among countries, the trade barriers from tariffs have become less important, and therefore the share of transportation cost in total cost is increasing.

Transportation costs vary together (co-vary) with distance and it satisfactorily explains why countries initially trade most with their neighbours. However, distance is not a perfect measure of the transportation cost since it does not reflect the change in the quality of transportation. With the decline in air transport costs and the development of technology which enables parts and components to be relocated in the smaller pieces, long distance trade is now relatively more attractive.

Therefore the expected sign of freight cost and value of trade can be either positive or negative depending on the type of traded commodities.

Trade Openness

Participation in the global production network depends on trade openness. A country with a more open trade flow is expected to have a higher participation in global production network, since it will be easier for the firms to move the parts and components across plants in different countries. Therefore the expected sign for trade openness is positive.

Infrastructure

An efficient infrastructure affects both the communications and coordination costs, as listed as elements of service link costs by Kimura *et al.* (2007). Efficient infrastructure includes reliable and affordable telecommunications and electricity, roads in good conditions, as well as reliable and efficient port management. This is especially the case for the electronics sector where just-in-time delivery is very crucial. Reliable infrastructure is necessary to guarantee that delivery from one production network to another in the same country as well as delivery from warehouse to port for export can be done on time. This characteristic differentiates the fragmentation trade from the traditional trade flows, where real wages and competitiveness are the most important factors.

Business and regulatory environment

Most of the production blocks located in foreign countries are conducted through FDI, therefore the business and regulatory environment related to FDI are important factors determining participation in global production networks (Jongwanich, 2010). FDI openness is crucial (especially in the electronics and automotive sectors) because with the possibility of having full foreign ownership in a country, foreign producers are willing to bring the latest technology and this in turn improves managerial practices and close supervision of assembly/production by bringing in foreign technicians and managers. It is expected that the more open the FDI policies in a country, the higher the participation in a global production network, and then the expected sign of *FDI_Openness* will be positive.

Dummy variables

Two dummy variables are included in the model. First, the country dummy variables (C) are included to capture the unobserved country differences such as geographical location and historical involvement in production networks. Second, the year dummy variables (T) are included to control for time-varying factors relating to parts and components such as technological and price changes.

Based on the discussion of the variables above, the full specification of the model can be written as follows:

$$Frag_{i,t} = \alpha + \beta_1 \ln Lab\_Cost_{i,t} + \beta_2 \ln RER_{i,t} + \beta_3 Trade\_Cost_i$$

$$+ \beta_4 Trade\_Open_{i,t} + \beta_5 Infrastructure_i + \beta_6 FDI\_Open_{i,t} \qquad (5.1)$$

$$+ \varphi_1 C + \tau_t T + \varepsilon_{i,t}$$

where subscript i represents the i-th country, i = 1,2, .., 98, and t represent the year, t = 1988, 1989,... , 2007. The variables are listed and defined below, with the expected sign of the coefficient for independent variables in parentheses:

Frag	Fragmentation trade (real export value of parts and components)
Lab_Cost	Labour cost (+)
RER	Real exchange rate (-)
Trade_Cost	Export cost (-)
Trade_Open	Trade openness (+)
Infrastructure	Infrastructure Condition (+)
FDI_Open	FDI openness (+)
T	A set of time dummy variables
C	A set of country dummy variables
α	A constant term

5.2.2 Variable construction and Data

The model covers 98 countries with had more than 0.01 percent share of world manufactured goods export in 2007 as provided in Appendix 2.3. The cut-off using the share of manufactured export was chosen to avoid a selection bias problem. The study focuses on two main sectors in the global production network namely the electronics and automotive sectors.

The dataset was assembled from six different databases: the UN COMTRADE, the ILO Laborsta, Index of Doing Business, UNCTAD database, the World Development Indicators (WDI) and the Logistic Performance Index by The World Bank. The initial point is 1988, because it is the first year the UN COMTRADE database commenced reporting under SITC Revision 3, on which the commodity listing of parts and components in this study is based. The end point is 2007, since this was the latest year for which data for most of the variables are available, and data for 2008 – 2009 are liable to have been affected by the global financial crisis.

Fragmentation Trade (dependent variable)

The dependent variable is the real value of the export and import of parts and components. The trade data are sourced from the UN COMTRADE database[10] and the data are originally expressed in nominal US$. The real value is derived using the US import price index collected from the US Department of Labor[11]. The electronics sector uses the import price index for semiconductors, and the automotive sector uses the import price index for automotive parts and accessories.

Athukorala's list (2011) is used for both electronics and automotive sectors with some modifications. For the electronics sector, the electronics sector is classified into three subsectors namely consumer electronics, industrial electronics, and components and parts. For the automotive sector, the list of parts and components has been modified by including other parts and components which are considered to be auto parts by the Japan Auto Parts Industries Association (JAPIA) and the Indonesian Automotive Parts and Components Industries Association (GIAMM). Additional parts and components include tyres, safety glass, automotive electronics parts, brakes, and safety airbags. The complete list of parts and components in the electronics and automotive sectors is provided in Appendices 2.1 and 2.2.

Labour cost

Labour cost is represented by real wage which is calculated from the nominal manufacturing wages of each country in $ deflated by the US Wholesale Price Index (WPI). Nominal wage from the ILO-Laborsta[12] database is expressed in the country's currency therefore it should be converted into US$ using the nominal exchange rate for each country sourced from the WDI website[13]. Unfortunately, 8 of 98 countries do not have wages data.

$$RWages = \frac{wage}{e * P^{US}} \tag{5.2}$$

where $wage$ denotes nominal wage in domestic currency for each country, e denotes the nominal exchange rate in the US$ and P^{US} denotes the US Wholesale Price Index as a deflator.

Real Exchange Rate

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[10] The trade data are collected from UN COMTRADE database website, http://COMTRADE.un.org/db/default.aspx

[11] The price indexes are available at Bureau of Labour Statistics, the US Department of Labor 's website, http://www.bls.gov/web/ximpim/beaimp.htm

[12] The wage data are collected from the ILO – Laborsta, http://laborsta.ilo.org/STP/guest

[13] Other data are collected from the World Development Indicator, the World Bank, http://data.worldbank.org/indicator

The real exchange rate can be defined in the long run as the nominal exchange rate (e) that is adjusted by the ratio of the foreign price level (P^w) to the domestic price level (P^d).

The real exchange rate (RER) is calculated by the following conventional formula:

$$RER = e * \frac{P^w}{P^d} \tag{5.3}$$

Where e denotes the nominal exchange rate measured in terms of foreign currency, P^w is an index of foreign price and P^d is an index of domestic price. The producer (wholesale) price index is used as a proxy of P^w and the GDP deflator is a proxy for P^d . The increase in the RER can be interpreted as the real depreciation of the domestic currency.

Trade cost

Trade cost in a broad definition includes policy barriers, and the cost for transportation, communications, enforcement, exchange rate, administration, legal and regulatory and local distribution. In this analysis only the administration cost at the port is included because of the data limitation for other variables. Data for tariffs and non-tariff barriers are not available at the disaggregated level and using the aggregate tariff data will result in a bias. Communications and local distribution costs data are not available for all countries included in this research. Therefore this analysis uses administration cost at the port as a proxy of trade cost.

Costs for export and import are sourced from The World Bank's Doing Business Survey which was conducted in 183 economies from 2004–2010. Costs for export and import are from the *Trading across Borders* indicators which compile procedural requirements for exporting and importing a standardized cargo of goods using ocean transport. The cargo is a dry-cargo, 20-foot, full container load of a domestic private, limited liability company that has at least 60 employees. The company is located in the economy's largest business city but does not operate in an export processing zone or in an industrial estate with special export or import privileges, and exports more than 10 percent if its sales. This specification is a limitation of this variable since many electronics and automotive firms are located either in export processing zone or in an industrial estate. With this limitation, an interpretation of the result should be done carefully because it may not reveal the true link between this variable and fragmentation trade.

For exporting goods, procedures range from packing the goods at the warehouse to their departure from the port of exit and it measures the fees levied on a 20- foot container in U.S.

dollars. These include costs for documents, administrative fees for customs clearance and technical control, customs broker fees, terminal handling charges and inland transport. The cost does not include customs tariffs and duties or costs related to ocean transport, and only official costs are recorded.

Trade Openness

Trade openness is measured as the ratio of total export and import to GDP.

$$Trade\_Open_{i,t} = \frac{Export + Import}{GDP} \tag{5.4}$$

This measurement has a shortcoming as discussed in Athukorala and Hill (2010). The caveat of using this measurement is that it is a comparison between a net and a gross concept. Trade is measured in gross terms (intermediate materials + value added) whereas GDP is measured on a value-added basis. Therefore the measured change in trade orientation is sensitive to changes in import intensity of export production. Krugman (1995) argued that countries involved in production networks tend to have (artificially) high trade to GDP ratios. Therefore the inclusion of this variable will raise endogeneity problem and instrumental variable is needed to fix the problem. The data are sourced from the WDI.

Transportation Cost

Some empirical models use distance (*Distance)* as a proxy of freight cost. Since this model uses a country's trade to the world instead of bilateral trade, the determination of distance (*Distance)* is not as straightforward as in the gravity model. Several alternative measurements are used. The first one is the distance between countries in a region with the largest export partner of that particular region. If a county is also the largest partner for the particular region, then the distance is measured by the distance between the country and its largest partner. The second alternative is the distance between a country and its largest export partner. However neither measurement provides good results because of the bias. This is because the largest partner country may not always be a major trade partner. For example, Indonesia's largest trade import partner in electronics in 2007 is Singapore, but its trade share is below 30 percent. Assuming that the transportation cost affecting Indonesian export is the distance between Indonesia and Singapore, then this measurement is biased since more than 70 percent of Indonesian electronics parts and components are exported to countries more distant than Singapore.

The alternative is to calculate the freight cost (*Freight_Cost),* making use of the reported cost-insurance-freight (CIF) records of imports and the free-on-board (FOB) records of export value. The expected sign is negative, since the higher freight cost will discourage fragmentation trade. Freight cost is calculated through several steps. Step one is to calculate the CIF-FOB ratio, which has to satisfy several conditions for a reasonable measurement for freight cost. First, the ratio should be larger than 1, which suggests that the CIF value is higher than the FOB value. If it is less than 1 this means that the freight cost is negative. The second condition is that the ratio should be between 1 and 2. If it is more than 2 this means that the freight cost is higher than the value of the shipment. This condition is illustrated as follows:

$$\frac{CIF}{FOB} = 1 + \frac{Freight}{FOB} \tag{5.5}$$

where the CIF value is the import value of each country, while the FOB value is the world export value to each country.

Although the calculation of freight value using the matched partner method is frequently used in the literature (Limão and Venables, 2001; Baier and Bergstrand, 2007) there is a well-known measurement error associated with this approach (Anderson and Wincoop, 2004; Hummels and Lugovskyy, 2006; Hummels, 2007). They found that the calculated freight cost does not necessarily reflect the real shipping cost variation. In fact, the freight cost calculated during the data construction stage turns out strangely. Since both measures are biased this variable is dropped from the model.

Infrastructure Condition

Logistic Performance Index constructed by The World Bank is used as a proxy of infrastructure condition. It is based on a worldwide survey of operators on the ground (global freight forwarders and express services), providing feedback on the logistic "friendliness" of the countries in which they operate and those with which they trade.

FDI openness

The variable used to represent FDI openness is ratio of FDI inflow stock to GDP sourced from the UNCTAD database. The use of FDI stock instead of FDI flow is to avoid high fluctuation in the data.

5.2.3 *Estimation Method*

The macro-level analysis aims to answer two research questions: the first is on the determinants of a country's participation in the global production network; the second is why Indonesia is being left behind.

Information on the data source for variables as explained in section 5.2.2 is summarized in Appendix 5.2. The unbalanced pooled trade data for 98 countries for the period 1988 – 2007 are estimated for two sectors: electronics and automotive.

There is a possible two-way causation between trade costs and trade flows. Besides the effect of trade costs on trade flows, it is possible that higher trade flows will stimulate lower trade costs since exporters and importers become more efficient and thus they can influence the government to reduce the trade costs. The Hausman-Wu specification test is conducted to judge whether this causation is a problem in the data compiled in this study. The result rejects the null hypothesis that there is causality from trade flows to trade cost. Therefore there is no evidence that trade flows will lower the trade costs.

However, there is still a possibility of endogeneity of trade openness. Quality of democracy and political institution from the Polity IV database[14] is used as an instrument. The democracy variable is the difference between the democracy and the autocracy scores in this database, averaged over the period $t-9$. It measures the competitiveness and regulation of political participation, the openness and competitiveness of executive recruitment, and the constraints on the executive. These instrument variables are directly correlated to trade openness but not directly related to the trade flows.

There are two estimation techniques available for panel data regression, fixed and random effects. Since the difference among countries is important, the fixed effect estimation is used for this model. The fixed effect estimator can be implemented in three ways: time demeaning (or within transformation), the first-difference, or the least square dummy variable (LSDV). The first two cannot be implemented in this model since they will eliminate the time-invariant variables such as trade cost, and infrastructure condition, all of which are important for the model. On the other hand, the LSDV technique with country and time dummies can handle the time-invariant variables. Finally, to guard against the heteroscedasticity problem, the author uses the heteroscedasticity-consistent standard errors (i.e. the White correction) clustered by country.

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[14]The data are collected from Polity IV Project: Political Regime Characteristics and Transitions, 1800-2010 website, http://www.systemicpeace.org/polity/polity4.htm.

The estimation results and analysis for both the electronics and automotive sectors are explained in Chapter 6.

5.3 Firm level analysis

In addition to undertaking the macro-level analysis to determine factors affecting a country's participation in global production network, this research also conducts analysis at the firm level to answer the second research question why is Indonesia being left behind in global production network. The firm-level analysis determines whether firm characteristics influence a firm's decision to participate in the network through its export and import activities. The analysis will focus on Indonesian firms in the electronics and automotive sectors.

The firm level data analysis has been the focus on both theoretical and empirical works for a long time. This empirical work has been made possible by the availability of more comprehensive firm level data in several countries. There are several groups of findings related to the export and import activities and firm characteristics. The first one is that exporting firms are more efficient than non-exporting firms (Chen and Tang, 1987; Aw and Hwang, 1995; Bernard et al., 1995; Bernard and Jensen, 1999), but these findings do not have any policy implications because they do not explore further the reasons for the differences.

This leads to the second group of studies, which concludes that exporting causes efficiency gains (learning-by-exporting hypothesis), or more productive firms become exporters (self-selection hypothesis). The first studies on this topic were conducted by Bernard and Jensen (1999) using US firm data and Clerides *et al.* (1998) using data from Colombia, Mexico and Morocco. In the learning-by-exporting hypothesis, exporters become more productive over time, because export markets are far more competitive than domestic markets (Biesebroeck (2003). The self-selection hypothesis, on the other hand, states that the more productive firms self-select in order to enter the export market. Empirical results reported by Bernard and Jensen (1999), Clerides *et al.* (1998) and Greenway and Kneller (2004) indicate that high plant efficiency increases the probability of becoming an exporter.

The third group of results is on the role of sunk costs in the decision to enter into the export market. Clerides *et al.* (1998), and Roberts and Tybout (1997), using Colombia data, find that there are sunk entry and exit costs in the export markets. The sunk costs may include the cost of international marketing, establishing a distribution system, the cost of gathering information about the export markets, and hiring employees with specific language training. Once these costs are incurred, they cannot be recovered. In addition to empirical studies, some theoretical works were also done in this topic, such as that of Bernard *et al.* (2003) and Melitz (2003).

Melitz (2003) introduces firm productivity heterogeneity into Krugman's model of trade under monopolistic competition and increasing returns. Using the interaction between productivity differences across firms and the fixed cost of exporting, he shows that, while high productivity firms become exporters, firms with lower productivity produce for the domestic market only, because they cannot generate sufficient profit in export markets to cover the fixed cost of entry. With the availability of more detailed firm-level data in both developed and developing countries, Melitz's model becomes a standard model for the analysis of the implications of firm heterogeneity on many aspects of international trade. The subsequent analysis of firm heterogeneity covers other firm characteristics such as size, ownership, location, and factor intensity.

5.3.1 Model Specification

The firm level analysis is based on the dynamic model of export participation with entry cost developed by Roberts and Tybout (1997). The decision to export is made in a similar way to a rational firm's decision to begin producing a new product. The profit-maximizing firm makes its export decision based on the expected current and future profit from exporting and taking into account the sunk cost of exporting. The profit function for a firm is:

$$\tilde{\pi}_{it}(X_t, Z_{it}, Y_{i,t-1}) = p_t q_{it}^* - c_{it}\left(X_t, \frac{Z_{it}}{q_{it}^*}\right) - N(1 - Y_{i,t-1}) \qquad (5.6)$$

where p_t is the price of the exported goods, q_{it}^* is the optimal quantity produced by the firm and $c_{it}(.)$ is the variable cost of producing goods for the export market and includes the cost of imported goods; X_t is a list of exogenous variables affecting profitability such as macroeconomic conditions (exchange rate, GDP growth, global market condition etc.); Z_{it} is firm specific factors drawn from the existing studies and can include size, age, factor intensity, productivity, skill, and ownership structure. N is the sunk cost of exporting/importing. If the firm exported in the previous period, then $Y_{i,t-1} = 1$, and the firm no longer has to pay sunk cost.

A firm will be an exporter if the expected profits are positive and the export status of the firm i at time t is denoted by Y_{it} where

$$
\begin{aligned}
Y_{it} &= 1 \text{ if } \tilde{\pi}_{it} \geq 0 \\
&= 0 \text{ if } \tilde{\pi}_{it} < 0
\end{aligned}
\tag{5.7}
$$

From Equation (5.7), the firm will export if the expected current and future profit is greater than the costs:

$$
\begin{aligned}
Y_{it} &= 1 \text{ if } \tilde{\pi}_{it} \geq c_{it} + N(1 - Y_{i,t-1}) \\
&= 0 \text{ if otherwise}
\end{aligned}
\tag{5.8}
$$

Following Roberts and Tybout (1997) there are two ways to estimate Equation (5.8). First, developing a structural representation of the participation condition by making specific assumptions about the form of the profit function and the processes that generate X_t and Z_{it}. The advantage of this approach is that it allows identification of the parameters of the profit function and provides a complete description of the dynamic process. However, the main disadvantage is that very restrictive parameterizations are required to make a structural estimation possible (Roberts and Tybout 1997, p. 13). Therefore, instead of attempting to parameterize the profit function, this research focuses on identifying the factors that increase the probability of the firm to become an exporter. The choice of whether to export or not can be modelled through a probit model, where the dependent variable equals 1 if the firm exports and equals zero otherwise. Therefore the estimation model is the binary model given by:

$$
\begin{aligned}
Y_{it} &= 1 \;\; if \;\; \beta Z_{it} - N(1 - Y_{i,t-1}) + \varepsilon_{it} > 0 \\
&= 0 \;\; otherwise
\end{aligned}
\tag{5.9}
$$

where Z_{it} is a vector consisting of plant characteristics, and residual ε_{it} captures any other effects.

In estimating this model two potential econometric issues need attention namely endogeneity and the initial conditions problem. It is possible that there are permanent and serially correlated unobserved characteristics of the firm that could influence the decision to export. Therefore the error term ε_{it} consists of two elements: one is the permanent firm specific effect, κ_i, and the other is exogenous shock η_{it}. Following Bernard and Wagner (2001), the one year lag of plant characteristics is included to avoid possible simultaneity problems. Given the nature of the binary dependent variable, this model can be estimated using a probit model with random effects and a linear probability model with fixed or random effects. The random effect probit model is given by:

$$Y_{it} = 1 \ if \ \ \beta Z_{i,t-1} + \theta Y_{i,t-1} + \kappa_i + \eta_{it} > 0$$
$$= 0 \ otherwise \qquad (5.10)$$

The second potential issue is the initial condition problem which arises because the start of the sample period is not the same as the start of the process that generates the export decision. Since we cannot observe the stochastic process from its start, it is impossible to treat y_0 (the first observation of the dependent variable in the dataset) as fixed. This is crucial in order to obtain consistent estimates in the dynamic models estimated through maximum likelihood (Hsiao, 2003). Three methodologies have been developed to tackle this problem. The first one was developed by Heckman (1981) then simplified by Orme (1997, 2001); and another approach was taken by Wooldridge (2005). Lawless (2009) explains the difference between the Heckman and Orme methodologies as follows.

Heckman (1981) deals with the initial condition by specifying a reduced form equation for the initial observation:

$$Y_{i0}^* = \lambda' X_i + u_i \qquad (5.11)$$

where $\mathrm{var}(u_i) = \alpha_u^2$ with $corr(\kappa_i, u_i) = \rho$ and X_i is a vector of exogenous instruments, which includes variables relevant in period 0 and other pre-sample information. A linear relationship is assumed between error components:

$$u_i = \varphi \kappa_i + \eta_{i0} \qquad (5.12)$$

Since κ_i and η_{i0} are orthogonal to each other, then $\varphi = \rho \sigma_u / \sigma_\kappa$ and $\mathrm{var}(u_{i0}) = \sigma_u^2 (1 - \rho^2)$. It is assumed that the initial observation y_{i0} is uncorrelated with u_{it} and u_{i0} is uncorrelated with the firm characteristics Z_{it}. Then the initial conditions equation can be written as

$$Y_{i0}^* = \lambda' X_i + \varphi \kappa_i + \eta_{i0} \qquad (5.13)$$

where $i = 1..N$ and $t = 0$. Equation (5.12) and (5.13) are solved through the system of equations by programming the maximum likelihood estimation, as is done by Roberts and Tybout (1997). However this approach is more expensive on computer time (Arumpalam and Stewart, 2009).

The second approach has been developed by Orme (1997) and improved further in Orme (2001) and is more practical and using two-step estimation procedure. This procedure has been implemented by Arulampalam *et al.* (2000) on unemployment persistence, Henley (2004) on self-employment status and Sinani and Hobdari (2010) on export market participation. The first step in this approach is estimating the initial condition probit equation (for the first year of the sample period) and then using the generalized residuals from this as a correction to the random effect probit model for the rest of the sample. Equation (5.12) is transformed into

$$\kappa_i = \delta u_i + e_i \tag{5.14}$$

where $\delta = \rho\sigma_\kappa / \sigma_e$ and $\mathrm{var}(e_i) = \sigma_\kappa^2(1-\rho^2)$. Substitution of κ_i into the random effect probit equation gives:

$$Y_{it} = \beta Z_{\mathrm{i,t\text{-}1}} + \theta Y_{i,t-1} + \delta u_i + e_i + \eta_{it} \tag{5.15}$$

where $i = 1..N$ and $t = 1...T$. This method requires all observations to enter the panel at the same start time, which is not the case in this research.

The third approach has been developed by Wooldridge (2005) who models the firm-specific effects κ_i as a function of the initial condition and the other explanatory variables. Thus, κ_i can be expressed as

$$\kappa_i = \beta_1 y_{i0} + \beta_2 \bar{z}_i + u_i \tag{5.16}$$

where u_i is assumed to be independently and normally distributed and $\bar{z}_i$ is the firm-level average of $\bar{z}_{it}$ over time.[15]

Inserting Equation (5.16) into Equation (5.10) yields

$$Y_{it} = \beta Z_{\mathrm{i,t\text{-}1}} + \theta Y_{i,t-1} + \beta_1 y_{i0} + \beta_2 \bar{z}_{it} + u_i + \eta_{it} \tag{5.17}$$

According to Wooldridge (2005), the variables for the average of firm-level characteristics are included to control for any unobserved individual effect and their estimated coefficients do not contain meaningful economic implications. Equation (5.17) is estimated using the random effect probit model. This use of random effect probit model has been chosen because the fixed effect model is not possible with short panel data, which is the case in this research.

[15] Like Wooldridge (2005) and Kneller *et al.* (2008), this research uses Mundlak's (1978) methodology which assumes that κ_i is related to the firm-level *means* of z_{it} . This is also an advantage as it allows the use of unbalanced panel data.

Explanatory variables

Explanatory variables in this model consist of firm characteristics, sunk cost, and locational spillover.

Firm characteristics

Based on the existing empirical studies, there are several hypotheses regarding the role of firm characteristics on export decision-making. The main hypothesis is that "good" firms become exporters. In this research, size, age, factor intensity, productivity, quality of labour and ownership of the firm are considered as factors affecting a firm's decision to enter the export market. In addition, spillover between firms located in the same location is also considered to affect the decision.

Size

From previous empirical studies, there are mixed results on the impact of a firm's size on its export decision. Some studies conducted in both developed and developing countries found a positive relationship between the size of the firm and export status, which implies that we expect larger firms to be more competitive, because of economies of scale, market power and their stronger financial resources.[16]

However, in the situation of extreme shocks to the business environment, small firms may be more flexible and nimble, as they may be less connected to the collapsing of financial sector. Wagner (2003) and Harvie *et al.* (2010) find that small firms are able to enter export/import markets because they have unique characteristics such as innovation efforts and managerial attitudes which enable them to successfully penetrate the international market. However, Narjoko and Hill (2007) find an ambiguous result on the effect of firm size on export decisions in Indonesia after the crisis which rebuts the argument that small firms are more flexible in times of crisis.

Age

It is rational to expect that age has a positive relationship with the performance of the firm. As postulated by Jovanovic (1982), firms learn and gain experiences and thus improve their efficiency over time, therefore age can be considered as a very appropriate proxy for firm

[16] These include Bernard and Jensen(2004) and Bernard *et al.* (2007) for U.S. exports, Roberts and Tybout (1997) for Columbia, Cole *et al.* (2008) for Thailand, Muûls and Pisu (2009) for Belgium, Özler *et al.* (2009) for Turkey, Castellani *et al.* (2010) for Italy and Sinani and Hobdari (2010) for Estonia.

efficiency (Roberts and Tybout, 1997). Older firms have more experience and knowledge and these factors are important for their participation in global production network.

However, a negative relationship between age and the performance of the firms has also been observed. This is because adjustment to change is more difficult for older firms, therefore younger firms find it easier to join global production network compared to the older ones. (See for example: Arnold and Hussinger (2005) for German firms; Harvie *et al.* (2010) for Asian SMEs; and Debaere *et al.* (2009) for Korean firms).

Factor Intensity

Firms with different factor intensities are predicted to have different opportunities to join global production network. Labour intensive firms are likely to join the global production network at the assembly stage, while technology/capital intensive firms are likely to join at the parts and components production stage. Meanwhile, firms with higher-skilled labour are more likely to export compared to firms with lower-skilled labour and that outsourcers are, on average, less capital intensive than other globalized firms (see for example: Kamata (2010); Tomiura (2007); Bernard *et al.* (2007); Corcos *et al.* (2008)).

Productivity

Productivity is another measure of firm success. As discussed by Melitz (2003), there are two productivity thresholds that determine a firm's success. The first threshold is the zero-profit productivity cut-off. A firm that has a productivity level below this threshold would make a negative profit and choose to exit from the industry, while a firm with a productivity level above the zero-profit cut-off will stay in the industry. The second threshold is the export productivity cut-off. A firm with productivity between the zero-profit and export productivity thresholds will stay in the industry but will focus on the domestic market, while a firm with productivity higher than the export productivity cut-off will stay and focus on the export markets. Therefore it is expected that the sign will be positive. The existing empirical studies show the positive relationship between level of productivity and the decision to export/import. See for example: Hallward-Driemeier *et al.* (2002), Debaere *et al.* (2009), and Tomiura (2007).

Quality of Labour

Several empirical studies add quality of labour as an explanatory variable, with the rationale that higher quality of labour in a firm is expected to result in higher productivity and it will increase the probability that the firm becomes an exporter. Bernard and Jensen (2004) find a positive relationship between labour quality and the decision to export. Meanwhile Sinani and Hobdari (2010) find that the quality of labour is not significant in determining the export decision.

Foreign ownership

Foreign ownership is expected to have a positive impact on the decision of export as it provides a firm with easier and better access to connect with international markets. A study by Cole *et al.* (2008) on Thailand shows foreign ownership raises the probability of exporting compared to domestic ownership, and this depends on the country of ownership. Several studies on Indonesia find the same results.[17]

Sunk Cost

Sunk cost affects the decision to enter export markets. Sunk costs are defined as a sink irreversible investment faced by a firm in order to enter the export markets. These costs may include the cost of international marketing, establishing a distribution system, the cost of gathering information about the export market, hiring employees with specific language training, and a combination of R&D spending to improve product quality in order, for example, to conform to the standards and safety regulations of a target country. Each individual firm faces a different sunk entry cost which will depend upon firm specific characteristics including geographical location. However, when a firm that has previously exited a market wants to re-enter, it will still face a sunk cost, which will vary depending on how long it has been absent from the market.

Many empirical studies have been conducted on the role of sunk cost in the decision to enter into the export/import markets, and all of them find a positive and significant relation between sunk cost and export/import decisions[18]. Studies on South East Asian countries include Narjoko and Hill (2007) and Narjoko and Atje (2007) on Indonesia and Cole *et al.* (2008) on Thailand, all found the same results.

Spillover

Some empirical studies focus on the spillovers between the activities and location of other firms and export behaviours. Aitken *et al.* (1994) use a static model of the export decision to estimate the effect of other exporters, and in particular multinationals, in the same region and the same industry. They argue that spillovers associated with one firm's export activities

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[17] See for example: Sjöholm (2003), Ramstetter and Takii (2005) and Narjoko and Hill (2007).

[18] See for example: Bernard and Jensen (2004); Robert and Tybout (1997); Clerides et. al (1998); Sinani and Hobdari (2010); Özler *et al.* (2009); Muûls and Pisu (2009).

reduce the cost of foreign market access for other firms. They find that in the Mexican case, spillovers happen with export activities of multinationals, but not with the general export activities in Mexican case. Clerides *et al.* (1998) find weak evidence of both regional and sectoral spillovers in Colombia, while Özler *et al.* (2009) find spillovers from the presence of exporters in the same industry in Turkey.

5.3.2 Variable Construction and Data

This research utilizes a rich database, namely the annual manufacturing survey of medium-and-large scale establishments (*Statistik Industri,* or SI) conducted by the Indonesian Central Board of Statistics (*Badan Pusat Statistik).* Such an establishment is defined as one with 20 or more employees. This survey is also accompanied by a census which is conducted every ten years, carried out in the years ending with 6.

SI data is considered one of the best, by developing countries standards. Since each establishment has a specific identification number ($psid$) and has a long time series, it is possible to conduct panel data analysis using the SI. The data cover a wide range of information on the establishments, including some basic information (ISIC classification, number of employees, ownership, location, year of starting production), production (gross output, value added, share of output exported and capital), material costs (domestic and imported materials) and various types of expenses (wages, energy).

However, there are some limitations of the data. First, the data do not provide information on whether the establishment is a single plant or a part of a multi-plant firm. Therefore the term "firm characteristics" in this research actually refers to plant characteristics. Second, they do not have some information which is relevant to the firm's heterogeneity, such as information on the type of worker based on their education level or skill, and number of working hours which is important in order to measure labour productivity accurately.

This research covers the period 1990 – 2007 which includes the crisis period (between 1997 – 2000). Because of the concern about data quality during the crisis period, the analysis will focus on the pre- and post-crisis period, i.e. 1990 – 1996 and 2001 – 2007. However, the crisis period and whole period estimations are also conducted for comparison.

Concordance and sector specification

The industry classification for the survey was changed in the year 2000 from *Klasifikasi Lapangan Usaha Indonesia (KLUI)* 1990 to *Klasifikasi Baku Lapangan Usaha Indonesia (KBLI)* 2000. *KLUI* 1990 is based on ISIC rev.2 while *KLBI* 2000 is based on ISIC rev.3. Since this research covers the period 1990 – 2007, both *KLUI 1990* and *KLBI 2000* are used. A concordance table between ISIC (International Standard Industrial Classification) Revision 2 and 3 is provided by BPS.

The firm-level analysis is conducted as the continuation from the macro-level analysis. Therefore the consistency between these two analyses is important. The macro-level analysis uses the trade data which is based on the Standard International Trade Classification (SITC), while the firm-level analysis uses the *Statistik Industri* which is based on the International Standard Industrial Classification (ISIC). For consistency between the macro-level and firm-level analyses, the concordance between SITC Revision 3 and ISIC Revision 2 provided by IEDB (International Economic Data Bank) is used for sectors covered in this research, i.e. electronics and automotive sectors. The concordance is conducted at the four-digit level. The complete list of concordances between KLUI 1990 and KBLI 2000 and between SITC Revision 3 and ISIC Revision 2 and 3 for the electronics and automotive industries is provided in Appendices 2.1 and 2.2.

Similar to the macro-level analysis, the electronics sector is classified into three subsectors, namely: consumer electronics, industrial electronics and components. However, due to the small number of observations in industrial electronics, the electronics sector is classified into two subsectors namely components and consumer electronics (includes the industrial electronics subsector). Meanwhile, the automotive sector is further classified into two subsectors auto parts and assembly.

Data cleaning

In spite of SI's quality, inevitably it contains errors, and therefore some procedures are taken to clean and adjust the entries, for example missing data, inconsistency in the data series and adjustment for location information. The latter is because of the change in regional administration since 2001 due to decentralization.

Percentage of output exported ($prprex$)

This variable is important because it determines the firm's exporting status which then becomes the dependent variable in the estimation model. There are some firms that have a $prprex$ of more than 100 percent. This is possible because when there is a major global disruption in one period which results in order cancellations and deferred orders, the firm then exports their inventory in the following period. Of 15,326 observations, only 30 observations have $prprex > 100$, therefore there is no adjustment made for this variable.

Foreign ownership ($dasing$)

There are some inconsistencies in the foreign ownership ($dasing$) variable over the panel period. Although the inconsistencies might reflect a real change in the ownership, most are likely to be the result of data entry error or misreporting. One of the inconsistencies is a missing value between three consecutive years. There are 784 observations from the total 15,326 observations which have this type of inconsistency. The adjustment made for these observations follows these rules:

1. If $dasing_t$ is missing and both $dasing_{t-1}$ and $dasing_{t+1}$ are not missing, then $dasing_t$ is replaced by $dasing_{t-1}$
2. If $dasing_t = 0$ and both $dasing_{t-1}$ and $dasing_{t+1}$ are not missing, then $dasing_t$ is replaced by $dasing_{t-1}$

Year of starting operation ($dyrstr$)

Data-entry errors and misreporting for the variable $dyrstr$ are significant. Of the 15,326 observations, only 4,297 observations are consistent. For the rest of the observations, the entries are not the same for some years within the panel period. Some of the observations have obvious mistakes, such as 0 or 1. Because of the large number of inconsistencies, it is not possible to remove all the inconsistent observations; therefore an adjustment is made for these observations. According to Narjoko (2006), the errors in reporting are due to the lack of knowledge on the part of people responsible for responding to the questionnaire. Therefore the following rules were applied in adjusting $dyrstr$:

1. Calculate $\Delta dyrstr = dyrstr_{it} - \overline{dyrstr_i}$ where $dyrstr_{it}$ is the year starting operation of the plant i at time t; and $\overline{dyrstr}$ is the average of $dyrstr$ over time.
2. If $\Delta dyrstr = 0$ then no adjustment is necessary
3. If $\Delta dyrstr \neq 0$ then $dyrstr_{it}$ is replaced by the mode of the frequencies. If the mode is ambiguous[19] then it is replaced by the most consistent series of entries.

Location

There are two variables representing the location of a firm, $dprovi$ and $dkabup$. $dprovi$ represents the location based on the provincial level while $dkabup$ represents the location

[19] For example if the mode of the frequencies is more recent than the first year of observation which resulted in the negative age variable then $dyrstr_{it}$ is replaced by the first year of observation.

based on *kabupaten/kota*. One province is comprised of a number of *kabupaten/kota* and in the larger provinces there can be as many as 40. Since 1999, there have been changes in the regional government administration which resulted in an increase in the number of provinces and *kabupaten/kota*. BPS provides a complete list of *kabupaten* from 1993-2009, and there was a change in many provincial and *kabupaten/kota* codes in 2003. Since the dataset covers the period 1990 to 2007, an adjustment for both $dprovi$ and $dkabup$ is needed.

It is assumed that there is no relocation of firm from one place to another; if a firm does change location, it has different identification number ($psid$). For example a plant that is located in Tangerang belonged to West Java province prior to 2001, and since 2001 it has belonged to Banten province, therefore its $dprovi$ variable changes from 32 (for West Java) before year 2001 to 36 (for Banten) although there is no physical relocation of the plant.

In general, variable $dprovi$ is adjusted following this rule:

$$\text{If } dprovi_{it} \neq dprovi_{i,t-1} \text{ then } dprovi_{i,t} \text{ is replaced by } dprovi_{i,t-1}$$

Since the change of regional administration began in 2000, seven new provinces have been established in Indonesia.[20] Two of them are relevant to this research because many of the electronics and automotive firms are located in these provinces, namely Kepulauan Riau (Riau Archipelago) and Banten. For these two provinces, the rule for adjustment is different and a detailed explanation of the adjustment is provided in Appendix 5.3.

Variables construction

Dependent variables

The binary dependent variable constructed for the model is export status (EX). Export status (EX) equals 1 if a firm exports any portion of their product and is measured by the proportion of exported output ($prprex$) *>0 percent* and $EX = 0$ otherwise.

Import status (IM) is defined as equal to 1 if the share of imported input (imp_share) is greater than 0 percent. Import share is calculated as

$$imp\_share_{it} = \frac{rimvcu_{it}}{rtlvcu_{it}} \tag{5.18}$$

where $rimvcu_{it}$ is the value of imported input and $rtlvcu_{it}$ is the value of total input.

[20] In 2010 there are 33 provinces and 497 *kabupaten/kota*

Explanatory variables

The explanatory variables consist of firm characteristics, sunk cost, spillover effect and other macroeconomic variables.

Firm characteristics

In addition to location, there are six variables representing firm characteristics, namely size, age, factor intensity, productivity, quality of labour and foreign ownership.

Size

Size is represented by the number of employees ($ltlnou$). The size of the plants varied from 20 – 9,538 for period 1990-2007. The largest plant with 9,538 employees is the electronics plant in years 1999 and 2000. Meanwhile the largest plant in the automotive sector has 8,375 employees for the period 2003-2007. Both are foreign and exporting firms.

Since the number of employees is correlated with other explanatory variables in the estimation model (labour productivity and labour quality), the model uses a binary variable of size, instead of the number of employees, to measure the size of the plants. The binary variable for size is determined *ad-hoc* as follows:

- $Small = 1$ if $ltlnou \leq 100$, $Small = 1$ otherwise
- $Medium = 1$ if $ltlnou > 100 \text{ and } ltlnou \leq 500$, $Medium = 0$ otherwise
- $Large = 1$ if $ltlnou > 500$, $Large = 0$ otherwise

Following Cole *et al.* (2008), another approach to use the quartile distribution of $ltltnou$ in each sector:

- $Small = 1$ if $ltlnou$ is in the first quartile distribution, $Small = 0$ otherwise
- $Medium = 1$ if $ltlnou$ is in the second quartile distribution, $Medium = 0$ otherwise
- $Large = 1$ if $ltlnou$ is in the third quartile distribution, $Large = 0$ otherwise
- $VLarge = 1$ if $ltlnou$ is in the last quartile distribution, $VLarge = 0$ otherwise

Age

The age of the firm is calculated by subtracting the year of starting operation ($dyrstr$) from the year of observation ($year$).

$$age_{it} = year_{it} - dyrstr_{it} \quad (5.19)$$

Since age is suspected to have a correlation with other variables such as size, wage and productivity (Arnold and Hussinger 2005), then a dummy variable for age is created. A firm is unlikely to gain more experience once it has reached a certain threshold age. But for relatively young firms, age may be important; therefore the dummy variable uses the lower third of the age distribution (age 10) as a benchmark. The rule for age dummy variable is:

$Young_{i.t} = 1$ if $age \leq 10$, $Young_{i.t} = 0$ otherwise

Factor Intensity

Factor intensity is usually measured by the capital/labour ratio. A higher ratio implies that a firm is more capital intensive. In this research, factor intensity is measured by the ratio capital to worker. The value of capital is proxied by the real value of total assets ($RAssets$) and the real value of machinery ($RMachine$).Real values for total assets and machinery are calculated using the WPI deflator collected from the WDI online database.

$$RAssets_{it} = \frac{v1115_{it}}{WPI_t} \quad (5.20)$$

$$RMachine_{it} = \frac{v1106_{it}}{WPI_t} \quad (5.21)$$

The variables for factor intensity are:

$$Factor1 = \frac{RMachine_{it}}{ltlnou_{it}} \quad (5.22)$$

$$Factor2 = \frac{RAssets_{it}}{ltlnou_{it}} \quad (5.23)$$

Since the *SI* does not provide information on labour heterogeneity, we therefore cannot calculate the factor intensity for skilled labour and non-skilled labour.

Productivity

Productivity can be measured in several ways such as total factor productivity, capital productivity and labour productivity. In this research, productivity is measured by labour productivity because calculating the total factor productivity for each sector is beyond the scope of this research and calculating the capital productivity might not give a good result because of the quality of capital variables in the *SI*.

Labour productivity is a ratio of real value added (RVA) to total employee ($ltlnou$) of each firm:

$$RVA_{it} = \frac{vtlvcu_{it}}{WPI_t} \tag{5.24}$$

And

$$Lab\_prod_{it} = \frac{RVA_{it}}{ltlnou_{it}} \tag{5.25}$$

Quality of labour

The quality of labour can be measured by the education skill or level, and the number of working hours. However, SI does not have information on education level nor the number of working hours by worker type. Therefore, this research uses two measurements for quality of labour. The first one is the ratio between non-productive workers ($lnpnou$) and total workers ($ltlnou$) as a proxy for labour quality. A higher ratio reflects a higher quality of labour.

$$Quality1_{it} = \frac{lnpnou_{it}}{ltlnou_{it}} \tag{5.26}$$

The second measurement is the real wages ($RWages$). The real wages is calculated using the CPI deflator from WDI database. A higher ratio reflects the higher quality of labour because higher skilled labours receive higher wages.

$$Quality2_{it} = RWages_{it} = \frac{Wages_{it}}{CPI_t} \tag{5.27}$$

Foreign Ownership

Foreign ownership is constructed as a binary variable based on the foreign share in a firm ($dasing$). There are two measurements for foreign ownership. The first measurement is:

$FRGN1_{it} = 1$ if $dasing_{it} > 0$, $FRGN1_{it} = 0$ otherwise

because some authors argue that any foreign presence in a firm is enough to influence the firm's decision to join global production network.

The second measurement is:

$$FRGN2_{it} = 1 \text{ if } dasing_{it} > 50\%,\ FRGN2_{it} = 0 \text{ otherwise}$$

because the foreign partner represents the majority of shareholders and it has more effect on the decision making in a firm.

Sunk Cost

Since it is difficult to measure sunk cost from the data, the coefficient of the lagged dependent variable is interpreted as a measure of the importance of sunk cost since if a firm exported in the previous year, the sunk cost was incurred in the past (Roberts and Tybout, 1997; Bernard and Jensen, 2004). There are two measurements of sunk cost: one-year lagged value of export status ($L1.EX$) and one-year lagged value of import status ($L1.IM$).

Locational Spillover Effect

Locational spillover effect is measured by the ratio of the number of exporter/importer firms to total firms in each location $(dloc)$.

Macroeconomic variables

Following the methodology developed by Roberts and Tybout (1997), time dummies are included to capture economy-wide shocks such as the (un)favourable change in exchange rates on export participation, industry demand shocks, change in domestic demand condition because of GDP growth and inflation, as well as changes in government policies.

5.3.3 Estimation Method

The firm-level analysis aims to answer the second research question on why Indonesia lags in the global production network by determining a firm's characteristics that influence its decision to export.

Methodology developed by Wooldridge (2005) for a dynamic binary model is adopted in this research, with the estimation equation as follows:

$$Y_{it} = \beta Z_{i,t-1} + \lambda X_{it} + \theta Y_{i,t-1} + \beta_1 y_{i0} + \beta_2 \overline{Z}_i + u_i + \eta_{it} \tag{5.28}$$

where subscript i represents the i -th plant (i =1, ... 1,668 for electronics sectors and i =1,.., 1,452 for automotive sectors) and t represent the year, t = 1990,... , 2007. The variables are listed and defined below with the expected sign of the coefficient for independent variables in parentheses:

Y_{it}: export status (binary variables: $Y_{it}=1$ if a firm exports, $Y_{it}=0$ otherwise) – dependent variable

Z_{it-1}: a vector consists of one-year lagged value of firm characteristics (size (+), age (+), labour productivity (+), labour quality (+), and foreign ownership(+))

X_{it}: a vector consists of other factors such as locational spillover (+) and year dummies

Y_{it-1}: sunk cost which is represented by one-year lagged value of dependent variables (+)

y_{i0}: initial exporter status, i.e. export status at $t=0$

$\overline{Z}_i$: the firm-level average of Z_{it} over time

A random effect probit model is used to estimate the above equation because of the short panel data used in this research (period 1990-1996 for pre-crisis period and 2001-2007 for post-crisis period). The variables for the average of firm-level characteristics are included to control for the unobserved individual effect, and their estimated coefficients do not contain meaningful economic implications.

Information on the source for variables used in the firm-level analysis is summarized in Appendix 5.4. The unbalanced firm level data for the period 1990 – 2007 are estimated. It is interesting to analyse and compare all sectors in the economy; however it is beyond the scope of this research. Therefore the estimation is only conducted for two sectors, namely the electronics and automotive sectors since these two are by far the most important participants in global production networks. The results and analysis for these industries are discussed in the Indonesian case study chapters (Chapter 7 for the electronics sector and Chapter 8 for the automotive sector).

5.4 Concluding Remarks

This chapter has developed an analytical framework to determine factors affecting a country's participation in the global production network at the macroeconomic level and at the firm-level.

The macroeconomic level analysis is based on the Jones and Kierzkowski (1990) fragmentation theory which implies that fragmentation depends on both relative costs and service link costs. An estimation model is developed based on this theory with the fragmentation trade (proxied by the real value of export of parts and components) as the dependent variable. The explanatory variables consist of the relative price and service link cost variables. Variables representing relative costs are labour cost, and competitiveness. Variables representing service link costs are trade cost, trade openness, infrastructure, and FDI openness cost.

The unbalanced panel data for 98 countries for the period 1988-2007 for the electronics and automotive sectors are estimated using the least square dummy variable method. The aim of the macroeconomic analysis is to answer two research questions; (1) what are the determinants of a country's participation in global production network; and (2) why Indonesia has been left behind. The trade data have been collected from the UN COMTRADE database which is available online. Meanwhile the data on the explanatory variables are collected from several sources such as the ILO Laborsta, Index of Doing Business, UNCTAD database, the World Development Indicators (WDI) and the Logistic Performance Index by the World Bank. The estimations are conducted for different datasets i.e. developed and developing countries, and for each subsectors of the electronic and automotive sectors. The estimation results and analysis are provided in Chapter 6.

The firm-level model is based on Roberts and Tybout's (1997) model for firm heterogeneity and its implication for international trade. The main hypothesis is that "good" firms become exporters. The firm-level analysis focuses on the Indonesian case study of the electronics and automotive sectors. It aims to complement the macroeconomic level analysis with regard to the second research question about the reason Indonesia is lagging behind in global production network. The binary variable dynamic model using the random effect probit model is adopted for the estimation using the Wooldridge (2005) approach to tackle the endogeneity problem as well as the initial condition problem that usually appear in this kind of model.

It utilizes the rich database on Indonesian firms, namely the *Statistik Industri*. Although this database is considered the best by developing countries standards, inevitably it contains errors, and therefore some steps are taken to clean and adjust the entries. Firm characteristics considered in this research include size, age, factor intensity, productivity, quality of labour and firm's ownership. Sunk cost and spillover effect are also considered as determinants of a firm's decision to export. The unbalanced panel data for firms in the electronics and automotive sectors for period 1990 – 2007 are used to estimate the model. Since the currency crisis in 1997 hit Indonesia severely and it is suspected of influencing the quality of the data collection, the analysis is therefore conducted for the pre-crisis period (1990 – 1996) and the post-crisis period (2001-2007). However estimations for all period (1990-2007) and during the crisis period (1997-2000) are also conducted for the comparison. The estimation results and analysis are provided in Chapter 7 for the electronics sector and in Chapter 8 for the automotive sector.

Appendix

Appendix 5.1: Logistic Performance Index

Logistics Performance Index (LPI) is the simple average of the country scores on the seven key dimensions:

i. Efficiency and effectiveness of the clearance process by Customs and other border control agencies;
ii. Quality of Transport and IT infrastructure for logistics;
iii. Ease and affordability of arranging shipments;
iv. Competence in the local logistics industry (e.g., transport operators, customs brokers);
v. Ability to track and trace shipments;
vi. Domestic logistics costs (e.g., local transportation, terminal handling, warehousing); and
vii. Timeliness of shipments in reaching destination.

The index is constructed using the Principal Component Analysis (PCA) method in order to improve the confidence intervals. The scorecards demonstrate comparative performance - the dimensions shown on a scale from 1 to 5 relevant to the possible Comparison groups – all countries (World), region and income groups.

Source: http://info.worldbank.org/etools/tradesurvey/mode1a.asp

Appendix 5.2: Summary of variables for macroeconomic analysis

Variables	Variables Names	Data	Data Source	Period	Expected Sign
DEPENDENT VARIABLE					
Fragmentation Trade	*Frag*	Real value of parts and components export	UN Comtrade	Varies among countries	
EXPLANATORY VARIABLES					
Labour cost	*Lab_Cost*	Real wage	LABORSTA	Varies among countries	(+)
Competitiveness	*RER*	RER	WDI	1980 - current	(+)
Trade Cost	*Trade_Cost*	Export cost	Doing Business Report	2007	(-)
Trade Opennes	*Trade_Open*	Ratio of Total Export and Import to GDP	WDI	All period	(+)
Infrastructure	*Infrastructure*	Logistic Perfomance Index	Connecting to Compete - LPI 2007 Report	2007	(+)
FDI Openness	*FDI_Open*	Ratio of FDI inflow stock to GDP	UNCTAD Database	All period	(+)

Appendix 5.3: Adjustment for Kepulauan Riau and Banten provinces.

1. **Adjustment for Kepulauan Riau province**

   Kepulauan Riau was legally established in year 2002, but the change was only reflected in the 2004 *SI* with a new $dprovi$ code equal to 20. Before 2002 Kepulauan Riau was part of Riau province with $dprovi_{it} = 14$. However in years 2006 and 2007, the $dprovi$ code for Kepulauan Riau changed to 21 and there were no observation with $dprovi$ equal to 20 or 21 in year 2005. With this condition, the rule for adjusting $dprovi$ for Kepulauan Riau is as follows:

   - For years 1990 – 2003, if $dprovi_{i,t} = 14$ and $dprovi_{i,2004} = 14$ then $dprovi_{i,t}$ is replaced by 21
   - For years 1990 – 2003, if $dprovi_{i,t} = 14$ and $dprovi_{i,2004} = 21$ then $dprovi_{i,t}$ is replaced by 21
   - For years 1990 – 2003, if $dprovi_{i,t} = 14$ and $dprovi_{i,2004} = 20$ then $dprovi_{i,t}$ is replaced by 21
   - For year 2004, if $dprovi_{i,2004} = 20$ then $dprovi_{i,2004}$ is replaced by 21

2. **Adjustment for Banten Province:**

   Banten province was legally established in year 2000 but the change appeared only in the 2001 *SI*. Prior to the year 2000, Banten was part of West Java province, but since 2000, the $dprovi_{i,t}$ code has changed from $dprovi_{i,t} = 32$ to $dprovi_{i,t} = 36$. The adjustment made for observations located in Banten is as follows:

   - For year 1990 – 2000, if $dprovi_{i,t} = 32$ and $dprovi_{i,2001} = 36$ then $dprovi_{i,t}$ is replaced by 36.

Variable $dkabup$ is not unique for each province, therefore one new variable $dloc$ is constructed with a uniquely defined location of each firm. $dloc$ is four-digit code which is a combination of $dprovi$ (the first two digits) and $dkabup$ (the last two digits). There is no $dkabup$ variable in SI in the year 2001. Therefore $dkabup_{2001}$ is replaced either by $dkabup_{2000}$ or $dkabup_{2002}$, while for other years, the inconsistency in $dkabup_t$ is replaced by $dkabup_{t-1}$.

Appendix 5.4: Summary of variables for the firm-level analysis

Variables	Data	Data Source	Expected Sign
DEPENDENT VARIABLE			
Export Status	*prprex*	Stastik Industri - 1990 - 2007	
Import Status	$imp\_share_{it} = \frac{rimvcu_{it}}{rtlvcu_{it}}$	Stastik Industri - 1990 - 2007	
FIRM CHARACTERISTICS			
Size	*ltlnou*	Stastik Industri - 1990 - 2007	(+)
Age	*year-dyrstr*	Stastik Industri - 1990 - 2007	(+)
Factor Intensity	$Factor\,1 = \frac{RMachine_{it}}{ltlnou_{it}}$	Stastik Industri - 1990 - 2007	(+)
	$Factor\ 2 = \frac{RAssets_{it}}{ltlnou_{it}}$	Stastik Industri - 1990 - 2007	(+)
Productivity	$Lab\_prod_{it} = \frac{RVA_{it}}{ltlnou_{it}}$	Stastik Industri - 1990 - 2007	(+)
Labour Quality	$Quality1_{it} = \frac{lnpnou_{it}}{ltlnou_{it}}$	Stastik Industri - 1990 - 2007	(+)
	$Quality2_{it} = \frac{RWages_{it}}{ltlnou_{it}}$	Stastik Industri - 1990 - 2007	(+)
Ownership	*dasing*	Stastik Industri - 1990 - 2007	(+)
Sunk Cost	one year lagged value of export and import status	Stastik Industri - 1990 - 2007	(+)
Spillover	*dprovi*	Stastik Industri - 1990 - 2007	(+)

Chapter 6: Determinants of Global Production Network: Analytical Results

6.1 Introduction

This chapter provides the estimation results and analysis at the macroeconomic level of the determinants of the participation in global production network as explained in Chapter 5. It aims to answer two research questions: first, what are the determinants of a country's participation in the global production network; and second, why is Indonesia being left behind. The model based on the fragmentation theory developed by Jones and Kierzkowski (1990), employs the least square dummy variable method using the unbalanced panel data for 98 countries during period 1988-2007.

The analysis focuses on two sectors, namely the electronics and automotive sectors, which are the most dynamic, largest and fastest growing industries in the world. Both sectors are also significantly fragmented in the production process and this allows more countries with different levels of income and technology to participate by specializing in their niche markets. In each sector, the analyses are conducted at the aggregate level (all countries and all components) as well as the disaggregated level (developing and developed countries, and at the subsectors level).

This chapter has two parts: the first one is the analysis of the electronics sector and the second part is the analysis of the automotive sectors. Each part consists of a separate analysis to answer the research questions outlined above. The final section presents a summary of the analysis at the macroeconomic level.

6.2 Electronics Sector

The electronics sector is the most dynamic, largest and fastest growing industry. In fact, it has become an engine of export growth in some Asian countries. Although the electronics sector is very technologically intensive, some of the production stages are very labour intensive. These labour intensive processes are accompanied by relatively simple and relatively stable technology which can be conducted in low-wage countries which usually have low technology and skills. Therefore both developed and developing countries can participate in the electronics global production network although each has a different role in it. In this sector, the developed countries are usually the providers of technology while the developing countries are the recipients of the technology.

The estimations are conducted using three different models. The first model uses the full sample, while Model 2 is for the developed countries, and Model 3 is for the developing countries. Developed and developing countries are determined by the GNI (Gross National Income) per capita in 2007. If a country's GNI per capita exceed $11,115 then it is categorized as a developed country.

Moreover, because of the different characteristics of the electronics subsectors, the analysis for the electronics sector is conducted not only for the total electronics sector but also for subsectors namely (i) consumer electronics; (ii) industrial electronics; and (iii) electronic components. The consumer industry subsector consists of parts and components for consumer electronics. The industrial electronics subsector consists of parts and components for electronics data processing, electronics office equipments and telecommunications, and the electronic components subsector includes other parts and components such as semiconductors. This classification is a based on Athukorala's (2011) classification.

To facilitate the interpretation of the key results, summary statistics and the correlation matrix for the data used in the model are presented in Appendix 6.1.

6.2.1 Determinants of participation in electronics global production networks

This section answers the first research question on the determinants of a country's participation in the electronics global production network. Participation in the global production network usually starts with passive participation through the import of parts and components. These imported parts and components are used as inputs for domestic production of both intermediate inputs and final goods. Depending on the size of domestic market, the intermediate inputs can be sold domestically or exported to other countries. The export of parts and components can be regarded as active participation in the global production network.

Analysis at aggregate level

Table 6.1 depicts the estimation results for trade of all electronics parts and components. Coefficient for labour cost (*Lab_Cost)* is positive and significant with a larger magnitude in developed countries compared to developing countries. This larger magnitude implies that electronics parts and component exported by developed countries required higher skilled labour compared to exports by developing countries. This is reasonable since most of the high-technology parts and components are still produced in developed countries because of high cost of this technology.

Previous studies using the augmented gravity model found different results on the relationship between labour cost and export of parts and components depending on the countries used in the models. Athukorala and Yamashita (2006) found a negative and significant relationship for East Asia countries, while Zeddies (2011) found a positive and significant relationship for the European Union. East Asian countries can be regarded as developing countries which are labour intensive, while the European Union members are developed countries, which are more technology intensive. Another study by Athukorala (2009) on 40 countries found a negative but insignificant relationship between labour cost and export of parts and components.

The positive and significant coefficient for developed countries agrees with previous studies. The positive and significant coefficient for developing countries is a new finding which is due to the different level of analysis. The existing studies were conducted for parts and components for all sectors, while this research focuses on electronics parts and components. Therefore the positive effect of labour cost to participation in global production networks in developing countries suggests that higher labour cost implies higher labour productivity which in turn will produce higher export value.

Quality of labour is closely related to technology level in each country. Technology capacity becomes a more important determinant as the increase in labour wage leads to a decline in the comparative advantage in simple labour intensive activities (Hill 2001). Technology capacity has a positive impact on participation in global production network through export, as argued by Lall (2000) and Fagerberg (1996). Products with simple technologies tend to have slower market growth; limited potentials; smaller scope to upgrade technology; and fewer spillover to other activities. The larger coefficient for the electronics sector compared to the automotive sector confirms Lall's argument that the high technology industries (i.e. electronics sector) are growing faster than other industries.

This positive and significant coefficient for *Lab_Cost* suggests that skilled labour is important in increasing a country's participation in the global production network and it is highly related to education level. Therefore it is crucial for a country to improve its education condition and provide an environment that enables technology development.

A country's competitiveness, as measured by the real exchange rate, has a positive effect on the fragmentation index, as predicted by the traditional trade theory. An increase in *RER* reflects the depreciation of the domestic currency, which in turn makes the exported parts and components more competitive in the world market. However the coefficients for both developed and developing countries are not significant, and this agrees with the findings of

Arndt and Huemer (2005) and Athukorala and Yamashita (2009) that the link between exchange rate and trade is weakened in the global production network trade.

Table 6.1: Estimation Results for the Electronics Parts and Components, 1988 – 2007

Dependent Variable: Real Export Value	All Electro P&C		
	All Countries	**Developed Countries**	**Developing Countries**
lnLab_Cost	0.656	0.735***	0.501**
	(0.427)	(0.259)	(0.218)
lnRER	0.144***	0.066	0.056
	(0.049)	(0.045)	(0.053)
lnXCost	-2.126	-0.493	1.201
	(1.454)	(0.302)	(1.278)
lnTrade_Open	2.848	1.217**	0.725
	(1.949)	(0.523)	(0.593)
Infrastructure	6.068***	1.110**	3.184***
	(0.457)	(0.492)	(0.694)
lnFDI_Open	-0.192	-0.022	-0.019
	(0.135)	(0.147)	(0.050)
_cons		7.932	-9.908
		(3.697)	(12.853)
Instrumental Var.	No	No	No
Country Dummy	Yes	Yes	Yes
Year Dummy	Yes	Yes	Yes
No. of Observation	1,055	496	559
Adjusted R2	0.959	0.962	0.947

Notes: Time and country dummies are included, but the results are suppressed here. Standard errors based on White's heteroscedasticity correction cluster by country are given in brackets, with statistical significance (two-tailed test) denoted as: *** p<0.01, ** p<0.05 and * p<0.1.

Trade cost, which is one element of the service link listed by Kimura and Takahashi (2004), is not significant in affecting a country's participation in global production networks although it has an expected negative coefficient for all countries and developed countries. The coefficient of trade cost in developing countries is positive and not significant.

As discussed by Kimura (2008), because of resource limitations, the late-comers in the developing countries do not have to improve their overall investment environment for the whole economy to attract more FDI. They can focus on a minimal set of FDI facilitation, infrastructure services and convenient service link arrangements at some specific locations in order to attract the initial wave of production blocks. One of the bottlenecks to overcome is the high service link cost such as customs clearance and logistics, which are included in the trade cost measure.

The negative relation between trade cost and fragmentation trade concurs with the results from previous studies although they used different variables to represent the trade cost. Most of the previous studies used distance, tariffs and transportation as a measure of trade cost. Distance is in the original gravity model variable and it negatively affects the trade flows between two countries. Athukorala and Yamashita (2006, 2009) found a negative relationship between distance and trade flows of parts and components in East Asian countries. Import tariff is also used as a measure of trade cost by Yi (2003). He found a nonlinear trade response to tariff reductions for the US case, using the two-country dynamic Ricardian trade model. Rubin and Tal (2008) use shipping cost as a major factor in the major slowdown in the growth of world trade, especially in the production network trade during the late 2010s. They argue that higher energy prices make transport more costly than the tariff and it offset all the trade liberalization efforts for the last three decades. Ma and Assche (2010), using data from China's processing trade regime, find that China's processing exports have become more sensitive to both import and export costs in a period of rising oil prices. They also find that processing exports are more sensitive to oil price movements than non-processing exports.

Another variable that directly relates to trade is trade openness (*Trade_Open*) which has a positive effect on the fragmentation but is significant only for export in developed countries. Trade openness is a measure of trade liberalization conducted by a country. The insignificant result for the developing countries is because -unlike the automotive sector- the electronics sector is not protected, all electronics parts and components are traded freely among countries. Therefore trade liberalization especially in the developing countries, does not significantly affect the trade of electronics parts and components. This is because this variable cannot pick up trade barriers in developing countries providing export zones work efficiently in these countries and many of the firms participating in the global production network are located in these export zones. For the electronics sector, 70 countries representing 97 percent of world trade in information technology products have signed the Information Technology Agreement (ITA) under the WTO. The ITA provides for participants to completely eliminate duties on IT products covered by the agreement.

Infrastructure condition, measured by the Logistic Performance Index, is the most important variable that determines the participation in the global production network. An efficient infrastructure affects both the communications and coordination costs, as listed as elements of service link costs by Kimura *et al.* (2007). Efficient infrastructure includes reliable and affordable telecommunication and electricity, roads in good conditions, as well as reliable and efficient port management. This is especially the case for the electronics sector where just-in-time delivery is crucial. Reliable infrastructure is necessary to guarantee that delivery from one production network to another in the same country as well as delivery from warehouse to port for export can be done on time. This characteristic differentiates the fragmentation trade from the traditional trade flows, where real wages and competitiveness are the most important factors.

There are several studies which focus on the role of infrastructure in global production network and all found the same results. Golub et al (2007) find evidence that successful exporters of manufactures in East Asia have relatively favourable service links such as transport and telecommunications infrastructure. Limao and Venables (2001) emphasize the relation between infrastructure and trade cost especially for landlocked countries. A deterioration of infrastructure will raise transportation cost and reduce trade flows. Their closer investigation on Southern African countries found that low trade flows in these countries are caused by poor infrastructure.

One surprising result in this model is the insignificance of the FDI openness variable. In particular, the negative estimated coefficient of the FDI openness contradicts the theory. It is expected that a country with a more open FDI regime will attract more foreign investment in the form of establishing the production blocks and in return will increase fragmentation trade. This negative coefficient for the developing countries can be explained by reason of the foreign investment in these countries. If the foreign investments are aimed at substituting imports, then the firms will import the parts and components but will not export the assembled parts and components, and instead will sell to the domestic market. With this kind of foreign investment, a more open FDI regime will reduce the export of parts and components. In addition to the large domestic market, the import substitution motive of the foreign investment is also affected by the high trade cost which is common for developing countries (Markusen and Venables 2007). However the estimation results at subsector level which will be discussed later on provide different results. This implies that this negative result is caused by the aggregation effect.

From the discussion above, it can be concluded that the service link variables are more important in determining participation in the global production network than are the usual relative cost variables. Service link variables such as infrastructure and trade openness are significant and have larger coefficients than the relative cost variables such as labour cost and competitiveness.

There are different determinants of participation in developed and developing countries. In developed countries, participation in the electronics global production network is determined mostly by trade openness and followed by infrastructure condition and labour cost.

Meanwhile for exports in the developing countries, the most important determinant is infrastructure condition, followed by labour cost.

Analysis at subsector level

The electronic sector can be classified into three subsectors which have different characteristics. The first one is consumer electronics which is generally an entry point for a country to join the global production network. The products are usually less technology intensive and have a low value-to-weight ratio. The second subsector is industrial electronics which has an increasing return and mass-production, has a fast product cycle and high up-front cost. The last category is electronics components which has the highest technology intensity among the subsectors, a fast product cycle, a high value-to-weight ratio and requires just-in-time delivery.

Table 6.2 presents the estimation results for each subsector for all models. Determinants of participation in each subsector are different with determinants of all electronics parts and components.

For electronics components subsector, determinants for developed and developing countries are different. For developed countries, trade openness is the most important determinant, followed by labour cost, infrastructure, trade cost and competitiveness. While for developing and all countries, infrastructure condition has the largest positive coefficient followed by trade openness, labour cost and competitiveness. Owing to a relatively poor condition of infrastructure in developing countries, the same improvement of infrastructure condition will increase more fragmentation trade in developing countries than in developed countries. Compared to other subsectors, the coefficient of infrastructure for electronics components subsector is the largest because the improvement of infrastructure condition will increase the certainty of the just-in-time delivery which is crucial in this subsector.

Coefficient for trade cost in developing countries is significant and positive which contradicts the theory. As explained before, this implies that trade cost variable cannot capture trade barriers in developing countries because most of electronics firms are located in export processing zone which is not captured in the construction of this variable (survey only includes firms located outside the EPZ). Higher trade cost outside the EPZ will provide more incentives to exporting electronics firms located in the EPZ which as result may increase participate in global production networks.

Table 6.2: Estimation Results for Electronics Subsectors, 1988 – 2007

Dependent Variable: Real Export Value	Electronics Components			Consumer Electronics P&C			Industrial Electronics P&C		
	All Countries	Developed	Developing	All Countries	Developed	Developing	All Countries	Developed	Developing
lnLab_Cost	1.041*** (0.293)	0.855*** (0.259)	0.524*** (0.204)	0.685* (0.367)	0.434** (0.188)	0.481** (0.244)	0.423 (0.587)	0.925** (0.422)	0.514** (0.206)
lnRER	0.152*** (0.041)	0.092** (0.038)	0.118*** (0.027)	0.132** (0.052)	0.069* (0.041)	0.060 (0.051)	0.203** (0.080)	0.097 (0.065)	0.054 (0.062)
lnXCost	-2.029 (1.270)	-0.621** (0.283)	2.980*** (0.265)	-2.036 (1.344)	0.153 (0.261)	0.632 (1.480)	-1.838 (1.912)	0.167 (0.381)	-4.285*** (0.834)
lnTrade_Open	3.510** (1.412)	1.456*** (0.495)	0.503 (0.336)	2.753* (1.522)	0.359 (0.404)	0.590 (0.481)	1.361 (2.867)	1.940** (0.756)	0.462 (0.663)
Infrastructure	4.650*** (0.379)	0.671* (0.405)	3.148*** (0.319)	5.447*** (0.428)	1.053*** (0.368)	1.924** (0.799)	6.482*** (0.659)	1.209* (0.673)	0.517 (0.692)
lnFDI_Open	-0.123 (0.092)	0.074 (0.093)	0.015 (0.050)	-0.089 (0.108)	0.012 (0.140)	0.095* (0.051)	0.023 (0.172)	0.126 (0.181)	0.120* (0.067)
_cons		7.668* (3.523)	-21.255** (3.372)		7.160 (3.052)	-2.164 (14.587)		-1.892 (5.088)	36.746*** (10.574)
Instrumental Var.	Yes	No	No	Yes	No	No	No	No	No
Country Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of Observation	727	497	560	714	496	550	1,038	491	547
Adjusted R2	0.943	0.962	0.955	0.944	0.957	0.941	0.938	0.957	0.914

Notes: Time and country dummies are included, but the results are suppressed here. Standard errors based on White's heteroscedasticity correction cluster by country are given in brackets, with statistical significance (two-tailed test) denoted as: *** p<0.01, ** p<0.05 and * p<0.1.

Unlike at the aggregate level, where FDI openness has negative coefficient and is not significant, FDI openness has positive coefficient but not significant for electronics component subsector. This suggests that although it is not statistically significant, more open FDI regime may increase a country's participation in global production networks. The labour cost has larger coefficient in developed countries than in developing countries which conjectures higher technology embodied in parts and components exported by developed countries.

For consumer electronics subsector, determinants are similar in developed and developing countries. Infrastructure condition is the most important, followed by labour cost. The only different is that competitiveness is significant in developed countries but not in developing countries, while FDI openness is significant in developing countries but not in developed countries. Competitiveness is not significant in developing countries because most of developing countries exports are intra-firm trade which does not depend on exchange rate movement but based on contractual agreements over a period of time.

Meanwhile, FDI openness is important for developing countries since this subsector is generally an entry point for developing countries to join global production networks through MNCs. One necessary condition in attracting MNCs to invest in a country is its open FDI regime. However, this is not a sufficient condition, since once foreign investors have invested in a country, they expect for certainty and security of their investment. Several studies have been conducted on the relation between these variables and the trade flows. Zeddies (2011) found that bilateral trade in parts and components in the EU countries is higher when the degree of economic freedom and legal certainty in trading partner countries is higher. The greater degree of economic freedom suggests that the property rights, freedom of corruption and trade, and business and investment freedom are vital prerequisites for production network participation. Thorbecke *et al.* (2010) argued that ASEAN countries need to maintain an environment friendly to foreign investment by resisting corruption, providing consistent and coherent enforcement of laws and regulations at all governmental levels, and maintaining stable macroeconomic fundamentals to sustain growth by leveraging the participation in the global production network. Anderson and Marcouiller (2002) use the import demand function for an insecure world where international exchange is insecure because shipments may be hijacked, bribes may be extorted and contracts may not be enforced. They found that trade expands dramatically when it is supported by strong institutions. They estimated that if the indexes of institutional quality associated with the Latin American countries were to rise to the level associated with the European countries, then Latin American trade would increase by 30% on average and this is roughly equivalent with the predicted level if there is a reduction of Latin American tariffs to US levels.

Therefore FDI openness, economic freedom and quality of an institution are important to attract MNCs in a country and in turn will increase participation in global production networks.

For industrial electronics subsector, the most important determinant for developed countries is trade openness followed by infrastructure and labour cost. Meanwhile, in developing countries, trade cost is the most important determinant, followed by labour cost and FDI openness.

It can be concluded from the above discussion that determinants of participation are different in developed and developing countries. In developed countries, the most important determinant is trade openness followed by labour cost and infrastructure. Meanwhile in developing countries, the most important determinant is infrastructure condition, followed by labour cost, FDI openness and trade cost.

Robustness test is conducted with several alternative specifications as displayed in Appendix 6.3 to Appendix 6.6). The first specification only includes determinants of the fragmentation trade based on the traditional trade theory. These variables are labour cost (*Lab_Cost)*, and the competitiveness (*RER)*. The second specification adds variables directly related to trade such as trade cost (*Trade_Cost)* and trade openness (*Trade_Open)*. The third specification replaces the trade variables with the service link cost variables i.e. infrastructure (*Infrastructure)*, and FDI openness and (*FDI_Open)*. The fourth specification includes all variables. As depicted in the Appendices, the inclusion of trade and service link variables does not change the signs and the significance of the coefficients in general.

6.2.2 Why Indonesia has been left behind in the electronics global production network?

The second research question is why Indonesia is being left behind. To answer this question, Equation 5.1 is modified by replacing the country dummy variables with dummy variables for ASEAN-4 countries which includes Indonesia, Malaysia, Philippines and Thailand. Singapore is not included because Singapore is considered as new industrialized economy while the other four countries are developing countries. The estimation equation for the second question is as follows:

$$Frag_{i,t} = \alpha + \beta_1 \ln Lab\_Cost_{i,t} + \beta_2 \ln RER_{i,t}$$

$$+ \beta_3 Trade\_Cost_i + \beta_4 Trade\_Open_{i,t}$$

$$+ \beta_5 Infrastructure_i + \beta_6 FDI\_Open_{i,t} \quad (6.1)$$

$$+ \varphi_1 d\_Ind + \varphi_2 d\_Thai + \varphi_3 d\_Phil + \varphi_4 d\_Mal$$

$$+ \tau_t T + \varepsilon_{i,t}$$

In order to make a reasonable comparison between Indonesia and other countries, Equation 6.1 is estimated for Asian countries data instead of the full dataset or the developing countries dataset.

The estimation results for the export side are shown in Table 6.3. The negative coefficient for *d_Ind* means that Indonesia's fragmentation trade is lower than average of Asian countries trade. The estimation results show that Indonesia lags in all three subsectors with the largest coefficient for industrial electronics subsector which means that Indonesia is the laggard in this sub-sector. The main reason for this is because the industrial electronics sub-sector has increasing returns, mass-production, and a fast product cycle, as well as a high up-front cost. With the high uncertainty in Indonesia's business environment and low quality of infrastructure, it is too risky for the investor to set up even an assembly firm for the industrial electronics.

Indonesia is lagging behind in electronic components, because of its relatively underdeveloped domestic industry. The participation in these subsectors requires high cost capital because of the specific environment needed for the production process. The existing firms in Indonesia still focus on the production of low-technology components, such as plastic, rubber, and metal parts; passive components; and mechanical parts, such as speakers, transformers, heat sinks, jointing cables, flyback transformers, and printed circuit boards (PCBs) (Negara 2009). All these products are not competitive in the global markets.

The coefficient *d_Ind* for consumer electronics subsector is the smallest owing to the earliest development of this subsector in the Indonesian electronics sector.

Table 6.3: Estimation Results for the Electornics Secor – Asian Countries Model, 1988 – 2007

Dependent Variable: Real Export Value	All Electronics P&C	Electronics Components	Consumer Electronics P&C	Industrial Electronics P&C
lnLab_Cost	-0.023 (0.146)	-0.096 (0.073)	-0.038 (0.055)	-0.271*** (0.067)
lnRER	0.460*** (0.165)	0.428*** (0.066)	0.516*** (0.106)	1.097*** (0.176)
lnXCost	-2.182** (1.044)	-1.916*** (0.547)	-2.149*** (0.431)	-3.726*** (0.527)
Infrastructure	1.894** (0.775)	2.006*** (0.296)	2.812*** (0.572)	4.732*** (0.775)
lnTrade_Open	-0.832 (0.724)	-0.373 (0.270)	-0.232 (0.697)	0.173 (1.008)
lnFDI_Open	2.566** (1.166)	2.652*** (0.569)	2.810*** (0.672)	4.133*** (1.008)
d_Ind	-0.379 (1.117)	-4.309*** (0.675)	-2.742** (1.234)	-6.770*** (1.827)
d_Thai	2.578*** (0.652)	1.515*** (0.344)	0.716 (0.784)	1.477 (1.144)
d_Philippines	5.062*** (0.822)	3.634*** (0.285)	2.462*** (0.458)	4.704*** (0.686)
d_Malaysia	1.924 (1.525)	1.580*** (0.610)	-0.539 (0.969)	0.459 (1.457)
_cons	12.006* (6.807)	11.095*** (3.158)	8.539** (4.119)	4.987 (5.611)
Instrumental Var.	Yes	Yes	Yes	Yes
Country Dummy	No	No	No	No
Year Dummy	Yes	Yes	Yes	Yes
No. of observations	111	147	147	144
Adjusted R2	0.821	0.917	0.889	0.863

Notes: Time and country dummies are included, but the results are suppressed here. Standard errors based on White's heteroscedasticity correction cluster by country are given in brackets, with statistical significance (two-tailed test) denoted as: *** $p<0.01$, ** $p<0.05$ and * $p<0.1$.

From the estimation results, the determinants of Asian countries' participation in the electronics global production network are FDI openness, infrastructure, trade cost and competitiveness. And those variables coincide with the factors that affect the MNCs decision to invest in a country. As mentioned earlier, the involvement of a country in the global production network is usually carried out through multinational corporation (MNCs). As dictated by data availability and methodology, this section will focus on qualitative analysis instead of quantitative analysis.

Infrastructure is the most important determinant for Asian countries in participating in global production networks. One factor that affects trade the most is the effectiveness of port management, and logistics between port and warehouse. Indonesia's port and infrastructure condition is quite poor compared to its neighbouring countries. Poor infrastructure condition in Indonesia is considered as the second most problematic factor for doing business in Indonesia (IMD, 2009) and in terms of adequacy of infrastructure, Indonesia was ranked 55th among 57 countries in 2009 and was far behind Malaysia (26th) and Thailand (42nd). A survey by Japanese affiliates ranks underdeveloped infrastructure as the most important barrier to investment in the Indonesian manufacturing sector and the third most important in services (JETRO, 2009). Based on the Logistic Performance Index (LPI) conducted by the World Bank every two years, Indonesia's position on infrastructure condition is worsening over time. In 2006, Indonesia was 44th out of 150 countries, and in 2010, Indonesia's position dropped to 69th out of 155 countries. The low quality of infrastructure in Indonesia, especially that related to trade processing, influenced Indonesia's competitiveness in attracting global production network. Comparing Indonesia with other East Asian countries such as China, Malaysia, Thailand, Philippines, Vietnam and Cambodia, shows that Indonesia is the second lowest country and only above Cambodia for the overall logistic performance index.

Port management is one key infrastructure that supports the production networks since most of the transportation of parts and components is conducted with container shipping which is much faster than unloading cargos in ports. Most containers in Indonesia are processed through three main container ports: Tanjung Priok in Jakarta, Tanjung Perak in Surabaya and Tanjung Mas in Semarang. Tanjung Priok, with a total peak throughput of 4.2 million 20-foot equivalent units, is the country's largest international container terminal. However, Tanjung Priok's performance lags behind that of most other major ports in Southeast Asia. Based on the volume of container handling, Indonesia was ranked 25th of the 50 major ports in the 2008 World Port Rankings (Fossey2008). In comparison, the Singapore port was ranked 1st worldwide, Port Klang of Malaysia was 14th, and Laem Chabang of Thailand was 20th. The only major port ranked below Tanjung Priok was Manila Port in the Philippines, at 37th. The low performance of Tanjung Priok port is also caused by the length and number of bureaucratic processes for clearance, waiting time, and port access.

Movements within the main Indonesian port are slow due both to general congestion and burdensome procedures. A truck entering the port must make multiple stops and complete redundant paperwork before proceeding to pick up or delivery points. Implementation of a one-stop service within the ports would significantly increase efficiency - streamline the process as much as possible and then establish an office where representatives of all the remaining functions can be co-located to complete all required documentation. The elimination of ad hoc obstacles should be a priority (Asrofi 2011).

The Indonesian government issued a new Shipping Law in 2008 which provides the foundation for a comprehensive reform of the Indonesian port system. The new legislation introduces a simpler regulatory structure, specifically in business licensing and port management. Local governments are now in charge of issuing licenses for inland waterways and ferries and coastal passenger transport. In addition, the law sets easier requirements than the previous system to obtain a shipping license, which could boost competition in the industry. Most notably the law ends the state-sector monopoly on managing ports effectively in 2011, and opens the door for new participation by the private sector. Similar changes in Mexico have resulted in significant improvements in the productivity of ports and reductions in cargo handling charges. This new regulation provided a good momentum to seriously reduce the cost of inter-island shipping by improving port efficiency and clarity in port regulation.

The second factor that discourages the MNCs from investing in Indonesia is the less open foreign investment regime in Indonesia. Indonesia's attitude towards foreign direct investment has always been rather ambivalent. There is a long tradition of scepticism towards foreign interests in general and multinational firms in particular (Lipsey and Sjöholm, 2010). Although Indonesia announced the 2007 Investment Law, which is considered a landmark of investment law, the implementation regulations are still lagging. This new investment law guarantees equal treatment of foreign and domestic firms in open sectors, but not equal opportunity to invest in all sectors. It gives standard protection to investors against expropriation and enshrines national treatment. Restrictions persist on foreign equity ownership. The provision of a Negative List of sectors where private investment is not permitted or where foreign investors are subject to restrictions has added to transparency, and the list has been streamlined (OECD, 2010).

Moreover, the foreign ownership restriction imposed by the government for 25 sectors is a major concern for the MNCs especially for the industries that are technology intensive and have proprietary rights, e.g. the electronics and automotive sectors. These industries are afraid that their technology will be imitated by the domestic firms. Ownership sharing has been abandoned in many other countries, since it does not provide any additional benefits to the host economy, and might deter inflows of FDI (Blomström and Sjöholm 1999). Actually, Indonesia was an early receipient of foreign multinational firms in electronics. For instance, Fairchild and National Semiconductor both established plants in Indonesia in the early 1970s. However, both firms closed their operations in Indonesia in the 1980s because of an unfavourable business environment (Thee, 1998, p. 223).

The decision by Research in Motion (RIM), a producer of BlackBerry smart phones, to manufacture the BlackBerry in Penang, Malaysia from July 1st 2011 is another example of how Indonesia is lagging in the electronics global production network. Although Indonesia has a bigger market and lower production cost than Malaysia, the better infrastructure facilities and financial incentives offered by Malaysia are more attractive. Reactions from several Indonesian officials made the Indonesian position even worse, since they threatened to remove the incentives and impose luxury taxes on the Blackberry.

Decentralization in Indonesia in 2001 complicates the situation since not all regional governments are equipped with qualified officials. Therefore some local governments have been encouraging local and foreign firms, whereas many others have constrained firms by imprudent regional regulations. For example, some good local governments can provide a one-stop-service for business licensing with faster processing and lower costs.

The success of the Special Economic Zones (SEZs) in China in attracting foreign investment inspired the Indonesian government to do the same, and Indonesia enacted the Law of Special Economic Zone in 2009. One of the SEZs is Batam, Belitung and Karimun (BBK) Islands which is located in proximity to Singapore and it is an expansion of successful Batam Island SEZ established in 1989. If the BBK can be successfully developed into a SEZ, the Indonesian economy will be revitalized, as it will be used as a successful model for the development of other SEZs in Indonesia. Based on their business environment and resource endowment, each island has particular sectors to be developed. Batam will be a location for electronics, electrical equipment, mechatronics, and ICT; Bintan will develop garment, food industries, footwear, canning, moulding and marine tourism; and Karimun will develop shipyard and components and casting, foundry and forging, agro base industry, fishery and marine tourism. Indonesia has had an Economic Cooperation Agreement with Singapore since 2006 and a key feature is that Singapore will assist with the development of the three islands as an SEZ. Partnering Singapore and these three islands to form production networks will tap the unique complementary locational advantages of the two locations, thereby reducing network set-up cost, service link costs and production cost *per se* (Heng and Kee, 2009). However, the result of this SEZ is not yet as expected as the number of foreign investment is lower than expected, but further streamlining and simplification of regulations (national and regional) are expected to speed up the development of this SEZ.

For Asian countries, labour cost and technology capacity are the other determinants that affect participation in the electronics global production network. Labour cost depends not only on the wages level but also on labour productivity. Labour productivity and technology capacity are closely related to a country's education and skill level of labour. Indonesia's human capital quality still lags its neighbours as already discussed in Chapter 4. First, the quality of labour in Indonesia is relatively low compared to the neighbouring countries. The completion rate of tertiary education is very low, only 1.4 percent in 2010, while the completion rates for primary and secondary education are 37.4 percent and 22.8 percent respectively in 2010. Comparing Indonesia with other South East Asian countries reveals that for the quality of labour force, in 2001 Indonesia is the second lowest of ten countries and Cambodia is the lowest. Improving education condition in Indonesia, not only for attracting FDI but also for affecting Indonesia's absorptive capacity.

As with skill level, Indonesia's technology capacity is still limited compared to other Asian countries. Many high-tech projects such as aircraft, shipbuilding, railroads, telecommunications, and steel and machinery were developed before the Asian crisis, but these projects have been abandoned since the crisis and no technology policies have been put in place to replace them. As a result, Indonesia remains near the bottom of the technology ladder in the region (Lipsey and Sjöholm, 2010) One indicator of this is the very low investment in research and development. This happened not only for the public sector, but also for foreign companies operating in Indonesia. A survey by the U.S. Bureau of Economic Analysis shows that R&D investment as a percent of employee compensation in US majority affiliates in Indonesia is only 0.6 percent, the lowest one compared to other Asian countries (such as Korea, Singapore, Malaysia, China and Malaysia). The highest percentage is Singapore and Taiwan at about 19 percent followed by China (14.9 percent) and Malaysia (11.2 percent), and the next lowest is Thailand at about 2.1 percent. The reluctance of U.S. affiliates to invest in R&D is closely related to the ownership restrictions discussed above.

It can be concluded that the reasons for Indonesia lagging behind in the electronics global production network are the poor condition of infrastructure, especially port management and roads, which affects the certainty of the just-in-time delivery requirement of the electronics sector; second, the relatively restrictive investment regulation directed towards foreign investment, especially the ownership restriction which discourages foreign companies from bringing the newest technology to Indonesia; lastly, the low education level in Indonesia, which hampers the absorptive capacity for new technology which is very important in the electronics sector.

Detailed information and further analysis on the Indonesian electronics sector is provided in Chapter 7.

6.3 Automotive Sector

The second sector discussed in this research is the automotive sector. The classification of parts and components for the automotive sector used in this research follows the classifications by Athukorala (2009), with additional parts and components such tyres, safety glass, automotive electronics parts and accessories.

6.3.1 Determinants of participation in the automotive global production network

Table 6.4 depicts the estimation results for all models of auto parts. Similar to the electronics sector, labour cost affects the export of auto parts both in all models. Compared to the electronics sector, the magnitude of coefficients for the auto parts models are smaller. These results show that the labour cost elasticity of auto parts export is lower than electronics parts and components export. The smaller coefficient on auto parts implies that the same increase in the labour cost, which represents more higher-skill labour, will increase the export of auto parts less than the export of the electronics parts and components.

Competitiveness measured by real exchange rate has a positive coefficient in all models although it is only significant for all countries model. Similar to electronics parts and components, most of the exports of auto parts are intra-firm trade which do not depend on the exchange rate but are based on contractual agreements over a period of time. Trade cost also does not significantly affect the fragmentation trade of auto parts, and the coefficient is positive which contradict the theory. The explanation is the same to that for the electronics parts and components, that most of auto parts firms located in the export processing zone or industrial estates which are not covered by the survey to collect the trade cost variable. The larger the difference of procedural cost between EPZs and non-EPZs the larger the incentives for auto parts firms in EPZs and this is more likely to increase the participation of these firms in global production networks.

As with the electronics sector, infrastructure condition is also the most important determinant in participation in the automotive global production networks. The coefficient for developing countries is larger than for developed countries. This larger coefficient implies participation in global production networks by developing countries is more sensitive to the improvement of infrastructure quality than it is for developed countries.

Table 6.4: Estimation Results for the Auto Parts, 1988 – 2007

Dependent Variable: Real Export Value	All Countries	Developed Countries	Developing Countries	Asian Countries
lnLab_Cost	0.257**	0.575***	0.315**	0.339**
	(0.119)	(0.205)	(0.139)	(0.150)
lnRER	0.053*	0.027	0.007	0.347**
	(0.028)	(0.037)	(0.037)	(0.164)
lnXCost	0.524	2.911***	0.493	-1.532**
	(0.691)	(0.211)	(0.979)	(0.681)
Infrastructure	4.197***	1.972***	3.114***	1.412
	(0.294)	(0.337)	(0.444)	(1.047)
lnTrade_Open	0.777**	1.517***	0.282	-0.994**
	(0.333)	(0.409)	(0.368)	(0.442)
lnFDI_Open	0.533***	-0.049	0.347**	2.212***
	(0.157)	(0.106)	(0.175)	(0.588)
d_Ind				-0.063
				(0.935)
d_Thai				1.616***
				(0.273)
_cons	-7.299	-19.864***	-3.004	12.486**
	(5.422)	(2.689)	(7.808)	(4.959)
Instrumental Var.	No	No	No	Yes
Country Dummy	Yes	Yes	Yes	No
Year Dummy	Yes	Yes	Yes	Yes
No. of observations	995	497	517	266
Adjusted R2	0.973	0.982	0.962	0.845

Notes: Time and country dummies are included, but the results are suppressed here. Standard errors based on White's heteroscedasticity correction cluster by country are given in brackets, with statistical significance (two-tailed test) denoted as: *** p<0.01, ** p<0.05 and * p<0.1.

The estimated coefficients for trade openness are positive and significant for the automotive sector. Trade openness is a result of trade liberalization and the automotive sector is usually highly protected in developing countries. Since the automotive sector is considered as a vital ingredient in national economic development strategies, government involvement in the sector is quite intense. The interventions support the development of domestic production and protection for domestic production; they are usually in the form of very high import tariffs and non-tariff barriers, both on the auto parts and the final goods. Trade liberalization in the automotive sector in the form of a reduction of tariff barriers and/or the elimination of non-tariff barriers increases trade openness and affects the trade of auto parts. Several studies in developing countries confirmed that trade liberalization, especially for the intermediate inputs, increases the variety of imported intermediate input and firms' productivity, which in turn increases their exports.[21]

The estimated coefficients for FDI openness are positive and significant except for developed countries. The coefficient for auto parts in developing countries is larger than the electronics sector. This suggests that the automotive sector is more sensitive to FDI regime compared to the electronics sector. With full ownership, foreign carmaker is willing to bring the latest technology and improve managerial practices and close supervision of assembly/production by bringing in foreign technicians and managers.

From the above analysis, it can be concluded that the determinants of participation are different in developed and developing countries in the automotive global production network. In the developed countries, participation through export of auto parts highly depends on trade cost, infrastructure, trade openness and labour quality. On the other hand, participation of the developing countries depends infrastructure condition, FDI openness and labour quality.

In general, the participation in the automotive global production network is less sensitive to a change in the determinants compared to the electronics sector.

6.3.2 Why Indonesia has been left behind in the automotive global production network?

The second question to be answered for the automotive sector is why Indonesia is being left behind in the automotive global production network. The estimation model used for the automotive sector is similar with that used previously for the electronics sector previously. In order to make reasonable comparison, Equation 6.1 is estimated for the Asian countries dataset instead of for the full dataset or the developing countries dataset.

The estimation result for the export model is depicted in the last column of Table 6.4. The coefficient of *d_Ind* is negative as expected. Meanwhile, the estimated coefficients for *d_Thai* are positive and significant which means that Thailand is ahead of other Asian countries this is consistent with the fact that Thailand is one of the major hubs of automotive production for regional and global markets.

From the estimation results, the major determinants for the Asian countries to participate in the automotive production networks are FDI openness, trade cost, labour quality and competitiveness. On this basis, the author provides the following analytical narrative.

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[21] See for example: Klenow and Rodriguez-Clare (1997) for Costa Rica; Takii (2004) for the Indonesian automotive sector; and Pavcnik (2000) for Chile.

As explained earlier in the electronics sector section, Indonesia is relatively more restrictive towards foreign direct investment, compared to Thailand and Malaysia. There are rather ambivalent attitudes toward foreign direct investment. The foreign direct investment policy (in 1974) requires the establishment of a joint ventured for foreign investment in Indonesia. Although this policy was changed in 1994 and allowed 100 percent of foreign ownership in Indonesia, a frequent change in policies affecting the automotive industry creates uncertainty for both domestic and foreign investments. With majority of foreign ownership not permitted before 1994, Japanese car makers were reluctant to transfer the related technology to their partners in Indonesia, which resulted in less participation in the production network compared to Thailand.

Trade cost and infrastructure affect Indonesian participation in the automotive production network because they increase uncertainty in delivering auto parts from one production block to another. In interviews with the auto parts firms in Jakarta which is discussed in more detailed in Chapter 8, the author found that many prefer to locate their plants near the port to avoid the traffic congestion to and from the port. If they do not have any choice to locate their plants near the port, they prefer to avoid the peak hours and choose to transport the parts at nights or on weekends. Although the additional cost of paying overtime for the drivers is cheaper than the cost of congestion, this additional cost still affects the competitiveness of their products.

An unexpected result from this model is the negative and significant coefficient for trade openness. As explained earlier, trade openness should have a positive impact on the trade of auto parts since the automotive sector is a protected sector and therefore any trade liberalization will improve the trade of auto parts. The negative coefficient in this model means that more open trade in the Asian countries leads to less trade in auto parts, especially in technology intensive auto parts. Since most Asian countries are developing countries, protection for the automotive sector is usually in the form of an import ban on cars, with the intention of developing a domestic car industry. However, since the domestic car industry (especially the auto parts producers) is not yet fully developed, the car industry has to import vital auto parts and they are usually technology intensive parts. Once the automotive sector is liberalized, the import ban on cars can be lifted and the domestic car industry can import cars rather than technology intensive parts. Therefore trade openness has a negative impact on the trade of the technology intensive auto parts.

Similar to the electronics sector, technology capacity and labour quality affect Indonesian participation in the production network. The relatively low education level in Indonesia hampers the absorption capacity for new technology, as argued by Jacob and Szirmai (2007).

It can be concluded that the reasons that Indonesia is not as advanced as Thailand in the automotive global production network are its restrictive investment policies towards the foreign investment, especially the restriction on the ownership discourage car-makers from making any substantial investment in Indonesia; the poor condition of infrastructure which not only reduces the competitiveness of the parts, but also limits the domestic demand for cars; and protection for the domestic car industry which is reflected in the relatively higher import tariffs for cars and auto parts.

More detailed information and analysis on the Indonesian automotive sector is provided in Chapter 8.

6.4 Concluding Remarks

This chapter provides a thorough analysis of the determinants of participation in the electronics and automotive sector global production network. Two research questions are answered in this chapter, the first one addresses the determinants of a country's participation in the global production network; and the second question is why Indonesia is being left behind in the global production network.

From the estimation results, it can be concluded that service link variables are more important in determining a country's participation in the global production network. Infrastructure is the most important determinant in developing countries for both the electronics and automotive sectors, followed by labour quality and the FDI openness.

For developed countries, trade openness is the most important determinant in the electronics sector and trade cost is the most important in the automotive sector. The second most important is labour quality in the electronics sector and infrastructure in the automotive.

In answering the second question, the Asian countries dataset is used instead of the dataset for developing countries, because it is more reasonable to compare Indonesia with its neighbours. From the estimation result, Indonesia is being left behind in the electronics global production network because of the poor condition in its infrastructure; the relatively more restrictive investment policies towards foreign investment, and the low education level which hampers the absorption capacity in technology which is important in the electronics sector.

With the huge domestic market in Indonesia which creates economies of scale, it is expected that the Indonesian automotive industry can participate more in the global production network than it can in its current condition. However its participation is hampered because of its investment policies, trade costs and the remaining high protection in the automotive sector. All of these influence the openness of trade.

In conclusion, the exports of auto parts are more sensitive to a change in FDI openness and trade openness compared to the export of electronics parts and components.

Appendix

Appendix 6.1: Summary Statistics and Correlation Matrix for the Electronics Sector, 1988 – 2007

Summary Statistics

Variable	Mean	Std. Dev	CV	Obs
Frag_trade	12.8	4.5	0.4	2,372
Lab_Cost	1.6	2.3	1.4	1,219
RER	5.2	2.9	0.6	2,006
XCost	6.9	0.5	0.1	2,072
Infrastructure	2.8	0.7	0.3	1,868
Trade_Open	4.3	0.5	0.1	2,211
FDI_Open	2.9	1.2	0.4	2,225

Correlation Matrix

Variable	Lab_Cost	RER	XCost	Infrastructure	Trade_Open	FDI_Open
Lab_Cost	1.00					
RER	-0.46	1.00				
XCost	-0.17	-0.02	1.00			
Infrastructure	0.41	-0.12	-0.34	1.00		
Trade_Open	-0.09	0.09	-0.03	-0.05	1.00	
FDI_Open	0.07	0.14	0.03	0.10	0.52	1.00

Appendix 6.2: Summary Statistics and Correlation Matrix for the Automotive Sector, 1988 – 2007

Summary Statistics

Variable	Mean	Std.Dev	CV	Obs.
Frag_trade	13.1	3.9	0.3	2,470
Lab_Cost	1.6	2.3	1.4	1,212
RER	5.2	2.9	0.6	2,026
XCost	6.9	0.5	0.1	2,094
Infrastructure	2.8	0.7	0.3	1,867
Trade_Open	4.3	0.5	0.1	2,231
FDI_Open	2.9	1.2	0.4	2,257

Correlation Matrix

Variable	Lab_Cost	RER	XCost	Infrastructure	Trade_Open	FDI_Open
Lab_Cost	1					
RER	-0.46	1				
XCost	-0.17	-0.02	1			
Infrastructure	0.41	-0.12	-0.35	1		
Trade_Open	-0.09	0.08	-0.04	-0.04	1	
FDI_Open	0.07	0.14	0.02	0.11	0.52	1

Appendix 6.3: Robustness test for All Electronic Parts and Components, 1988 - 2007

	Model 1 - All Countries				Model 1 - Developed Countries				Model 1 - Developing Countries			
Specification	**1.1**	**1.2**	**1.3**	**1.4**	**2.1**	**2.2**	**2.3**	**2.4**	**3.1**	**3.2**	**3.3**	**3.4**
lnLab_Cost	0.389**	0.432**	0.369**	0.439**	0.723***	0.692**	0.658***	0.735***	0.459**	0.498**	0.450**	0.501**
	(0.161)	(0.176)	(0.159)	(0.178)	(0.253)	(0.271)	(0.245)	(0.259)	(0.203)	(0.216)	(0.201)	(0.218)
lnRER	0.114***	0.102***	0.106**	0.108***	0.071	0.062	0.074	0.066	0.042	0.046	0.044	0.056
	(0.042)	(0.038)	(0.042)	(0.039)	(0.055)	(0.039)	(0.066)	(0.045)	(0.053)	(0.051)	(0.050)	(0.053)
lnXCost		-3.486***		1.782**		-0.724**		-0.493		-0.815		1.201
		(0.560)		(0.828)		(0.357)		(0.302)		(0.857)		(1.278)
lnTrade_Open		0.935**		1.028**		1.168**		1.217**		0.635		0.725
		(0.438)		(0.456)		(0.543)		(0.523)		(0.569)		(0.593)
Infrastructure			2.924**	4.973***			3.893***	1.110**			2.295***	3.184***
			(1.193)	(0.328)			(0.621)	(0.492)			(0.141)	(0.694)
lnFDI_Open			0.047	-0.033			0.116	-0.022			0.033	-0.019
			(0.054)	(0.059)			(0.167)	(0.147)			(0.050)	(0.050)
_cons	11.164***	32.266***	5.201	-18.704**	16.470***	14.386**	0.528	7.932**	13.331***	12.328	4.052***	-9.908
	(1.332)	(6.220)	(4.091)	(8.475)	(1.160)	(5.657)	(2.691)	(3.697)	(1.561)	(7.919)	(0.357)	(12.853)
No. of observations	1,154	1,083	1,087	1,055	585	514	528	496	569	569	559	559
Adjusted R2	0.957	0.958	0.958	0.959	0.972	0.969	0.966	0.962	0.944	0.944	0.946	0.947

Notes: Time and country dummies are included, but the results are suppressed here. Standard errors based on White's heteroscedasticity correction cluster by country are given in brackets, with statistical significance (two-tailed test) denoted as: *** p<0.01, ** p<0.05 and * p<0.1.

Appendix 6.4: Robustness Test for Electronics Components Subsector, 1988 – 2007

	Model 1 - All Countries				Model 1 - Developed Countries				Model 1 - Developing Countries			
Specification	1.1	1.2	1.3	1.4	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4
lnLab_Cost	0.445***	0.527***	0.441***	1.041***	0.720***	0.856***	0.682***	0.855***	0.480***	0.526***	0.479***	0.524***
	(0.151)	(0.172)	(0.154)	(0.293)	(0.223)	(0.250)	(0.232)	(0.259)	(0.180)	(0.198)	(0.185)	(0.204)
lnRER	0.119***	0.135***	0.112***	0.152***	0.056	0.090***	0.055	0.092**	0.114***	0.122***	0.106***	0.118***
	(0.026)	(0.023)	(0.025)	(0.041)	(0.040)	(0.033)	(0.048)	(0.038)	(0.029)	(0.028)	(0.027)	(0.027)
lnXCost		-0.509		-2.029		-0.783**		-0.621**		0.040		2.980***
		(0.870)		(1.424)		(0.316)		(0.283)		(0.911)		(0.265)
lnTrade_Open		0.867***		3.510**		1.459***		1.456***		0.536*		0.503
		(0.263)		(1.412)		(0.478)		(0.495)		(0.298)		(0.336)
Infrastructure			-0.060	4.650***			2.835***	0.671*			1.269***	3.148***
			(1.184)	(0.379)			(0.551)	(0.405)			(0.171)	(0.319)
lnFDI_Open			0.075*	-0.123			0.155*	0.074			0.049	0.015
			(0.043)	(0.092)			(0.090)	(0.093)			(0.046)	(0.050)
_cons	11.195***	10.534	14.800***		16.964***	11.615**	2.933**	7.668**	10.274***	7.792	7.896***	-21.255***
	(1.308)	(7.315)	(4.299)		(0.346)	(4.974)	(1.277)	(3.523)	(1.611)	(7.838)	(0.369)	(3.372)
No. of observations	1,154	1,083	1,089	727	586	515	529	497	568	568	560	560
Adjusted R2	0.962	0.964	0.961	0.943	0.966	0.967	0.960	0.962	0.954	0.955	0.955	0.955

Notes: Time and country dummies are included, but the results are suppressed here. Standard errors based on White's heteroscedasticity correction cluster by country are given in brackets, with statistical significance (two-tailed test) denoted as: *** p<0.01, ** p<0.05 and * p<0.1.

Appendix 6.5: Robustness Test for Consumer Electronics Subsector, 1988 - 2007

	Model 1 - All Countries				Model 1 - Developed Countries				Model 1 - Developing Countries			
Specification	**1.1**	**1.2**	**1.3**	**1.4**	**2.1**	**2.2**	**2.3**	**2.4**	**3.1**	**3.2**	**3.3**	**3.4**
lnLab_Cost	0.394**	0.411**	0.372**	0.685*	0.587**	0.419**	0.611**	0.434**	0.458**	0.500**	0.440*	0.481**
	(0.179)	(0.192)	(0.178)	(0.367)	(0.243)	(0.203)	(0.249)	(0.188)	(0.228)	(0.240)	(0.227)	(0.244)
lnRER	0.110**	0.098**	0.096**	0.132**	0.072*	0.059*	0.075	0.069*	0.065	0.070	0.050	0.060
	(0.045)	(0.043)	(0.040)	(0.052)	(0.044)	(0.035)	(0.050)	(0.041)	(0.058)	(0.055)	(0.047)	(0.051)
lnXCost		-1.037		-2.036		-0.039		0.153		-0.525		0.632
		(0.763)		(1.556)		(0.294)		(0.261)		(0.951)		(1.480)
lnTrade_Open		0.703*		2.753*		0.376		0.359		0.681		0.590
		(0.382)		(1.522)		(0.439)		(0.404)		(0.468)		(0.481)
Infrastructure			2.731***	5.447***			2.467***	1.053***			1.387***	1.924**
			(0.282)	(0.428)			(0.575)	(0.368)			(0.167)	(0.799)
lnFDI_Open			0.100*	-0.089			-0.028	0.012			0.136**	0.095*
			(0.059)	(0.108)			(0.162)	(0.140)			(0.058)	(0.051)
_cons	10.965***	14.742**	4.249***	(dropped)	14.973***	12.808***	4.426*	7.160**	9.791***	10.335	6.142***	-2.164
	(1.531)	(7.091)	(0.448)		(1.055)	(4.378)	(2.509)	(3.052)	(2.038)	(8.747)	(0.437)	(14.587)
No. of observations	1,145	1,074	1,078	714	585	514	528	496	560	560	550	550
Adjusted R2	0.953	0.953	0.954	0.944	0.970	0.965	0.963	0.957	0.936	0.937	0.940	0.941

Notes: Time and country dummies are included, but the results are suppressed here. Standard errors based on White's heteroscedasticity correction cluster by country are given in brackets, with statistical significance (two-tailed test) denoted as: *** p<0.01, ** p<0.05 and * p<0.1.

Appendix 6.6: Robustness Test for Industrial Electornics Subsector, 1988 - 2007

	Model 1 - All Countries				Model 1 - Developed Countries				Model 1 - Developing Countries			
Specification	1.1	1.2	1.3	1.4	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4
lnLab_Cost	0.386**	0.439**	0.352**	0.428**	0.833**	0.903**	0.709*	0.925**	0.510**	0.543***	0.482**	0.514**
	(0.179)	(0.184)	(0.178)	(0.185)	(0.411)	(0.405)	(0.379)	(0.422)	(0.200)	(0.206)	(0.198)	(0.206)
lnRER	0.182**	0.155***	0.182***	0.158***	0.117	0.080	0.167	0.097	0.055	0.061	0.044	0.054
	(0.071)	(0.054)	(0.071)	(0.051)	(0.121)	(0.061)	(0.134)	(0.065)	(0.069)	(0.067)	(0.061)	(0.062)
lnXCost		-3.687***		2.392***		-0.164		0.167		-0.252		-4.285***
		(0.578)		(0.927)		(0.478)		(0.381)		(0.825)		(0.834)
lnTrade_Open		1.116**		1.139**		1.846**		1.940**		0.543		0.462
		(0.485)		(0.500)		(0.752)		(0.756)		(0.650)		(0.663)
Infrastructure			4.426***	5.929***			3.354***	1.209*			3.029***	0.517
			(1.323)	(0.429)			(0.737)	(0.673)			(0.117)	(0.692)
lnFDI_Open			0.158**	0.078			0.322*	0.126			0.152**	0.120*
			(0.075)	(0.090)			(0.190)	(0.181)			(0.060)	(0.067)
_cons	8.892***	31.241***	-2.228	-28.263***	16.373***	5.548	1.434	-1.892	11.020***	5.973	-0.188	36.746***
	(1.591)	(6.524)	(4.568)	(9.112)	(0.889)	(8.057)	(1.428)	(5.088)	(1.632)	(7.273)	(0.616)	(10.574)
No. of observations	1,132	1,066	1,067	1,038	575	509	520	491	557	557	547	547
Adjusted R2	0.929	0.935	0.935	0.938	0.942	0.949	0.951	0.957	0.911	0.912	0.914	0.914

Notes: Time and country dummies are included, but the results are suppressed here. Standard errors based on White's heteroscedasticity correction cluster by country are given in brackets, with statistical significance (two-tailed test) denoted as: *** p<0.01, ** p<0.05 and * p<0.1.

Appendix 6.7: Robustness Test for Auto Parts, 1988 - 2007

	Model 1 - All Countries				Model 1 - Developed Countries				Model 1 - Developing Countries			
Specification	**1.1**	**1.2**	**1.3**	**1.4**	**2.1**	**2.2**	**2.3**	**2.4**	**3.1**	**3.2**	**3.3**	**3.4**
lnLab_Cost	0.200	0.269**	0.194	0.280**	0.355*	0.564***	0.335*	0.575***	0.292**	0.309**	0.295**	0.321**
	(0.123)	(0.119)	(0.124)	(0.120)	(0.191)	(0.192)	(0.174)	(0.205)	(0.136)	(0.134)	(0.140)	(0.137)
lnRER	0.037	0.055**	0.040	0.062**	-0.022	0.015	-0.014	0.027	0.012	0.014	0.015	0.022
	(0.031)	(0.027)	(0.032)	(0.029)	(0.045)	(0.036)	(0.051)	(0.037)	(0.036)	(0.035)	(0.038)	(0.037)
lnXCost		-1.657***		0.760		2.478***		2.911***		-1.506**		0.547
		(0.633)		(0.637)		(0.258)		(0.211)		(0.651)		(0.933)
lnTrade_Open		0.743**		0.832**		1.437***		1.517***		0.291		0.375
		(0.322)		(0.333)		(0.393)		(0.409)		(0.357)		(0.364)
Infrastructure			3.394***	4.240***			5.535***	1.972***			2.710***	3.124***
			(0.964)	(0.262)			(0.469)	(0.337)			(0.110)	(0.448)
lnFDI_Open			0.014	-0.051			0.076	-0.049			-0.019	-0.046
			(0.047)	(0.040)			(0.105)	(0.106)			(0.057)	(0.050)
_cons	12.892***	21.209***	4.729	-6.948	17.976***	-8.666**	-3.619***	-19.864***	12.143***	20.434***	4.651***	-1.891
	(1.172)	(4.915)	(3.445)	(5.618)	(0.366)	(4.063)	(1.108)	(2.689)	(1.226)	(5.103)	(0.324)	(8.320)
No. of observations	1,147	1,076	1,080	1,048	586	515	529	497	561	561	551	551
Adjusted R2	0.971	0.973	0.971	0.973	0.981	0.985	0.977	0.982	0.959	0.960	0.962	0.962

Notes: Time and country dummies are included, but the results are suppressed here. Standard errors based on White's heteroscedasticity correction cluster by country are given in brackets, with statistical significance (two-tailed test) denoted as: *** p<0.01, ** p<0.05 and * p<0.1.

Chapter 7: Case Study: The Electronics Sector

7.1 Introduction

The electronics sector is considered to be the largest and fastest growing sector in the world and also the most globally integrated manufacturing sector. This chapter provides a case study of the Indonesian electronics sector as an example of Indonesian involvement in global production networks. As discussed in Chapter 6, Indonesia's electronics sector is lagging behind other Asian countries in its participation in global production networks. This is not only caused by Indonesia's macroeconomic condition but also by its under-developed electronics sector compared to other Asian countries. Development of the Indonesian electronics sector is considered to be lagging because it did not begin until the 1970s. Since then, the electronics sector has been affected by different policy regimes which had significant effects on its development.

Since participation in global production networks occurs through export and import of parts and components, a firm-level analysis is conducted to determine how firms' heterogeneity affects international trade. To supplement other findings, fieldwork was conducted with semi structured interviews with several electronics firms in Indonesia to determine factors affecting firms' participation in global production networks.

This chapter is organized as followed. The first section looks at the development and position of the Indonesian electronics sector in regional production networks. The second section provides a firm-level analysis on the determinants of a firm's participation. The third section provides an insight into the Indonesian electronics sector based on fieldwork and the last section concludes.

7.2 Electronics Production Networks in Indonesia

The electronics sector in Indonesia only began to develop in the 1970s. Prior to that, the sector was very under-developed and only consisted of a small number of importers, repairers, service centres and a few assemblers. As described by Surgeon *et al.* (2008), production networks can be categorized into local, national, regional and global and participation in production networks is measured by the trade of parts and components. In order to analyse local and national production networks, this study employs the *SI* (Statistik Industri – the annual manufacturing survey of medium-and-large scale establishments with at least 20 workers). Following classification by Athukorala (2011), the electronics sector in Indonesia is classified into two major subsectors, namely (i) electronics components, and (ii) consumer electronics (consisting of electrical goods, office machinery and telecommunications equipment). Since the analysis is on participation in global production networks, the data only focus on parts and components and not final goods.

Composition of the Electronics Sector

As shown in Table 7.1, the number of firms in the electronics sector varied over the period 1990 to 2007. There was a slight decrease in 1998 due to the financial crisis which hit Indonesia severely. The period 2000 -2003 saw another dip that was due to declining demand in the world electronics market. The lower number in 2001 and 2005 does not represent an actual decline in the number of firms but an under-enumeration because, for yet unknown reasons, no data have been collected for Batam Island, one of the electronics production centres, for both years.

The electronics sector in Indonesia is dominated by the electronics components subsector in terms of number of firms and real value added as well as the number of workers. Right before the crisis, all subsectors showed a promising trend and continuing increase in real value added. However, the 1997 crisis caused an abrupt decline in both subsectors resulting in a significant decline in real value added in 1998. Real value added dropped from around Rp.40 billion to Rp.30 billion in electronics components and from Rp.22 billion to Rp. 15 billion in consumer electronics. While consumer electronics was able to rebound in the following year, electronics components continued to experience a decline in real value added in 1999.

In 2000, both sectors had real value added higher than in the pre-crisis period, but as a result of the slowdown of the international electronics market, the real value added continued to decline over 2001 to 2007.

Characteristics of the Electronics Sector

Table 7.2 presents characteristics of the two subsectors for three different time periods. The first is the pre crisis period which includes 1990-1996, the second is the crisis period (1997–2000) and the third is the post crisis period (2001-2007).

The average share of exported output is less than 20 percent for the electronics sector, with the largest export share occurring in the pre crisis period. During the crisis period, the export share declined slightly because many firms were forced to close down. Between the two subsectors, the components subsector had a larger export share of 21 percent for the whole period, compared with 12 percent in consumer electronics. The low export share of consumer electronics is consistent with the purpose of the establishing such firms in Indonesia, to serve the large domestic market.

Table 7.1: Composition of Electronics Sector, 1990 – 2007

Year	All Electronics P&C			Electronics Components			Consumer Electronics P&C		
	No. of Firms	Real VA (2000 Rp. million)	Average No. Of Employ-ment	No. of Firms	Real VA (2000 Rp. million)	Average No. Of Employ-ment	No. of Firms	Real VA (2000 Rp. million)	Average No. Of Employ-ment
1990	271	10,908	222	135	11,327	225	136	10,493	219
1991	298	12,406	247	149	11,277	252	149	13,535	242
1992	333	20,684	261	180	22,450	257	153	18,605	265
1993	356	17,001	305	189	16,091	325	167	18,030	283
1994	411	19,192	353	231	19,874	375	180	18,316	326
1995	463	27,102	357	262	22,951	380	201	32,514	328
1996	502	36,944	333	291	30,330	366	211	46,066	288
1997	553	32,514	338	325	39,761	381	228	22,186	277
1998	518	23,857	358	312	30,009	400	206	14,541	295
1999	547	29,105	423	329	28,354	485	218	30,237	329
2000	445	50,133	482	287	51,112	526	158	48,355	401
2001*	326	38,372	366	162	33,527	340	164	43,158	392
2002	372	42,591	383	206	52,714	396	166	30,029	368
2003	412	39,522	439	246	43,967	488	166	32,936	366
2004	424	44,362	456	245	47,747	487	179	39,729	413
2005*	307	38,588	396	153	43,228	409	154	33,978	382
2006	513	33,179	435	276	36,050	502	237	29,836	356
2007	521	29,919	447	300	28,457	485	221	31,904	396

Source: Statistik Industri
Notes:
- **: Incomplete database because of under-enumeration, Batam is not included*
- *Deflator: WPI (2000)*
- *Electronics Components – SITC 772 + 776*
- *Consumer Electronics P&C - SITC 771 + 773 + 774 + 775 + 778 + 752 + 759 + 762 + 764*

As expected, the import share of the electronics sector is much higher than its export share indicating the high dependent of this sector on imported input. Only a small number of firms have the capability to conduct modification, design and engineering innovation. The sole agents (*ATPM*) import parts and components from their principals. Even local producers have to import their main parts and components. The imported input share in electronics components was 50 percent on average, and 33 percent for consumer electronics. Although the high imported input is a feature of global production networks, it also reflects the failure of the government's effort to develop domestic supporting industries for the electronics sector.

As mentioned earlier, one reason for the under-developed local supporting industry is low absorptive capacity owing to inadequate trained and skilled local employees. As revealed in the interviews, many firms have to provide skills training and productivity development in-house. This is may not be a problem for large firms, but small and medium firms may find it difficult to offer the necessary in-house training for newly recruited employees.

With an under-developed sector, it is expected that foreign ownership in this sector is going to be higher than in the automotive sector. On average, foreign ownership was between 20-37 percent, with the highest share in the electronics components subsector because of embodied technology in this subsector is usually propriety of foreign firms. The consumer electronics subsector has lower foreign participation, because of the existence of local electronics firms which began operations back in the 1970s. One example of a successful fully domestic electronics firm is PT Hartono Istana Teknologi with the Polytron brand name. This firm was established in 1975 as PT Indonesian Electronics & Engineering, a subsidiary of the successful cigarette company, PT Jarum Kudus. From the beginning, it did not want any foreign investment; because it did not want to pay any royalty to a foreign principal. With two factories in East Java, its main products are TV sets, mobile phones, refrigerators and audio sets. It has been successfully exporting products to the European market although under different names (Polytron, 2010).

The foreign investment share increased significantly during the crisis period. Just before the crisis, at least three joint venture firms[22] were established to produce active components (components that require electrical power to operate), mainly semiconductor devices and integrated circuits (ICs). Another reason for the increase in foreign participation was a FDI fire-sale of Indonesian companies because of excess capacity and asset prices falling drastically as a result of real exchange rate depreciation.

The average firm size in the electronics sector was smaller than the automotive sector, less than 400 employees. Before the crisis, the average firm size for the whole sector was 306, while the average for the electronics components subsector was 326, and for the consumer electronics subsectors 283 employees. The same patterns occurred during and after the crisis period. Surprisingly, the average firm size during the crisis was higher than for any other period. For the electronics components subsector, both the number of firms and firm size increased during the crisis. This was because most of the new firms were foreign companies that were larger than the incumbents. For consumer electronics, the number of firms declined but average firm size increased. This indicates that many firms had to exit the industry after the crisis and the remaining firms in the subsectors were larger since small firms could not survive the crisis due to the sudden drop in domestic demand for electrical goods.

[22] PT Sharp Semiconductor Indonesia, PT NEC Semiconductor Indonesia and PT Panasonic Semiconductor Indonesia.

Table 7.2: Characteristic of the Indonesian Electronics Sector: 1990 - 2007

Variable	All Period (1990 - 2007)	Pre Crisis (1990 - 1996)	Crisis (1997 - 2000)	Post Crisis (2001 - 2007)
		Electronics P&C		
Number of firms	1,668	772	738	1,181
Export Share (%)	17	19	14	17
Import Share (%)	43	41	44	43
Foreign Equity Shares (%)	29	18	36	34
Number of workers	375	306	397	422
Age of firm (year)	10	8	13	12
Real Value Added (2000 Rp.million)	31,041	22,238	33,237	37,531
Real Wages/Worker (2000 Rp.000)	5,095	3,728	4,980	6,429
Factor Intensity - K/L ratio	22,247	9,275	30,325	27,534
Labour Productivity - Real VA/Worker (2000 Rp.000)	68,868	47,482	70,729	87,126
Labour Productivity - Real Output/Worker (2000 Rp.000)	188,890	147,072	181,822	232,267
		Electronics Component		
Number of firms	991	408	439	691
Export Share (%)	21	25	18	20
Import Share (%)	50	47	51	52
Foreign Equity Shares (%)	36	23	44	40
Number of workers	409	326	446	455
Age of firm (year)	9	7	12	11
Real Value Added (2000 Rp.million)	32,704	20,683	36,937	40,242
Real Wages/Worker (2000 Rp.000)	5,415	3,943	5,651	6,559
Factor Intensity - K/L ratio	25,767	9,456	37,283	29,592
Labour Productivity - Real VA/Worker (2000 Rp.000)	70,062	44,887	76,077	88,096
Labour Productivity - Real Output/Worker (2000 Rp.000)	183,113	138,933	191,263	216,676
		Consumer Electronics P&C		
Number of firms	693	314	300	495
Export Share (%)	12	13	8	12
Import Share (%)	33	33	33	33
Foreign Equity Shares (%)	21	13	23	27
Number of workers	331	283	320	381
Age of firm (year)	11	9	14	13
Real Value Added (2000 Rp.million)	28,881	24,105	27,513	34,185
Real Wages/Worker (2000 Rp.000)	4,680	3,470	3,940	6,269
Factor Intensity - K/L ratio	17,762	9,065	19,570	25,147
Labour Productivity - Real VA/Worker (2000 Rp.000)	67,318	50,598	62,456	85,929
Labour Productivity - Real Output/Worker (2000 Rp.000)	196,387	156,842	167,253	251,504

Source: Statistik Industri

Notes:

- *Deflator: CPI (2000) for real wages*
- *Deflator: WPI (2000) for real VA and real output*

Consistent with the development of the Indonesian electronics sector, whereby the first firms established in Indonesia were consumer electronics firms, the oldest subsector is consumer electronics. The average firm age for this subsector was 12 years. However, the average firm age in the post crisis period was lower than in the crisis period, again indicating that many firms closed down during the crisis and many new firms were established afterwards.

In general, the average real wages per worker in the electronics sector was Rp.5 million (approximately $555) over the period 1990 - 2007. The highest real wages were in electronics components which was consistent with the higher labour quality employed in this sector. This is because the production process in this sector not only involves simple assembly which does not require skilled labour, but also includes a more complicated process which needs higher-skilled labour. Meanwhile, average real wages were lower in the consumer electronics subsector because this sector is merely production and assembly of simple parts and components. After the crisis, average real wages for both subsectors increased with the largest increase in the consumer electronics sector. One of the reasons for this real wages increase was the minimum wages regulation which was determined at the sub-provincial level. Nominal wages almost doubled in just three years from 1999 – 2002 (Bird and Hill, 2006).

Factor intensity is measured by the Capital/Labour (K/L) ratio, calculated as the ratio of capital value to worker. The electronics components subsector has a higher ratio than consumer electronics which indicates that the electronics component subsector is more capital intensive than consumer electronics. During the crisis period, there was a significant increase in the electronics component subsector due to several new capital intensive firms established right before the crisis as discussed earlier.

Labour productivity is measured in two ways. The first measure is real value added per worker, and the second is real output per worker. The real wage is consistent with the first measurement of labour productivity, namely real value added per worker. Electronics components subsector has a larger Real VA/worker, while consumer electronics has larger Real Output/worker. This implies that, although the output value in the consumer electronics subsector is higher its value added is still lower than electronics components. This is due to the simpler assembly conducted in consumer electronics compared with the electronics component subsector.

Geographic Concentration of the Indonesian Electronics Sector

Indonesia is an archipelago as shown in the map of Indonesia in Appendix 7.1. Economic activities are concentrated in Java Island and the second biggest island (in terms of economic activities) is Sumatra Island. As expected, the electronics sector is concentrated in these two big islands as presented in Table 7.3.

The highest concentration of electronics firms is in West Java province, followed by the Greater Jakarta area (Jakarta and Banten[23] provinces). Outside Java, electronics firms are concentrated in Batam island, the first special economic zone established in the late 1980s. Special autonomy was given to the Batam Island Development Agency (BIDA) to control land

[23] Banten province was legally established in the year 2000, but the change appeared only in the 2001 *SI*. Prior to the year 2000, Banten was part of West Java province. For consistency of the data, a back-cast is conducted for firms located in Banten (full explanation of the adjustment is provided in Chapter 5).

allocations, investment applications and other areas which are usually the preserve of central government ministries. The special treatment for Batam includes several aspects. First, a declaration that all Batam Island is a bonded zone with the aim of encouraging development of export-oriented industries and to facilitate the free importation of material required by manufacturing industries located in the island. Second, a special foreign investment policy for Batam Island where 100 percent foreign ownership is allowed with the condition only that a 5 percent divestment to an Indonesian partner occurs within five years. 100 percent foreign ownership in the electronics industry is crucial to protect proprietary technology. Third, private foreign and domestic companies are allowed to set up industrial estates, and Batamindo Industrial Park was established as a joint venture between an Indonesian consortium (60 percent equity) and two Singapore government-owned companies (40 percent). This special treatment for Batam Island successfully attracted foreign investors, especially from multinational enterprises (MNCs) based in Singapore, to relocate their production to Batam. The majority of these electronics firms were second wave, medium-sized firms utilizing low to medium-level technology which was less competitive in the international market.

Although electronics firms are concentrated in West Java, until 1996 the highest real value added was in the Greater Jakarta Area and then in Batam. The low value added in West Java showed that most of the electronics firms in this region mainly conduct simple assembly with low value added.

The only exception was in 2002 and 2003 when two firms surveyed in Central Java reported their high value added.[24] It was not confirmed whether this reported value added was the actual number or a reporting error since it happened only in those two years.

The clustering of electronics firms can be explained by the economics of agglomeration as well as the pull of the market. Firms locate themselves in proximity to others to take advantage of three sets of localization economies, namely a pooled market for workers with specialized skills, the availability of specialized inputs and services, and technological spillovers.

[24] This particular firm is a domestic firm that serves only domestic market, located in Central Java with ISIC code 32300. Its imported input increased six times in 2002 from its 1999 figure and real value added increased ten times.

Table 7.3: Geographic Concentration of the Indonesian Electronics Sector, 1990 – 2007

All Electronics Parts and Components

Year	Number of Firms								Real Value Added (2000 Rp. million)							
	All regions	Batam	Jakarta	West Java	Banten	East Java	Central Java	Others	All regions	Batam	Jakarta	West Java	Banten	East Java	Central Java	Others
1990	271	4	72	97	32	38	11	17	10,908	22,390	18,434	10,858	7,476	3,625	9,886	2,811
1991	298	17	65	100	42	48	11	15	12,406	14,402	25,237	10,587	8,150	6,614	11,213	2,568
1992	333	34	72	105	42	56	13	11	20,684	21,452	33,082	26,299	12,223	6,406	7,328	5,205
1993	356	31	77	122	44	55	15	12	17,001	18,856	29,589	15,870	12,799	6,722	13,338	4,139
1994	411	51	80	138	55	57	15	15	19,192	25,030	28,119	16,546	24,340	6,915	18,502	3,540
1995	463	62	77	164	61	65	18	16	27,102	32,246	64,217	20,404	23,821	7,841	18,708	3,460
1996	502	69	81	176	61	76	20	19	36,944	52,279	93,864	29,247	19,175	7,287	15,765	14,888
1997	553	39	81	191	66	86	25	65	32,514	56,403	18,985	39,709	29,130	5,530	1,897	25,758
1998	518	70	68	202	67	71	15	25	23,857	75,563	11,283	25,363	11,234	4,045	7,444	2,108
1999	547	88	68	213	77	65	15	21	29,105	66,392	19,345	31,266	14,045	5,993	12,088	10,806
2000	445	74	57	176	73	54	1	10	50,133	156,117	28,853	37,629	17,163	8,783	694	42,535
2001 *	326	-	52	163	42	41	3	25	38,372	-	25,313	26,502	56,554	44,609	884	62,453
2002	372	50	48	157	63	41	-	13	42,591	51,287	22,398	53,100	38,186	12,595	-	72,728
2003	412	76	41	172	56	46	3	18	39,522	33,082	21,909	46,603	41,782	8,576	246,705	40,983
2004	424	95	40	187	50	47	5	-	44,362	64,356	27,954	35,839	64,705	26,587	78,126	-
2005 *	307	-	44	145	53	46	9	10	38,588	-	36,509	35,603	50,752	49,736	6,484	4,008
2006	513	84	60	220	52	61	16	20	33,179	53,039	29,263	27,859	51,248	28,199	23,397	2,748
2007	521	90	56	218	48	66	22	21	29,919	44,980	36,105	28,743	38,047	13,921	32,340	2,744

Electronics Component

Year	Number of Firms								Real Value Added (2000 Rp. million)							
	All regions	Batam	Jakarta	West Java	Banten	East Java	Central Java	Others	All regions	Batam	Jakarta	West Java	Banten	East Java	Central Java	Others
1990	135	4	31	56	14	19	5	6	11,327	22,390	17,242	13,472	4,217	3,191	982	5,001
1991	149	16	26	55	20	22	5	5	11,277	12,111	21,486	13,450	4,188	3,152	582	7,714
1992	180	29	30	60	19	31	5	6	22,450	23,706	16,650	39,274	13,226	5,822	659	9,382
1993	189	26	33	70	20	29	5	6	16,091	19,540	18,059	20,203	10,346	8,506	749	5,599
1994	231	44	36	83	25	29	5	9	19,874	25,452	21,687	19,448	29,220	9,363	445	3,621
1995	262	55	35	93	29	33	7	10	22,951	30,404	19,496	27,465	26,937	7,679	416	3,021
1996	291	61	41	98	29	41	8	13	30,330	48,670	27,035	40,397	14,778	5,293	368	5,589
1997	325	36	39	117	31	40	10	52	39,761	54,753	13,480	54,109	31,805	6,232	335	24,118
1998	312	61	32	128	32	33	7	19	30,008	76,381	8,094	31,595	7,285	3,426	1,324	1,673
1999	329	77	30	134	34	30	10	14	28,354	52,902	10,820	31,295	8,524	5,066	12,600	8,119
2000	287	65	29	121	33	29	1	9	51,112	124,656	24,590	38,168	6,658	8,888	694	47,547
2001 *	162	-	26	76	17	18	1	24	33,527	-	28,835	20,412	22,678	4,816	2,416	65,075
2002	206	40	22	91	23	19	-	11	52,713	57,573	33,437	65,758	46,651	5,217	-	60,394
2003	246	66	19	105	18	23	1	14	43,967	34,596	32,130	52,731	61,284	8,935	32,341	40,535
2004	245	77	18	108	18	21	3	-	47,747	63,727	46,236	38,592	52,028	33,921	47,298	-
2005 *	153	-	20	84	19	21	4	5	43,228	-	58,824	34,358	38,304	84,286	9,729	2,698
2006	276	65	23	124	19	28	7	10	36,050	51,852	49,075	29,037	45,491	30,867	13,365	3,042
2007	300	70	30	124	20	33	11	12	28,457	47,120	34,909	28,516	13,244	8,292	6,591	3,802

Consumer Electronics Parts and Components

Year	Number of Firms								Real Value Added (2000 Rp. million)							
	All regions	Batam	Jakarta	West Java	Banten	East Java	Central Java	Others	All regions	Batam	Jakarta	West Java	Banten	East Java	Central Java	Others
1990	136	-	41	41	18	19	6	11	10,493	-	19,336	7,288	10,011	4,058	10,274	4,312
1991	149	1	39	45	22	26	6	10	13,535	51,050	27,737	7,088	11,751	9,543	11,774	2,349
1992	153	5	42	45	23	25	8	5	18,605	8,377	44,819	9,000	11,394	7,130	7,593	7,864
1993	167	5	44	52	24	26	10	6	18,030	15,302	38,236	10,036	14,844	4,733	17,293	8,990
1994	180	7	44	55	30	28	10	6	18,316	22,374	33,382	12,167	20,273	4,380	22,392	9,633
1995	201	7	42	71	32	32	11	6	32,514	46,716	101,485	11,156	20,996	8,008	20,930	11,324
1996	211	8	40	78	32	35	12	6	46,066	79,802	162,363	15,237	23,160	9,624	20,060	13,771
1997	228	3	42	74	35	46	15	13	22,186	76,192	24,097	16,940	26,760	4,920	2,634	66,701
1998	206	9	36	74	35	38	8	6	14,541	70,014	14,117	14,584	14,843	4,583	7,793	6,708
1999	218	11	38	79	43	35	5	7	30,237	160,825	26,076	31,216	18,412	6,788	17,363	20,241
2000	158	9	28	55	40	25	-	1	48,355	383,339	33,269	36,444	25,830	8,662	-	4,330
2001 *	164	-	26	87	25	23	2	1	43,158	-	21,792	31,823	79,589	75,752	119	10,455
2002	166	10	26	66	40	22	-	2	30,029	26,146	13,057	35,646	33,319	18,967	-	140,566
2003	166	10	22	67	38	23	2	4	32,936	23,090	13,083	37,000	32,544	8,217	353,888	84,076
2004	179	18	22	79	32	26	2	-	39,729	67,048	12,995	32,075	71,836	20,663	124,369	-
2005 *	154	-	24	61	34	25	5	5	33,978	-	17,913	37,319	57,709	20,715	3,889	5,373
2006	237	19	37	96	33	33	9	10	29,836	57,101	16,947	26,338	54,562	25,935	22,853	4,496
2007	221	20	26	94	28	33	11	9	31,904	37,488	37,485	29,043	55,764	19,551	38,609	3,197

Source: Statistik Industri

*Notes: *: incomplete data because of under-enumeration*

Deflator: WPI(2000)

Specifically, for exporting firms, proximity to ports/airports is important because this sector depends highly on "just-in-time" delivery. Studies by Kuncoro and Dowling (2004) on Indonesia's agglomeration pattern confirm infrastructure as one of the important components in the agglomeration process. On the other hand, Deichmannn et al (2005) suggest that increasing infrastructure endowment for lagging regions may only have a limited payoff in terms of attracting firms from other more established "leading" regions, particularly in main stream sectors that have already concentrated in other leading regions.

It can be concluded from the above discussion that the Indonesian electronics sector is dominated by electronics components even though consumer electronics was established earlier. The electronics sector is highly dependent on imported input because of the under-developed domestic supporting industries. The involvement of foreign principals is high and increased following the 1997 financial crisis. The consumer electronics subsector does not provide high value added compared to the electronics component subsector. This is due to relatively simple assembly process in this sector. The export performance of this sector is low, since most products are for the domestic market.

7.3 Determinants of Firm Participation in the Electronics Global Production Networks

Participation in the global production networks is conducted through the export and import of parts and components. Imports can be regarded as participation if the imported inputs are used in an assembly or production process which are then exported. Unfortunately the trade data and firm-level data cannot distinguish the specific use of the imported input. Therefore, analysis on Indonesia's participation in the global production networks is conducted on the export of parts and components.

This section uses the firm-level analysis explained in Chapter 5 to examine the role of firm characteristics in determining a firm's decision to participate in the electronics global production networks through export of electronics parts and components. Before analysing the estimation results based on an adaptation of Roberts and Tybout's model on the Indonesian electronics sector, a descriptive analysis is conducted to provide a better understanding of this sector.

7.3.1 Descriptive Analysis

The firm-level analysis uses the annual manufacturing survey of medium-and-large scale establishments – firms with at least 20 workers (*Statistik Industri,* or SI) conducted by the Indonesian Central Board of Statistics (*Badan Pusat Statistik – BPS*). The electronics sector is classified into two subsectors: (i) electronics components, and (ii) consumer electronics. The list of commodities is provided in Appendix 2.1.

Table 7.4 presents some characteristics of the exporting and foreign firms. The number of exporting firms has increased over time except in 1998, 2003 and 2007 (declines in 2001 and 2005 were caused by under-enumeration). The proportion of exporting firms reached a peak of 33 percent in 1996, just before the financial crisis. Between the two subsectors, the electronics components subsector constantly had the largest proportion of exporting firms, reaching a peak in 1996 with almost 40 percent of firms in this subsector exporting. This high proportion dominated by export oriented joint venture firms established in Batam Island.

The real value added of exporting firms showed an increasing trend except for a slight decline in 1998. This was caused by the significant decline in real value added in consumer electronics that was offset by an increase in real value added in the electronics components subsector.

A similar pattern occurred in the number of workers employed in the electronics sector. The size of exporting firms in the consumer electronics subsector continued to decline from 1995 reaching a low in 1998, before increasing and then declining again in 2003.

Since electronics is considered a green-field sector, foreign investment is also high. After the 1994 investment liberalization, the electronics sector became one of the favoured sectors for foreign investors and the number of foreign owned firms increased significantly, reaching a peak in 1999. Many of this foreign investment occurred in the form of mergers and acquisitions (M&A). The number of foreign firms is larger in the electronics components subsector compared to consumer electronics because most of the technology embodied in the parts and components are propriety of principal firms.

In contrast to the value added for all firms as explained earlier, the value added of foreign firms in the consumer electronics is higher than for firms in electronics components. This reflects the dualism in the consumer electronics subsector. The foreign firms, which are only a small proportion of consumer electronics firms, have higher value added than the domestic firms which dominate this subsector. The foreign firms in the consumer electronics subsector are smaller in size than those in the electronics components subsector.

Table 7.4: Exporting and Foreign Owned Firms: Number of Firms, Real Value Added and Average Number of Employment, 1990 - 2007

Year	Exporting Firms								
	Electronics P&C			Component			Consumer		
	No. of Firms	Real VA (2000 Rp. million)	Average No. Of Employ-ment	No. of Firms	Real VA (2000 Rp. million)	Average No. Of Employ-ment	No. of Firms	Real VA (2000 Rp. million)	Average No. Of Employ-ment
1990	42	31,984	522	18	36,873	628	24	28,318	442
1991	62	26,640	480	31	16,789	435	31	36,492	524
1992	105	31,642	443	63	28,050	442	42	37,029	444
1993	105	27,913	568	63	23,236	606	42	34,928	511
1994	127	37,311	720	85	38,003	754	42	35,910	651
1995	133	45,160	736	89	45,581	733	44	44,311	744
1996	165	54,738	655	107	56,491	708	58	51,502	558
1997	123	65,442	646	95	63,593	690	28	71,716	496
1998	40	64,154	925	35	71,571	1,005	5	12,239	360
1999	102	67,626	717	68	63,899	856	34	75,082	438
2000	104	119,690	848	75	103,655	890	29	161,159	738
2001*	38	48,262	545	18	30,995	455	20	63,801	627
2002	105	64,884	709	72	63,003	728	33	68,988	666
2003	57	90,259	682	38	109,999	844	19	50,781	357
2004	88	70,654	643	59	71,717	698	29	68,491	532
2005*	46	72,405	613	24	92,114	739	22	50,904	475
2006	175	52,483	752	109	53,585	849	66	50,663	592
2007	146	51,026	760	88	47,833	826	58	55,869	661

Year	Foreign Owned Firms								
	Electronics P&C			Component			Consumer		
	No. of Firms	Real VA (2000 Rp. million)	Average No. Of Employ-ment	No. of Firms	Real VA (2000 Rp. million)	Average No. Of Employ-ment	No. of Firms	Real VA (2000 Rp. million)	Average No. Of Employ-ment
1990	37	32,207	389	17	34,871	359	20	29,943	415
1991	54	28,489	426	27	25,070	375	27	31,908	477
1992	78	41,178	406	45	36,224	382	33	47,933	439
1993	94	29,247	515	58	24,400	526	36	37,057	498
1994	125	39,879	612	84	37,271	620	41	45,223	594
1995	134	47,545	623	94	45,452	647	40	52,466	567
1996	150	60,678	624	104	56,011	668	46	71,230	523
1997	200	69,630	605	145	70,745	616	55	66,689	577
1998	233	37,557	527	163	40,025	543	70	31,809	492
1999	245	53,537	609	175	43,259	636	70	79,233	541
2000	199	94,724	739	151	83,027	726	48	131,519	778
2001*	113	70,348	620	64	71,207	593	49	69,227	655
2002	126	88,652	662	80	98,849	636	46	70,919	706
2003	170	62,416	645	117	63,107	673	53	60,890	582
2004	131	69,118	655	82	63,260	690	49	78,921	595
2005*	106	73,177	633	58	75,936	644	48	69,844	621
2006	221	55,339	680	142	52,119	716	79	61,127	616
2007	225	51,866	761	149	49,411	805	76	56,679	676

Source: Statistik Industri

Notes:

- *Exporting firm: firm which exports any of its product*
- *Foreign firm: firm with any foreign ownership*
- **: incomplete data because of under – enumeration*
- *Deflator using WPI(2000)*

Characteristics of exporting and non-exporting firms

Table 7.5 depicts the characteristic of exporting and non-exporting firms for three different periods. For all electronics parts and components, a share of foreign firms to total electronics firms declined sharply during the crisis, from 27 percent before the crisis to only 18 percent during the crisis, and then increased slightly to 22 percent after the crisis. In the pre crisis period less than 30 percent of firms were exporting, and during both the crisis and post crisis periods, the proportion declined to less than 20 percent. The exporting firms were younger, larger and better (in terms of higher value added and output, higher labour productivity and quality) with a higher K/L ratio. Younger firm is more competitive because adjustment to market and technological changes is more difficult for older firms therefore it is easier for younger firms to join global production network. Larger firms can benefit from economies of scale which is one of characteristics of electronics sector. Therefore larger firms is more competitive and be able to export.

Firm's productivity affect a decision to export as mentioned by Melitz (2003) and showed by several empirical studies (for example: Hallward-Driemeier *et al.* (2002), Debaere *et al.* (2009), and Tomiura (2007)). A firm with higher productivity will be more likely to export, while a firm with lower productivity will focus on domestic market. This higher productivity is a result of higher quality of labour as well as higher K/L ratio.

However, after the crisis, there is a change in characteristic of exporting firm with older firm is more likely to export than younger firm. This implies that older firm has more experience and knowledge than younger firm therefore it survived the crisis. Moreover, there was many firms exited the sector during the crisis and many new firms entered the market after the crisis, which made the average age of non exporting firm is lower in the post crisis period compared to crisis period.

In the electronics components subsector, the average share of exporting firms to total electronics component firms was 30 percent in the pre crisis period, declining to 22 and 20 percent during the crisis and post crisis periods, respectively. The characteristics firms in electronics components subsector is the same with firms in the electronics sector in general, except for the crisis period. In the electronics component subsector, exporting firms during the crisis period are older than non exporting firms. This implies that even before the crisis, there were many younger firms have to exit the export markets because they cannot compete due to significant drop of demand in export markets. . Another different characteristic is that during the crisis firms with lower K/L ratio can survive, which implies that firm with higher K/L ratio decided to temporary exit the export markets and return to this market once the condition rebound.

The characteristics of exporting firms in the consumer electronics subsector are different from firms in the electronics components subsector. Exporting firms during the crisis period is younger firms while exporting firms in the pre and post crisis period are older firms. Therefore during the 'normal' period, firms in the consumer electronics subsector follow Jovanovic's (1982) argument that firms learn and gain experiences and thus improve efficiency over time, therefore they can export.

It can be concluded from the above discussion, that there are different characteristics between exporting and non exporting firms. This raises the question as to whether a firm's decision to export is affected by firm characteristics. The next section attempts to answer the question in discussing the results from the firm-level analysis.

7.3.2 Estimation Results and Discussion

Methodology for the firm level analysis estimation is discussed in detailed in Chapter 5. This section reports and discusses the estimation results of Equation 5.28 carried out using a random effect probit model. A random effect probit model is used to estimate the above equation because of the short panel data used in this research (period 1990-1996 for the pre - crisis period and 2001-2007 for the post-crisis period). The main hypothesis is that "good" firms become exporters/importers. In this research, size, age, factor intensity, productivity, quality of labour and firm ownership are considered to be factors affecting a firm's decision to enter the export/import market. In addition, spillover between firms located in the same location is also considered to affect the decision.

The estimations are conducted in two models, the first is the standard probit model and the second the Wooldridge model to control for the initial condition problem (as explained in detail in Chapter 5). The random effect probit model has been chosen because the fixed effect model is not possible with short panel data, which is the case in this research. The analysis is conducted for both the pre and post crisis period. However, the results both for all and during crisis periods are provided for comparison in Appendix 7.2 and Appendix 7.3. The non-linearity of the probit specification makes economic interpretation of the coefficient difficult, therefore the results are reported in their marginal effects of a change in the independent variables on the probability of exporting/importing.

Table 7.5: Characteristics of Exporting and Non-Exporting Firms, 1990 - 2007

Electronics

Variable	All Period		Pre Crisis		During Crisis		Post Crisis	
	Exporter	Non Exporter	Exporter	Non Exporter	Exporter	Non Exporter	Exporter	Non Exporter
Age (year)	9	10	7	8	12	13	13	11
Number of workers	677	283	616	186	753	319	704	339
Factor Intensity: K/L ratio	30,093	30,093	30,093	30,093	30,093	30,093	30,093	30,093
Real VA (2000 Rp. million)	56,132	23,426	39,276	15,594	81,195	22,790	61,029	30,598
Real Output (2000 Rp. million)	169,598	65,469	140,527	39,640	207,083	69,149	181,395	84,712
Real Wages/Worker (2000 Rp.000)	5,987	4,824	4,808	3,307	6,303	4,691	7,140	6,220
Labour Productivity: VA/Worker (2000 Rp.000)	86,791	63,429	62,513	41,621	112,925	61,537	99,459	83,488
Labour Productivity: Output/Worker (2000 Rp.000)	240,165	173,343	197,880	127,258	296,514	156,960	256,299	225,176

Component

Variable	All Period		Pre Crisis		During Crisis		Post Crisis	
	Exporter	Non Exporter	Exporter	Non Exporter	Exporter	Non Exporter	Exporter	Non Exporter
Age (year)	8	10	5	8	13	12	11	11
Number of workers	737	290	649	176	827	340	776	344
Factor Intensity: K/L ratio	23,833	26,419	11,113	8,730	28,465	39,730	35,786	27,656
Real VA (2000 Rp. million)	56,445	24,110	38,918	12,207	75,698	26,140	63,152	32,321
Real Output (2000 Rp. million)	169,846	63,991	139,616	29,622	193,720	82,281	187,775	77,390
Real Wages/Worker (2000 Rp.000)	6,387	5,063	5,239	3,341	6,901	5,303	7,325	6,294
Labour Productivity: VA/Worker (2000 Rp.000)	78,473	67,017	59,868	37,924	90,619	72,025	91,141	87,043
Labour Productivity: Output/Worker (2000 Rp.000)	216,084	171,195	188,238	116,015	241,683	177,306	230,203	211,999

Consumer

Variable	All Period Exporter	All Period Non Exporter	Pre Crisis Exporter	Pre Crisis Non Exporter	During Crisis Exporter	During Crisis Non Exporter	Post Crisis Exporter	Post Crisis Non Exporter
Age (year)	11	11	10	9	12	14	16	12
Number of workers	569	275	563	196	542	290	585	333
Factor Intensity: K/L ratio	41,402	12,645	13,755	7,678	47,453	15,821	74,578	14,550
Real VA (2000 Rp. million)	55,561	22,621	39,852	19,229	96,829	18,193	57,521	28,643
Real Output (2000 Rp. million)	169,149	67,209	141,995	50,393	244,804	51,142	170,856	93,019
Real Wages/Worker (2000 Rp.000)	5,262	4,543	4,113	3,271	4,603	3,851	6,836	6,135
Labour Productivity: VA/Worker (2000 Rp.000)	101,898	59,205	66,775	45,589	176,358	47,142	113,199	79,453
Labour Productivity: Output/Worker (2000 Rp.000)	283,825	175,872	213,416	139,325	451,297	129,062	299,404	240,127

Source: Statistik Indonesia

Notes: Deflator: CPI (2000) for wages
WPI (2000) for value added and output

Most firms do not participate only in export or import, but do both. As shown by Muuls and Pisu (2009), productivity advantages are different between exporter, importer, both exporter and importer and non-trader firms. A firm that export and import at the same time has higher productivity advantages than a firm that only import or export. Therefore, only taking into account the exporter advantages in the research when importer advantages are larger may have overstated the productivity of exporters. Hence the estimations are also conducted for a firm that exports and imports at the same time.

The second, fourth, sixth and eighth columns in the result tables (Table 7.6 and Table 7.7 as well as Appendix 7.2 and Appendix 7.3) take this feature into account by adding the lag of imports to the exports regression. This allows the interaction between the export and import decision to be analysed and whether import in the previous period affects export in the current period.

Electronics Components Subsector

As presented in Table 7.6 the results for the pre crisis period using the standard probit model (without correcting for the initial condition) reveal that foreign ownership, firm size, sunk cost and locational spillover all affect the decision to export. Foreign ownership has a positive impact which implies that being a foreign firm increases the probability to export by 12.1 percent. This is because foreign firms or joint-venture firms were established to serve the export market. This is consistent with other studies on Indonesia. [25]

The size of the firm relates to economies of scale. A larger firm may be associated with lower average, or marginal costs, providing a separate mechanism for size to increase the likelihood of exporting (Bernard and Jensen, 2004, p.565). The result confirms this hypothesis with smaller firms less likely to export, and being a large or a very large firm increasing the probability to export by 7 percent and 15 percent, respectively. Most of the large and very large firms are foreign owned, therefore their probability to export is higher than smaller firms which are usually domestic firms. In addition, the electronics components usually have economies of scale, therefore it is easier for larger firms to achieve economies of scale and become more competitive and able to serve the export market.

Coefficient for sunk cost, measured by the export status in previous period, are positive and significant which is consistent with other empirical results, such by Roberts and Tybout (1997) for Colombian manufacturing plants and Bernard and Jensen (2004) for US manufacturing

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[25] See for example: Sjöholm (2003), Ramstetter and Takii (2005) and Narjoko and Hill (2007).

plants. Sunk costs are defined as a sunk irreversible investment faced by a firm in order to enter the export market. These costs include the cost of international marketing, establishing a distribution system, gathering information about the export market, hiring employees with specific language training, and a combination of R&D spending to improve product quality in order, for example, to conform to the standard and safety requirements of a target country. The positive sunk cost implies that as it is costly for firms to start exporting their output, once they enter the market, they tend to stay unless there are major events that force them to exit such as happened during the 1997 financial crisis. Although many foreign firms especially that located in Batam were not badly affected.

Coefficients for the locational spillover variable are positive and significant, which means that being in the same location (province) with other exporters increases the probability of a firm to export their product by 53 percent. This result confirms the agglomeration effect in electronics sector, where a pool of skilled labour, better infrastructure, and proximity to airport/port are factors that pull firms to the same locations.

The second and fourth columns in Table 7.6 show the estimation results of including an import sunk cost (measured by import status in previous year) in the export equation to see whether being an importer increases the probability to export. The result for electronics components is negative but not significant. This implies that being importer does not increase the probability of a firm to export their products. Furthermore, the magnitudes of other coefficients are similar.

The Wooldridge model is used to correct for the initial problem which arises because the start of the sample period is not the same as the start of the process that generates the export decision. Since the stochastic process cannot be observed from its start, it is impossible to treat y_0 (the first observation of the dependent variable in the dataset – initial status of export) as fixed. The Wooldridge model includes the initial status of export (y_0) and the average of the other explanatory variables as independent variables. The variables for the average of firm-level characteristics are included to control for any unobserved individual effect. However, their estimated coefficients do not contain meaningful economic implication thus they are not reported in the tables.

Once the initial status of export is included, the coefficient for the initial status is positive and significant, but the coefficient for other firm characteristics change. Foreign ownership becomes insignificant and the negative effect of being a small firm becomes significant. This implies that the initial export status captures the superior performance characteristic between exporter and non-exporter (Kneller *et al.*, 2008). This means that foreign firms in the electronics components subsector were established to serve the export market. In part because the regulation said that they have to export more than 85 percent of their product to be able to have 95 percent foreign equity and in the case of firms located in Batam, they have to export all their products if they want to have full foreign equity.

Consumer Electronics Subsector

For the consumer electronics subsector, the results from the standard probit model show that firm size, sunk cost and locational spillover affect the probability to export. Being a small firm decreases the probability to export by 18 percent and being a very large firm increases the probability by 18 percent. The coefficient of foreign ownership is positive but not significant, which means that being a foreign owned firm in this subsector does not significantly increase the probability to export. Moreover there are several large domestic firms in this sector that export. Positive and significant coefficient implies that competitive firms which are able to export in the consumer electronics subsector are large firms which have the advantage of economies of scale. This result also reflects the government's policy that has been biased towards domestic consumer electronics firms. With the investment liberalization in 1990s, the foreign principals came to Indonesia to serve the large domestic market instead of making Indonesia a production base for the Asian region.

Both export and import sunk cost affect the decision to export. This suggests that the international experience in purchasing import input in the previous period raises the probability to export in the following period because a firm has an exposure to international markets. The coefficient of import sunk cost is smaller than the coefficient of export sunk cost. This indicates that accessing export market is more expensive than import market.

Being in the same location as other exporters increases the probability to export by almost 60 percent, higher than in that of the electronics component subsector. This suggests that spillover among consumer electronics firms is higher than electronics components firms. This is due to the higher technology propriety in the electronics components subsector compared to the consumer electronics subsector.

The results from the Wooldridge model show that after controlling for the initial status, small size and import sunk cost become insignificant and the magnitude of all coefficients becomes smaller. This implies that the initial decision already captures the superiority of these variables. This means that once the initial condition is controlled, size and import sunk cost do not increase probability to export anymore.

Therefore it can be concluded that in the pre crisis period, a firm's decision to export was affected by firm characteristics, sunk cost (both export and import sunk cost) and locational spillover. Firm characteristics affecting the decision were different in the electronics components and consumer electronics subsectors. In the electronics components subsector, foreign ownership and firm size are important. In consumer electronics, foreign ownership is not an important determinant, while firm size is still important.

Post Crisis Period (2001 - 2007)

The Electronics Component Subsector

The results for the post crisis period are presented in Table 7.7. Unlike the pre crisis period, only firm size affect a decision to export in the post crisis period. Even being a small firm has a positive impact on the probability to export. This result implies a change in the structure of the electronics component industry. The small firms in the post crisis period are firms that survived the crisis, which means that they are "good' firms. This positive coefficient for small size may capture other characteristics of small firms in the post crisis period such as productivity and ownership. The larger the firm size, the higher the probability to export. Being a small firm increases the probability to export by only 15 percent, while being a large firm increases the probability by 20 percent and being a very large firm increases the probability by 21 percent. Sunk cost and locational spillover are still important.

Foreign ownership has a positive coefficient but is not significant, which implies that after the crisis, the performance gap between foreign and domestic firms became smaller. Therefore both foreign and domestic firms had the same probability to export. Whether the narrow gap was a result of technology spillover from the foreign firms to domestic firms or the fact that the good foreign firms left Indonesia after the crisis is an interesting topic by is beyond the scope of this research.

The coefficient for export sunk cost is positive and significant with a larger magnitude compared to the pre crisis period. This implies that the costs to enter the export market became more expensive after the crisis. This was due to higher competition in the export market which made it more difficult to gather the necessary information regarding the export market. The import sunk cost is not significant, as for the pre crisis period.

Table 7.6: Random Effect Probit Estimation Results – Marginal Effect: Electronics Components and Consumer Electronics Subsectors, 1990 - 1996

	Electronics Component				Consumer Electronics			
	Pre Crisis - Probit		Pre Crisis - Wooldridge		Pre Crisis - Probit		Pre Crisis - Wooldridge	
	Exporter	Exporter and Importer	Exporter	Exporter and Importer	Exporter	Exporter and Importer	Exporter	Exporter and Importer
L1lnAge	-0.005 (0.014)	-0.005 (0.014)	0.013 (0.015)	0.013 (0.015)	0.010 (0.017)	0.014 (0.017)	0.004 (0.018)	0.005 (0.018)
L1lnRWages	0.011 (0.010)	0.011 (0.010)	-0.001 (0.007)	-0.001 (0.007)	0.006 (0.014)	0.003 (0.014)	-0.007 (0.010)	-0.007 (0.010)
L1lnProd	-0.001 (0.010)	-0.001 (0.010)	-0.014 (0.010)	-0.014 (0.010)	0.010 (0.012)	0.009 (0.012)	0.007 (0.011)	0.007 (0.011)
L1FRGN	0.121*** (0.027)	0.121*** (0.027)	0.049 (0.051)	0.048 (0.051)	0.047 (0.033)	0.040 (0.033)	-0.032 (0.036)	-0.032 (0.036)
Small	-0.088 (0.057)	-0.089 (0.057)	-0.082* (0.047)	-0.082* (0.047)	-0.168** (0.077)	-0.143* (0.076)	-0.075 (0.049)	-0.068 (0.050)
Large	0.070* (0.037)	0.071* (0.037)	0.032 (0.026)	0.032 (0.026)	0.063 (0.043)	0.060 (0.044)	0.037 (0.029)	0.036 (0.029)
Vlarge	0.152*** (0.039)	0.153*** (0.039)	0.082*** (0.029)	0.083*** (0.029)	0.180*** (0.055)	0.174*** (0.055)	0.100*** (0.036)	0.099*** (0.036)
L1EXP	0.083*** (0.025)	0.084*** (0.026)	0.055** (0.022)	0.055** (0.022)	0.092*** (0.032)	0.089*** (0.032)	0.041* (0.022)	0.040* (0.022)
L1IMP		-0.009 (0.027)		-0.005 (0.020)		0.078** (0.037)		0.023 (0.024)
share_dloc_fix_EXP	0.517*** (0.057)	0.519*** (0.058)	0.285*** (0.048)	0.285*** (0.048)	0.554*** (0.088)	0.552*** (0.087)	0.333*** (0.075)	0.333*** (0.075)
EXP_0			0.137*** (0.016)	0.136*** (0.017)			0.188*** (0.016)	0.187*** (0.016)
Number of observations	884	884	881	881	790	790	786	786

note: *** p<0.01, ** p<0.05, * p<0.1

Table 7.7: Random Effect Probit Estimation Results – Marginal Effect: Electronics Components and Consumer Electronics Subsectors, 2001-2007

	Electronics Component				Consumer Electronics			
	Post Crisis - Probit		Post Crisis - Wooldridge		Post Crisis - Probit		Post Crisis - Wooldridge	
	Exporter	Exporter and Importer	Exporter	Exporter and Importer	Exporter	Exporter and Importer	Exporter	Exporter and Importer
L1lnAge	0.036 (0.023)	0.034 (0.023)	-0.022 (0.051)	-0.013 (0.049)	0.009 (0.015)	0.009 (0.015)	0.014 (0.023)	0.014 (0.023)
L1lnRWages	0.002 (0.017)	0.005 (0.017)	0.009 (0.018)	0.012 (0.017)	0.024* (0.014)	0.024* (0.014)	0.027* (0.014)	0.027* (0.014)
L1lnProd	0.022 (0.019)	0.022 (0.018)	0.008 (0.031)	0.003 (0.030)	0.007 (0.011)	0.007 (0.012)	-0.011 (0.014)	-0.011 (0.014)
L1FRGN	0.044 (0.058)	0.053 (0.058)	0.009 (0.108)	0.000 (0.105)	0.004 (0.033)	0.005 (0.033)	-0.001 (0.053)	0.001 (0.053)
Small	0.152* (0.087)	0.136 (0.087)	0.158* (0.088)	0.135 (0.088)	-0.132* (0.073)	-0.132* (0.073)	-0.107 (0.073)	-0.107 (0.073)
Large	0.204*** (0.077)	0.198** (0.077)	0.206** (0.082)	0.192** (0.081)	0.045 (0.045)	0.045 (0.045)	0.038 (0.046)	0.038 (0.046)
Vlarge	0.217*** (0.076)	0.212*** (0.075)	0.200** (0.080)	0.189** (0.079)	0.092* (0.050)	0.093* (0.050)	0.086 (0.052)	0.086 (0.052)
L1EXP	0.125** (0.052)	0.140** (0.054)	0.115* (0.066)	0.125* (0.067)	-0.004 (0.028)	-0.004 (0.028)	-0.041 (0.028)	-0.041 (0.028)
L1IMP		-0.074 (0.065)		-0.088 (0.068)		-0.007 (0.031)		-0.007 (0.031)
share_dloc_fix_EXP	0.535*** (0.143)	0.543*** (0.145)	0.486*** (0.145)	0.483*** (0.146)	0.575*** (0.087)	0.575*** (0.087)	0.606*** (0.088)	0.606*** (0.088)
EXP_0			-0.003 (0.065)	0.010 (0.065)			0.116*** (0.039)	0.116*** (0.039)
Number of observations	258	258	255	255	662	662	656	656

note: *** p<0.01, ** p<0.05, * p<0.1

In the Wooldridge model, the coefficient for the initial status is not significant and the other coefficients do not change. This result may be caused by the fact that many firms were established after the crisis, so there is no initial condition problem.

Consumer Electronics Subsector

The probability to export in the consumer electronics subsector depends on labour quality, firm size, and locational spillover. Labour quality, which is measured by the real wages, has a positive impact on the probability to export. This result implies higher competition in the world market of consumer electronics parts and components. Previously, labour quality did not affect a firm's decision to export. However, after the crisis, only firms with higher labour quality can export their products. Moreover, this result also implies that consumer electronics in Indonesia have changed their production mode from simple assembly to more complicated ones which required higher-skilled labour.

Firm size is still an important determinant after the crisis. Economies of scale became more important and being a small firm decreases the probability to export by 14 percent, and being a very large firm increases the probability to export by 13 percent.

Unlike other results, the export and import sunk costs do not significantly affect the decision to export, which implies that for a firm in the consumer electronics subsector, any cost related to entering the export and import market does not increase the probability to export in the following period. This is because the main game for this subsector is the local market. Meanwhile, being in the same location with other exporters increases the probability to export by 55 percent. After controlling for the initial status in the Wooldridge model, labour productivity is still significant which implies that this variable affects the decision to export regardless of the initial export status.

It can be concluded from the above discussion that following the crisis period there was a change in the determinant of a firm's decision to export. Changes in the structure of each subsector as well as change in the export market influenced the change in determinants. Foreign ownership is no longer important in the export decision for both subsectors. Labour quality becomes an important determinant for a consumer electronics firm to export. Other factors such as firm size, sunk cost and location spillover still affect a firm's decision.

7.4 Insights from the Firm Survey

To supplement other findings, fieldwork was undertaken and interviews were conducted with six electronics firms in the Greater Jakarta area. The respondents were selected from the list provided by the Indonesian Association of Electronics and Electrical Goods Producer

(*Gabungan Perusahaan Industri Elekronika dan Alat-alat Listrik Rumah Tangga Indonesia – GB Elektronika*). Interviews were conducted with managers of these firms using a semi structured interview to ensure consistency of questions and increase the reliability and credibility of the research data.

Although many electronics firms, especially electronics components firms, are in Batam Island, because of the funding limitation for fieldwork interviews were only conducted in the Greater Jakarta Area which includes Jakarta, Cikarang and Cibitung (east of Jakarta). Since only 20 percent of total electronics firms are located in the Greater Jakarta area, this sample cannot represent a general picture of the Indonesian electronics sector. The selection of the firms to be interviewed was not based on the random sample but on the availability of the firm management. Fortunately, the six interviewed firms capture both electronics component and consumer electronics firms. Appendix 7.4 lists major features of the firms.

Based on ownership, three of the interviewed firms are 100 percent foreign owned (one is 100 percent Japanese owned, one 100 percent Korean owned and another 33 percent Japanese and 67 percent Singaporean owned), and the rest are joint venture with majority (more than 90 percent) Japanese ownership. This structure of ownership in this survey sample reflects a high dependence of the Indonesian electronics firm on the Japanese technology. However, this is not the general case. Japanese domination in the electronics products is not that strong and it cannot be concluded that electronics sector is dominated by Japan. Unfortunately, *SI* does not provide information on the country of FDI.

Location of the interviewed firm is highly correlated with the date of establishment. One firm established in the 1960s is located in Cakung, Jakarta, which is the nearest industrial area from the biggest port, Tanjung Priok. Other firms which were established in the 1990s are located in Cibitung and Cikarang, the industrial estates established by joint-ventures between Indonesia, Japan and Korea. Although the location is quite far from Tanjung Priok port, these industrial estates offer better infrastructure and security to tenants. To avoid the bad traffic jams to and from the port, they usually arrange deliveries either for early in the morning or late at night. The government has recently built a separate exit from the toll road to these industrial estates and plans to provide a special toll road from Tanjung Priok port.

Four of six interviewed firms are consumer electronics firms and the other two are electronics components firms. The main products of the interviewed firms vary from household appliances (TV LCD sets, refrigerators, washing machines), electronics ballast, lighting fixtures, wiring devices, relays and switches and components (Surface Mount Technology - SMT, Auto Insert and Printed Circuit Board - PCB).

All the interviewed firms are subsidiaries of Japanese and Korean electronics firms. The purpose of their establishment in Indonesia was to serve both the domestic and export markets. Only one interviewed firm sells all output in the domestic market, as inputs to a big Japanese consumer electronics firm which is located in the same industrial estate. This Japanese consumer electronics export its products therefore the interviewed firm can be regarded as a 2nd tier that export indirectly. The rest of the interviewed firms sell their output in the export market. The export share varies between 70 – 100 percent. Electronics parts and components are more standardized compared to auto parts, therefore one of the interviewed firms exports 100 percent of its output to several principals while another exports 100 percent of its output to several firms within its group. The export destinations vary among the interviewed firms. One of them exports to Japan, Malaysia, Australia and the Middle East, while another firm export to the Asia Pacific (45 percent), Europe (30 percent) and the US (25 percent).

As previously discussed, the share of imported input in the electronics sector is high. The share of imported input by the interviewed firms varies between 30 – 100 percent of total input. One of the interviewed firms revealed that 100 percent of its raw materials were imported from China, and only packaging materials were sourced domestically. Another firm imports 60 percent of its input from within its group and the rest is sourced locally from Japanese companies located in Indonesia. One firm explained that they do not directly contact the supplier of their raw materials but use Singapore as a hub. Most of the raw materials are imported from China, and Japan, while parts and components are imported from China, Taiwan and Hong Kong. For one of the interviewed firms, all inputs are sourced domestically from both purely domestic firms or foreign firms located in Indonesia. One reason to source from foreign firms located in Indonesia rather than import directly is because it is cheaper and more reliable in terms of timing and firms do not have to deal with importation procedures. The high imported input share of these interviewed firms confirmed the weak state of the domestic support industry to serve the electronics sector.

One purpose of the interview was to verify the estimation results on factors affecting participation in the global production networks. From the macro-economic estimation, factors affecting a country's participation in the electronics global production networks are labour cost (as a proxy of labour quality), exchange rates, infrastructure condition, trade openness and FDI policies. Five of the interviewed firms confirmed that government regulations often hampered their operations. One example is the tax refund issue. Although a firm can request a tax refund, the process take 2 – 3 years and on average only 80 percent of the tax refund is received by the firm. This made the firm reluctant to request for a tax refund. Another example is on the luxury taxes imposed on electronics products which decrease domestic demand for electronics goods.

Labour conditions were also mentioned as one problem faced by firms. There is a lack of trained and skilled labour in the market, and firms must conduct their own in-house training to equip newly hired employees with the necessary skills. One human resource manager said it usually takes 3 months for new employee to master the necessary skills and there are no guarantees that these skilled workers will stay with the same firms. Because of the limited trained and skilled labour, there are frequent "employee-hijack" incidences amongst firms located in the same industrial estate. This situation makes training costs for new employee relatively costly for the firm. The current labour law which makes it more difficult for firms to hire and fire permanent workers encourages them to hire contract workers instead of permanent workers. From the interviewed firms, the proportion of contract workers varies between 30 – 70 percent of total employees.

FDI policy is not an issue for the interviewed firms. However this answer may be biased because of sample selection bias. The interviewed firms are the firms that already invested in Indonesia that still exist. The ideal approach would be to interview firms who decided not to locate in Indonesia or who left. If the interviews had been conducted with potential firms or with firms that had decided not invest in Indonesia, the answers might have been different.

Infrastructure condition is major problem faced by the interviewed firms. This includes electricity provision and traffic. One firm not located in the industrial estate raised electricity provision as a major issue. This is because right before the interview was conducted (early 2010), there were frequent blackouts in the Greater Jakarta area without any prior warning. For the interviewed firms located in the private industrial estate, electricity supply is not a problem because it is supplied by private generators provided by the industrial estate. Although they have to spend more on electricity compared to the firms located outside the industrial estates, certainty of electricity provision was preferred.

The interviewed firms consider the lack of adequate roads to be such an intractable problem that they have been forced to incorporate traffic jam delays into their delivery lag times. This clearly lowers their competitiveness due to the inflexibility caused by the inability to make or receive deliveries outside of either very early morning or very late night hours in order to avoid traffic. The government has recently opened a new exit from a toll road dedicated to one of the industrial estates (Cikarang) and there is a plan to build a dedicated toll road connecting this industrial estate to Tanjung Priok port. However, the plan is not yet been implemented.

With a better economic condition both in Indonesia and internationally, three of the interviewed firms have plans to expand their production capacity. This new production capacity will be dedicated to serve both domestic and export markets.

The main challenge faced by the interviewed firms is competition both in the domestic and export markets. China was considered a main competitor especially in term of the quality of products. In addition, the domestic competition from firms producing the same products was also intense. Another challenge was frequent changes in government regulations that confuse not only the firms but also government officials in the field. For an example is the implementing regulation of 2007 Investment Law which has several interpretation and there is no consistency of this interpretation.

In order to improve networking, one of the interviewed firms revealed that they depend on the parent company to connect them with other firms within the group. Another interviewed firm had begun to develop a network with other TV producers in Indonesia.

It can be concluded from the semi-structured interviews with 6 electronics firms in the Greater Jakarta Area that the results from the macro-economic and firm-level analysis were confirmed. Labour conditions and infrastructure provision are important determinants in their competitiveness which in turn affects their participation in the electronics global production networks. The high import share and low export share of the interviewed firms is consistent with the low competitiveness of Indonesia's parts and components electronics industry which cannot even fully support the domestic electronics sector let alone compete in the international market.

7.5 Concluding Remarks

The electronics sector in Indonesia is lagging behind other Asian countries because of the late starter of this sector which only began in 1970s with a simple assembly process. The government's efforts to develop the sector have not been successful.

The export share of the electronics sector is low. Only 30 percent of firms export any of their products. On the other hand, the import share is high with more than 50 percent of input in the electronics component subsector imported. Firms exporting in the electronics sector are younger, larger and better (high value added and output, higher labour productivity and labour quality).

The results from the firm level analysis conducted to determine factors affecting a firm's decision to export show a change in determinants in the pre and post crisis period. In the pre crisis period, foreign ownership, firm size, sunk cost and locational spillover increased the probability to export. In contrast, labour quality, firm size, sunk cost and locational spillover increase the probability to export in the post crisis period. This change in determinant is a result of both domestic and international factors.

The structure in the electronics sector contributed to this change. After the crisis, the performance gap between foreign and domestic firms became smaller. Therefore both foreign and domestic firms had the same probability to export. The narrow gap may have been a result of technology spillover from foreign firms to domestic firms or because the good foreign firms left Indonesia after the crisis. Moreover, only firms with higher labour quality can export which means that consumer electronics in Indonesia had changed their production mode from a simple assembly to a more complicated ones which requires higher-skilled labour. Existing studies have showed that there is an evidence of spillover from foreign firms.

The international factor that influenced the change in determinants is the higher competition in the export market which translated into higher skilled labour requirements. With many different niches in the international networks, the labour issues could mean that Indonesia is still competitive at the lower if the other factors are supportive. However lower labour quality in Indonesia is not accompanied by lower wages therefore it made Indonesia less competitive.

A survey conducted with several firms in the Greater Jakarta area confirms both the macroeconomic and firm-level analysis. High import dependence and low export share are the characteristics of the electronics sector in Indonesia. Based on their experience, the bad infrastructure condition, low quality of labour and increased competition are the challenges facing their participation in the global production networks.

The low competitiveness of the parts and components electronics industry in Indonesia that cannot fully support the domestic electronics sector let alone compete in the international market is the main explanation of Indonesia has been left behind in the electronics production networks.

Appendix

Appendix 7.1: Map of Indonesia

Source: http://panpa.org.au/wp-content/uploads/2011/02/indonesia-map.gif

Appendix 7.2: Random Effect Probit Estimation – Marginal Effect: Electronics Components and Consumer Electronics Subsectors, All Period, 1990 – 2001

	Electronics Component				Consumer Electronics			
	All Period - Probit		All Period - Wooldridge		All Period - Probit		All Period - Wooldridge	
	Exporter	Exporter and Importer	Exporter	Exporter and Importer	Exporter	Exporter and Importer	Exporter	Exporter and Importer
L1lnAge	-0.005	-0.005	-0.005	-0.005	0.015	0.017*	0.018	0.020
	(0.009)	(0.009)	0.014	0.014	(0.009)	(0.009)	(0.013)	(0.014)
L1lnRWages	0.007	0.008	(0.003)	(0.004)	0.009	0.007	0.005	0.003
	(0.007)	(0.007)	0.007	0.007	(0.007)	(0.007)	(0.007)	(0.007)
L1lnProd	0.015**	0.015**	(0.004)	(0.005)	0.006	0.005	-0.006	-0.006
	(0.007)	(0.007)	0.009	0.009	(0.007)	(0.007)	(0.008)	(0.008)
L1FRGN	0.081***	0.084***	(0.027)	(0.026)	0.024	0.021	0.008	0.005
	(0.022)	(0.022)	0.046	0.046	(0.020)	(0.020)	(0.030)	(0.030)
Small	-0.045	-0.047	(-0.029)	(-0.031)	-0.099***	-0.095**	-0.072**	-0.069*
	(0.034)	(0.034)	0.035	0.034	(0.038)	(0.038)	(0.036)	(0.036)
Large	0.077***	0.078***	(0.074)	(0.075)	0.050**	0.048**	0.041*	0.040*
	(0.025)	(0.025)	0.025***	0.025***	(0.024)	(0.024)	(0.023)	(0.023)
Vlarge	0.132***	0.133***	(0.112)	(0.113)	0.124***	0.122***	0.105***	0.104***
	(0.027)	(0.027)	0.027***	0.027***	(0.028)	(0.028)	(0.027)	(0.027)
L1EXP	0.051***	0.053***	(0.028)	(0.030)	0.028*	0.028*	0.002	0.002
	(0.019)	(0.019)	0.019	0.019	(0.017)	(0.017)	(0.016)	(0.016)
L1IMP		-0.020		(-0.027)		0.030		0.025
		(0.023)		0.023		(0.019)		(0.019)
share_dloc_fix_EXP	0.580***	0.582***	(0.485)	(0.485)	0.531***	0.529***	0.491***	0.490***
	(0.036)	(0.036)	0.042***	0.042***	(0.049)	(0.048)	(0.048)	(0.048)
EXP_0			(0.107)	(0.107)			0.149***	0.148***
			0.024***	0.024***			(0.021)	(0.021)
Number of observations	1,786	1,786	1,696	1,696	1,898	1,898	1,852	1,852

note: *** p<0.01, ** p<0.05, * p<0.1

Appendix 7.3: Random Effect Probit Estimation – Marginal Effect: Electronics Components and Consumer Electronics Subsectors, Crisis Period, 1997 – 2000

	Electronics Component				Consumer Electronics			
	Crisis - Probit		Crisis - Wooldridge		Crisis - Probit		Crisis - Wooldridge	
	Exporter	Exporter and Importer	Exporter	Exporter and Importer	Exporter	Exporter and Importer	Exporter	Exporter and Importer
L1lnAge	-0.011	-0.011	-0.036	-0.036	0.035**	0.036**	coef/se	coef/se
	(0.013)	(0.014)	0.027	0.027	(0.015)	(0.015)	0.065**	0.066**
L1lnRWages	-0.008	-0.009	(-0.010)	(-0.011)	-0.010	-0.012	(0.031)	(0.031)
	(0.013)	(0.013)	0.015	0.015	(0.013)	(0.013)	-0.008	-0.011
L1lnProd	0.030***	0.029***	(0.028)	(0.027)	0.011	0.011	(0.014)	(0.015)
	(0.011)	(0.011)	0.018	0.019	(0.011)	(0.011)	-0.008	-0.007
L1FRGN	0.033	0.025	(0.024)	(0.017)	0.004	0.002	(0.015)	(0.015)
	(0.035)	(0.036)	0.104	0.105	(0.031)	(0.031)	0.001	-0.002
Small	-0.145**	-0.144**	(-0.121)	(-0.124)	0.031	0.034	(0.060)	(0.060)
	(0.062)	(0.062)	0.069*	0.070*	(0.054)	(0.055)	0.045	0.047
Large	0.003	-0.001	(0.017)	(0.010)	0.089*	0.087*	(0.055)	(0.056)
	(0.044)	(0.044)	0.050	0.050	(0.046)	(0.046)	0.088*	0.088*
Vlarge	0.102**	0.096**	(0.098)	(0.090)	0.124**	0.123**	(0.046)	(0.047)
	(0.047)	(0.048)	0.056*	0.056	(0.052)	(0.052)	0.097*	0.098*
L1EXP	0.078**	0.076**	(0.058)	(0.055)	0.055*	0.051*	(0.055)	(0.055)
	(0.032)	(0.032)	0.037	0.037	(0.031)	(0.031)	0.060*	0.058*
L1IMP		0.050		(0.059)		0.026	(0.034)	(0.034)
		(0.048)		0.053		(0.033)		0.025
share_dloc_fix_EXP	0.546***	0.542***	(0.497)	(0.492)	0.425***	0.426***		(0.034)
	(0.061)	(0.062)	0.082***	0.083***	(0.078)	(0.078)	0.385***	0.386***
EXP_0			(0.036)	(0.035)			(0.083)	(0.083)
			0.043	0.043			0.032	0.030
Number of observations	644	644	560	560	443	443	410	410

note: *** p<0.01, ** p<0.05, * p<0.1

Appendix 7.4: Major Features of Interviewed Firms (listing according to the date of interview)

No	Location	Status	Establishment date	Number of workers	Main products	Sub-sector	Position in network
Firm E1	Cibitung	Japan: 100%	1989	871	Alkaline Battery	Consumer Electronics	P&C producer
Firm E2	Cikarang	Japan: 33% Singapore: 67%	1995	750	TV LCD and spare parts	Consumer Electronics	Assembler
Firm E3	Cikarang	Joint Venture	1992	800	Electronics ballast (62%) Lighting fixture (16%) Wiring devices (22%): for domestic	Consumer Electronics	P&C producer Assembler
Firm E4	Cikarang	JV: Japan: 99%, Indonesia: 1%	1992	1,881	Relays (60%) Switch (40%)	Electronics Component	Assembler
Firm E5	Cakung	JV: Japan: 93%, Indonesia: 7%	1968	3,000	CTV Refrigerator Washing Machine (twin tubes)	Consumer Electronics	Assembler of final goods
Firm E6	Cibitung	100% Korea	1999	400	SMT Auto Insert PCB	Electronics Component	Assembler of parts and components

Chapter 8: Case Study: The Automotive Sector

8.1 Introduction

This chapter provides a case study of the Indonesian automotive sector as another example of Indonesian involvement in a global production network. Based on the estimation results in Chapter 6, the Indonesian automotive sector is lagging behind other Asian countries especially compared to Thailand.

The automotive sector is considered a vital ingredient in national economic development strategies, hence government intervention in the automotive sector is quite intense and often perverse. This affects development of the sector and, in turn, affects Indonesia's position in regional automotive production networks.

Since participation in the network is conducted through export and import of auto parts therefore it is necessary to analyse a firm's heterogeneity and its implication for international trade. For this purpose, a firm-level analysis is conducted to determine factors affecting the decision to export. To confirm the findings from the macroeconomic analysis in Chapter 6, and the firm-level analysis in this chapter, fieldwork was conducted in Indonesia in order to obtain first hand information from automotive firms on the factors that affect their participation.

This chapter is organized as follows. The first section discusses the automotive production networks in Indonesia. The second section provides an analysis of the determinants of firm participation. The third section provides a snapshot of the Indonesian automotive sector based on the fieldwork results, and the last section concludes.

8.2 Automotive Production Networks in Indonesia

The automotive sector in Indonesia has been established since 1927, but was mainly for trading activities since assembly activities were very limited and the import of cars was not regulated. Rapid development of assembly activities started in the early 1970s because of the oil boom. Automobile assembly production fluctuated over time with an increasing trend (Table 8.1) from around 22 thousand units in 1972 and increasing sharply in 1981 to 212 thousand units and reaching 702 thousand units in 2010. Big slumps occurred several times due to significant events. The most notable was 1998 when financial crises hit Indonesia badly and the production level dropped to 58 thousand units which was almost the same as the 1972 level (Tarmidi, 2004). Another dip took place in 2006 with the production of 296 thousand units although the growth of transportation and machinery equipment was the largest contributor for the non oil manufacturing sector in GDP in 2006. This sharp reduction was caused by the adverse impact of the steep rise in domestic fuel prices. The last sharp production decline was in 2009 following the global financial crisis. In 2009, car assembling plants only operated at 53.5 percent of their capacity (ICN, 2010).

Table 8.1: Production of Automobiles, 1972 – 2011*

Year	Production	Annual Growth (%)
1972	22,118	
1981	212,669	29
1985	139,438	-10
1990	271,712	14
1992	172,234	-20
1995	387,541	31
1998	58,079	-47
2000	292,710	124
2001	279,187	-5
2005	500,710	16
2006	296,008	-41
2008	600,628	42
2009	464,816	-23
2010	702,508	51
2011	837,948	19

Source: Tarmidi (2004) and GAIKINDO data
*Notes: *: Passenger and commercial cars*

The automotive market in Indonesia is categorized into passenger and commercial cars. It consists of sedan, passenger car (4X2 and 4X4 types), bus, pick up/truck and double cabin.[26] As shown in Table 8.2, in 2009 more than 90 percent of domestic market share was held by Japanese car makers (Toyota, Daihatsu, Mitsubishi, Suzuki, Honda, Nissan, Isuzu, and Hino). Based on GAIKINDO (Association of Indonesia Automotive Industries) data in 2010, there are 22 car manufacturing firms in Indonesia and 17 car trading companies (as sole agent and distributors). From the 22 car manufacturers, 14 are manufacturers for Japanese cars and the rest are for Chinese, Korean and European cars. Toyota has the largest market share and it was the largest car producer in Indonesia from 1991 – 2011. Other car makers are relatively small players in the Indonesian automotive sector. Unfortunately GAIKINDO has discontinued publishing data on domestic market by brands since 2010.

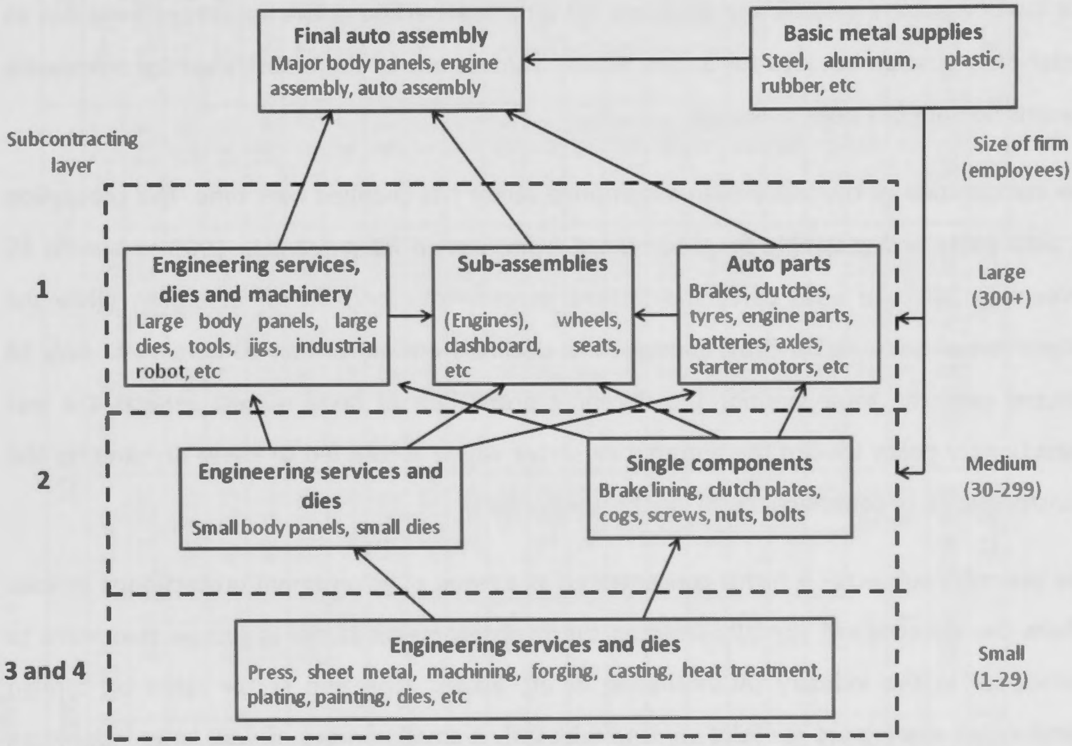
The automotive sector in Indonesia can be categorized into 3 groups, namely (i) auto parts, (ii) assembly, and (iii) body maker. The body maker firm established as a result of distortionary policy which favours commercial vehicles by the imposition of lower import duties on their components and lower value-added taxes on assembled commercial vehicles (Aswicahyono, *et*

[26] 4X2 type is two-wheel drive and 4X4 is four-wheel drive cars.

al., 2000). These body maker firms convert commercial vehicles, especially small category I vehicles (minibuses and vans) into passenger cars in the form of minivans (Thee, 2005a).

Dicken (2003) classified the auto parts industry based on their position in the value chain as depicted in Figure 8.1. Tier 1 suppliers supply directly to the car assemblers; Tier 2 suppliers supply the Tier 1 firms; and Tier 3 supplier supplies Tier 2 firms.

Figure 8.1: Functional Tiers in Automotive Sector



Source: Dicken, 2003

Automotive assembling is dominated by passenger cars and trucks. Almost 98 percent of domestic production is 4X2 type passenger cars and trucks (as shown in Appendix 8.1). The largest car producer in Indonesia, Toyota, has two companies in Indonesia: PT Toyota Motor Manufacturing Indonesia (TMMIN) and PT Astra Daihatsu Motor (ADM) which produce four models of cars: Innova, Fortuner, Dyna and Avanza, with total production of 189 thousand units in 2010 (Toyota, 2010). Avanza model is produced by both companies while the other models are produced by PT TMMIN. While most of the production is for the domestic market, the Innova and Avanza are also for the export market since Indonesia is a production base for Innova and Avanza for the Asian market.

Import of CBU cars is relatively small because of the high import tariff, at around 30 thousand units during 2005 – 2009 with a sharp increase in 2007 and 2008 reaching 55 thousand units and 72 thousand units respectively because of the better economic condition where domestic market increased to 433,341 and 603,774 respectively.

Composition of Automotive Sector

As shown in Table 8.3, the number of firms in the automotive sector continued to increase from 1990 to 2007 except for 1998 and 2005 when there were 8 and 11 percent decline in the number of firms respectively. The 1998 decline was due to the financial crisis which hit Indonesia very badly and resulted in 30 percent decrease in the number of body maker firms. The lower numbers in 2001 and 2005 are not an actual decline in the number of firms but an under-enumeration because for Batam Island, which is one of the industry yet for unknowing reasons no data has been collected.

The composition of the Indonesian automotive sector has changed over time. The proportion of auto parts and assembly firms increased from around 60 percent in 1990 to almost 80 percent in 2007 for auto parts and from 3 percent to 7 percent for assembly, while the proportion of body maker firms continued to decline from more than 30 percent to only 14 percent over the same period. The declining proportion of body makers reflects the less distortionary policy toward the automotive sector which in turn led to lower demand for the transformation of commercial cars into passenger cars.

The assembly subsector is highly concentrated as a result of government protectionist policies where the government virtually selected the major domestic business groups that were to participate in the industry (Aswicahyono et al., 2000). This sub sector relies on foreign partners; all assemblers are joint-venture with only a small number of very large Indonesian firms. Almost all assemblers are owned by one of the three largest automobile enterprises in Indonesia: Astra, Indomobil and Krama Yudha. The auto parts firms are less concentrated, because in general they are more labour intensive and less dominated by the large firms. Some of these firms are not owned by the large automotive companies. Because of the lower barriers to entry and in response to rising domestic demand for cars (this will increase future demand for auto parts for car production and replacement), the auto parts industry grew rapidly over the past two decades.

Table 8.2: Indonesia: Domestic Market Share (MS) by Brand, 2001 – 2009

No	Brand	2001		2005		2006		2007		2008		2009	
		Unit	MS (%)	Unit	MS (%)	Unit	MS (%)	Unit	MS (%)	Unit	MS (%)	Unit	MS (%)
1	Toyota	80,069	26.7	182,765	34.2	123,703	38.8	150,631	34.8	211,909	35.1	186,687	38.6
2	Daihatsu	20,592	6.9	48,762	9.1	33,021	10.4	51,957	12.0	78,041	12.9	77,513	16.0
3	Mitsubishi	66,104	22.1	89,158	16.7	47,023	14.7	61,547	14.2	87,524	14.5	61,735	12.8
4	Suzuki	53,187	17.8	87,274	16.3	44,760	14.0	58,095	13.4	73,067	12.1	44,689	9.2
5	Honda	11,510	3.8	53,750	10.1	30,000	9.4	40,000	9.2	52,500	8.7	39,570	8.2
6	Nissan	4,015	1.3	10,551	2.0	4,006	1.3	19,030	4.4	31,879	5.3	21,440	4.4
7	Isuzu	31,290	10.4	25,010	4.7	16,605	5.2	18,270	4.2	25,325	4.2	15,236	3.2
8	Hino	3,035	1.0	6,145	1.2	4,193	1.3	8,224	1.9	14,227	2.4	11,390	2.4
9	Ford	54	0.0	5,727	1.1	3,515	1.1	6,405	1.5	7,999	1.3	6,348	1.3
10	Mercedez Benz	3,006	1.0	2,443	0.5	914	0.3	2,022	0.5	2,872	0.5	3,450	0.7
11	KIA	6,534	2.2	8,668	1.6	3,852	1.2	4,039	0.9	3,880	0.6	3,195	0.7
12	Hyundai (PC)	8,854	3.0	6,391	1.2	3,003	0.9	4,020	0.9	3,800	0.6	2,667	0.6
13	Chevrolet	531	0.2	2,085	0.4	825	0.3	1,396	0.3	2,657	0.4	2,612	0.5
14	Mazda	243	0.1	652	0.1	203	0.1	1,336	0.3	2,241	0.4	1,542	0.3
15	UD Nissan Diesel	3,924	1.3	1,867	0.3	1,380	0.4	2,115	0.5	2,391	0.4	1,298	0.3
16	BMW	2,830	0.9	1,257	0.2	600	0.2	1,000	0.2	720	0.1	901	0.2
17	Peugeot	1,886	0.6	486	0.1	118	0.0	85	0.0	59	0.0	44	0.0
18	Volvo	131	0.0	143	0.0	69	0.0	60	0.0	62	0.0	25	0.0
19	Timor	2,091	0.7	239	0.0	170	0.1	242	0.1	4	0.0	-	-
20	Others	1,197	0.4	544	0.1	944	0.3	2,867	0.7	2,617	0.4	3,206	0.7
	Domestic Market	**299,573**	**100.0**	**533,917**	**100.0**	**318,904**	**100.0**	**433,341**	**100.0**	**603,774**	**100.0**	**483,548**	**100.0**
	Import	**N/A**		**31,760**		**33,663**		**55,112**		**72,646**		**32,678**	

Source: GAIKINDO

Table 8.3: Composition of Automotive Sector, 1990 – 2007

Year	All Automotive			Auto Parts			Assembly			Body Maker		
	No. of Firms	Real VA (2000 Rp. million)	Average No. Of Employ-ment	No. of Firms	Real VA (2000 Rp. million)	Average No. Of Employ-ment	No. of Firms	Real VA (2000 Rp. million)	Average No. Of Employ-ment	No. of Firms	Real VA (2000 Rp. million)	Average No. Of Employ-ment
1990	285	26,154	235	174	34,078	264	9	136,434	843	102	2,907	131
1991	283	25,805	275	171	22,701	321	8	357,688	1,044	104	5,379	141
1992	308	33,049	244	190	31,922	265	8	451,728	1,021	110	4,545	151
1993	324	43,581	221	198	51,413	259	7	499,211	826	119	3,748	121
1994	337	65,344	269	215	72,401	309	8	737,781	1,032	114	4,845	141
1995	366	58,934	292	240	61,156	322	8	799,236	1,527	118	4,225	146
1996	397	57,537	274	263	69,129	300	11	372,450	1,165	123	4,589	139
1997	407	27,700	259	293	25,950	269	13	274,012	1,109	101	3,477	120
1998	374	40,619	238	291	47,523	261	13	85,720	485	70	3,540	98
1999	377	50,868	243	287	62,785	266	12	79,566	626	78	2,602	98
2000	375	76,410	282	290	66,063	257	22	424,921	1,130	63	2,340	100
2001*	361	56,988	287	278	55,978	315	17	268,530	387	66	6,753	141
2002	408	72,827	282	315	20,088	260	27	859,313	877	66	2,794	140
2003	408	70,697	312	311	23,027	283	29	738,683	1,029	68	3,840	137
2004	418	79,656	313	319	26,982	279	36	679,829	918	63	3,418	140
2005*	373	99,202	338	285	25,328	293	31	952,582	1,106	57	4,453	146
2006	583	62,429	268	459	23,044	247	41	623,120	802	83	3,267	121
2007	549	70,611	297	431	27,435	258	40	666,856	1,053	78	3,418	125

Source: Statistik Industri

Notes:: Incomplete database because of under-enumeration, Batam is not included*

- *Deflator: WPI (2000)*
- *Auto Parts: SITC 251 + 261 + 289 + 291 +311 + 314 + 315 +319 + 323 + 333 + 343 + 359 + 361*
- *Assembly: SITC 341*
- *Body Maker: SITC 342*

Assembly subsector has the highest real value added and the highest average number of employment. This is consistent with the characteristics of assembly subsector which is very labour intensive. On the other hand, body maker subsector has the lowest real value added and average number of employment because most of firms in this subsector are small domestic firms.

Characteristics of Automotive Sector

Table 8.4 presents the characteristics of each subsector for the three periods: pre crisis (1990 – 1996), crisis (1997 – 2000) and post crisis (2001-2005) periods. The share of exported output for the automotive sector is low with the average of export share less than 7 percent for all subsectors and all periods. This is because most of the assembled cars are destined for the domestic market. The export share increased slightly during the crisis period due to the sharp depreciation of the rupiah and collapse in domestic demand and firms were able to switch their sales from the domestic market to the export market.

The auto-parts subsector has the largest export shares compared to other subsectors because some of these firms are affiliated with foreign principals which have a global procurement system which controls procurements among the affiliated firms and this subsector is less distorted sector. Auto parts firms that do not have foreign affiliation find it more difficult to export their products not only because they do not have any international networks but also because of the low quality of their products which cannot fulfil the strict specifications required by the foreign car makers.

The automotive sector in general depends heavily on the imported inputs. The average import share is around 20-35 percent with the highest import share in the assembly subsector. The share of imported input has increased over time and with a slight decrease after the financial crisis except for the assembly subsector. The body maker subsector has the lowest import share (less than 5 percent) because main activity is to convert commercial vehicles into passenger cars and so it does not need many imported inputs.

The assembly subsector has the highest import share owing to a less qualified domestic auto parts industry to fulfil strict requirements set by car makers. The share increased substantially after the financial crisis from only 22 percent prior to 2001 to almost 35 percent. This increase was caused by an increase in domestic demand for cars after the crisis because the better economic conditions in Indonesia as well as more liberalized automotive sector as a result of the IMF structural adjustment program. However, the import share of auto parts firms declined in the post crisis period. This reflects the localization policies adopted by car makers requiring their suppliers to procure components domestically as much as possible to repress production costs. It also reflects improvement in the domestic sub components industry to fulfil the strict requirements set by the car makers.

The import share figures may under-estimate the actual participation of firms in the global production networks because some small firms do not import their inputs directly but procure them from foreign firms or trading firms located in Indonesia. This is because it is cheaper for them to procure inputs locally rather than import because of the quantity factor. This condition is not reflected in the imported input data since it is reported as domestic input by firms.

As mentioned, the automotive sector depends heavily on foreign ownership, especially in the assembly subsector. The removal of ownership restrictions for foreign investment in Indonesia in 2004 is reflected in the higher foreign ownership share in the automotive sector. A substantial increase in foreign ownership took place in the auto parts subsector after 1997 when the average foreign ownership increased from less than 9 percent in 1996 to almost 13 percent in 1998 and reaching 21 percent in 2007. Foreign ownership increased in the assembly subsector, from around 11 percent in 1990 to 31 percent in 2007, and it experienced the highest increase in 2000 (increasing from 24 percent to 35 percent).

Based on the literature on Multi National Corporation (MNC), MNCs are more productive than local companies because they have managerial advantages such as the intangible assets related to technological knowledge in production and marketing as well as managerial know-how (Dunning 1988; Caves 1996; Markusen 1991). Since this is a feature of the auto industry globally, therefore Indonesia's automotive sector also has this feature. Firms in the assembly subsector are dominated by MNCs and have higher real wages, higher labour productivity and higher labour quality compared to other subsectors. Real wages (nominal wages deflated by the consumer price index - CPI) in the assembly subsector are higher than any other subsectors. The higher real wages in the assembly sector reflects the higher labour productivity and labour quality in this sector which implies higher skill intensity. Labour productivity in this subsector is five times higher and labour quality almost double than that in the overall sector. The assembly subsector is the oldest subsector with an average firm age of 16 years (compared to 13 years in the auto parts and body maker subsectors).

Table 8.4: Characteristics of the Indonesian Automotive Sector: 1990 – 2007

Variable	All Period (1990 - 2007)	Pre Crisis (1990 - 1996)	Crisis (1997 - 2000)	Post Crisis (2001 - 2007)
	All Automotive			
Number of firms	6,933	2,300	1,533	3,100
Export Share (%)	4	3	5	5
Import Share (%)	22	19	24	25
Foreign Equity Shares (%)	12	6	12	17
Number of workers	276	260	255	297
Age of firm (year)	13	11	12	15
Real Value Added (2000 Rp.million)	58,340	45,865	48,505	72,449
Real Wages/Worker (2000 Rp.000)	4,797	3,575	4,138	6,029
Factor Intensity - K/L ratio	28,200	21,838	23,634	36,274
Labour Productivity - Real VA/Worker (2000 Rp.000)	84,929	64,493	83,241	100,925
Labour Productivity - Real Output/Worker (2000 Rp.000)	190,172	159,164	169,883	223,189
	Auto Parts			
Number of firms	5,010	1,451	1,161	2,398
Export Share (%)	5	4	6	6
Import Share (%)	28	26	30	28
Foreign Equity Shares (%)	15	8	15	18
Number of workers	277	293	263	273
Age of firm (year)	13	11	12	14
Real Value Added (2000 Rp.million)	40,000	51,331	50,525	28,056
Real Wages/Worker (2000 Rp.000)	4,978	3,469	4,304	6,218
Factor Intensity - K/L ratio	27,987	12,034	28,105	38,355
Labour Productivity - Real VA/Worker (2000 Rp.000)	79,167	76,904	97,367	71,739
Labour Productivity - Real Output/Worker (2000 Rp.000)	187,677	190,798	192,391	183,512
	Assembly			
Number of firms	340	59	60	221
Export Share (%)	3	2	5	3
Import Share (%)	29	22	22	34
Foreign Equity Shares (%)	26	12	25	31
Number of workers	937	1,071	885	916
Age of firm (year)	16	15	15	16
Real Value Added (2000 Rp.million)	583,217	467,641	249,247	703,232
Real Wages/Worker (2000 Rp.000)	7,291	5,868	5,664	8,113
Factor Intensity - K/L ratio	84,305	183,047	31,929	74,626
Labour Productivity - Real VA/Worker (2000 Rp.000)	448,739	298,046	153,487	567,792
Labour Productivity - Real Output/Worker (2000 Rp.000)	858,971	766,011	419,237	999,831
	Body Maker			
Number of firms	1,583	790	312	481
Export Share (%)	1	1	2	1
Import Share (%)	4	4	5	2
Foreign Equity Shares (%)	2	2	2	2
Number of workers	131	139	106	135
Age of firm (year)	13	11	14	17
Real Value Added (2000 Rp.million)	3,958	4,326	3,043	3,946
Real Wages/Worker (2000 Rp.000)	3,686	3,597	3,226	4,132
Factor Intensity - K/L ratio	17,626	27,701	5,401	10,098
Labour Productivity - Real VA/Worker (2000 Rp.000)	25,250	24,255	17,485	31,921
Labour Productivity - Real Output/Worker (2000 Rp.000)	55,686	55,741	39,991	65,777

Source: Statistik Industri

Geographic Concentration of the Indonesian Automotive Sector

As shown in Table 8.5, car assemblers are mostly located in the Jakarta Greater Area (Jakarta and Banten) with a small number of firms in Surabaya, East Java, to take advantage of its proximity to the market. Car body makers on the other hand are more scattered throughout Indonesia to serve a lower market since cars converted from commercial to passenger are more affordable. Parts and components for cars are usually bulky and heavy and so parts makers are usually located near car assemblers and body car makers to save on transportation costs and ensure "just-in-time" delivery. This pattern appears in the Indonesian automotive industry where parts makers are located throughout Indonesia with the highest concentration in the Jakarta Greater Area followed by East Java mainly Surabaya. Similar to the electronics sector, the clustering of automotive firms can be explained by the economics of agglomeration as well as the pull of the market and in the case of the highly protected sector, proximity to the centre of largeness and patronage is also important (Aswicahyono, Basri, and Hill 2000).

It can be concluded from the above discussion, that the automotive production networks in Indonesia have developed rapidly over the last twenty years with an increasing number of firms. These stronger local production networks are due to policies set up by the Japanese car makers to optimize local procurement for cost efficiency and to minimize exchange rate risk. The high dependency on Japanese car makers hampers the development of domestic auto parts firms since they are bound to a cooperation agreement with the principal which sometimes rules out the possibility of cooperation with other companies and restricts them to reaching economies of scale.

Comparison with Thailand

The Thailand automotive sector has grown rapidly in the last twenty years and became a major hub for automotive production for regional and global market. This rapid development is a result of combination between a change in global automotive sector and favourable policy environment set by Thailand government. Similar with other developing countries, Thailand adopted import substitution policy during the period 1960s-1980s and then switched to export oriented policy in early 1990s.

Table 8.5: Geographic Concentration of the Automotive Sector: 1990 – 2007

All Automotive

Year	Number of Firms								Real Value Added (2000 Rp. million)							
	All regions	Jakarta	West Java	Banten	East Java	Central Java	Suma-tra	Others	All regions	Jakarta	West Java	Banten	East Java	Central Java	Suma-tra	Others
1990	285	77	78	59	19	26	23	3	26,154	73,060	17,344	1,752	7,288	4,313	2,110	20,737
1991	283	70	67	68	19	33	24	2	25,805	71,474	24,364	1,903	20,567	3,147	993	10,672
1992	308	74	73	71	25	27	29	9	33,049	80,686	40,716	3,729	24,544	11,067	768	3,236
1993	324	65	83	80	25	29	32	10	43,581	152,752	38,043	3,393	21,393	5,637	656	2,619
1994	337	68	83	82	33	27	35	9	65,344	222,903	67,241	5,366	17,558	5,448	1,561	3,507
1995	366	64	96	91	39	32	35	9	58,934	234,451	54,774	2,928	19,501	2,868	2,803	3,013
1996	397	68	106	101	42	37	33	10	57,537	200,180	68,618	2,708	31,612	3,161	3,922	2,617
1997	407	64	119	97	54	33	31	9	27,700	115,333	18,586	3,081	21,452	3,366	1,643	2,061
1998	374	59	115	79	52	33	31	5	40,619	80,377	82,758	1,497	9,948	1,543	1,822	4,365
1999	377	53	122	80	53	34	29	6	50,868	116,536	96,317	2,744	11,955	8,355	1,784	4,392
2000	375	58	132	83	56	25	17	4	76,410	200,513	118,869	2,550	16,887	3,653	5,848	1,351
2001 *	361	55	113	77	70	32	14	-	56,988	257,788	38,832	4,883	19,468	7,988	533	-
2002	408	55	147	92	63	32	16	3	72,827	387,090	45,160	5,171	17,613	3,990	2,778	1,018
2003	408	60	157	86	60	30	14	1	70,697	342,152	41,374	5,075	18,829	4,531	5,680	367
2004	418	54	168	84	72	27	12	1	79,656	430,817	46,196	8,262	17,378	10,083	3,274	691
2005 *	373	45	145	73	59	24	21	6	99,202	616,747	47,764	6,986	21,458	10,844	1,550	3,735
2006	583	68	229	114	90	41	29	12	62,429	375,052	35,866	5,730	14,031	8,559	3,220	4,084
2007	549	64	216	110	86	38	26	9	70,611	420,910	43,794	6,843	14,521	4,778	4,476	3,189

Auto Parts

Year	Number of Firms								Real Value Added (2000 Rp. million)							
	All regions	Jakarta	West Java	Banten	East Java	Central Java	Suma-tra	Others	All regions	Jakarta	West Java	Banten	East Java	Central Java	Suma-tra	Others
1990	174	61	41	30	14	11	15	2	34,078	71,716	30,076	2,170	7,839	2,564	3,591	30,964
1991	171	53	40	36	13	12	16	1	22,701	39,435	37,025	1,962	12,022	3,660	1,172	21,222
1992	190	56	44	38	18	11	19	4	31,922	40,325	63,763	5,421	27,507	22,469	896	5,034
1993	198	52	50	43	18	10	20	5	51,413	122,113	60,446	4,782	25,048	9,390	948	4,043
1994	215	56	53	45	26	8	22	5	72,401	162,618	102,346	8,043	19,373	10,179	2,666	4,973
1995	240	52	64	56	29	11	24	4	61,156	163,315	80,159	3,549	22,832	7,873	3,318	4,694
1996	263	53	68	66	32	16	23	5	69,129	178,051	104,451	3,254	37,807	3,295	4,521	3,840
1997	293	50	89	67	45	14	22	6	25,950	81,405	22,671	3,621	23,928	2,921	2,615	2,555
1998	291	49	91	62	44	20	21	4	47,523	74,673	104,088	1,613	11,230	1,167	998	4,439
1999	287	42	95	60	44	20	21	5	62,785	124,771	123,396	3,217	13,857	9,730	1,722	4,512
2000	290	40	108	62	47	12	17	4	66,063	88,179	133,720	2,694	19,682	1,048	5,848	1,351
2001 *	278	42	88	59	58	18	13	-	55,978	250,634	38,440	4,727	21,912	5,060	906	-
2002	315	38	120	68	50	20	16	3	20,088	31,048	29,789	5,936	20,027	4,809	2,778	1,018
2003	311	42	127	64	45	18	14	1	23,027	37,378	31,701	5,686	22,722	3,430	5,680	367
2004	319	38	140	61	52	15	12	1	26,982	57,505	32,958	9,667	19,463	10,151	3,274	691
2005 *	285	32	120	54	44	13	17	5	25,328	38,239	34,995	7,032	27,185	6,617	1,626	3,766
2006	459	51	198	85	70	22	23	10	23,044	45,839	31,898	6,542	15,943	3,399	3,112	4,055
2007	431	47	185	82	68	22	20	7	27,435	47,893	41,275	7,992	16,387	4,079	4,551	3,267

Assembly

Year	Number of Firms								Real Value Added (2000 Rp. million)							
	All regions	Jakarta	West Java	Banten	East Java	Central Java	Suma-tra	Others	All regions	Jakarta	West Java	Banten	East Java	Central Java	Suma-tra	Others
1990	9	7	-	2	-	-	-	-	136,434	174,507	-	3,181	-	-	-	-
1991	8	6	-	2	-	-	-	-	357,688	475,442	-	4,425	-	-	-	-
1992	8	6	-	2	-	-	-	-	451,728	600,510	-	5,380	-	-	-	-
1993	7	4	1	2	-	-	-	-	499,211	867,882	11,881	5,534	-	-	-	-
1994	8	4	1	3	-	-	-	-	737,781	1,466,199	20,097	5,784	-	-	-	-
1995	8	5	1	2	-	-	-	-	799,236	1,272,007	22,373	5,743	-	-	-	-
1996	11	7	2	2	-	-	-	-	372,450	577,871	21,654	4,270	-	-	-	-
1997	13	7	3	3	-	-	-	-	274,012	525,254	41,343	4,195	-	-	-	-
1998	13	6	4	2	-	-	1	-	85,720	180,043	6,484	3,297	-	-	1,574	-
1999	12	6	4	2	-	-	-	-	79,566	155,631	2,179	6,146	-	-	-	-
2000	22	13	5	3	1	-	-	-	424,921	623,069	245,272	6,979	1,068	-	-	-
2001 *	17	8	6	-	3	-	-	-	268,530	455,118	146,772	-	14,479	-	-	-
2002	27	12	9	3	3	-	-	-	859,313	1,675,201	333,806	9,906	21,691	-	-	-
2003	29	13	8	3	5	-	-	-	738,683	1,458,067	298,829	6,758	11,206	-	-	-
2004	36	12	9	6	9	-	-	-	679,829	1,756,271	346,013	12,869	23,028	-	-	-
2005 *	31	11	8	5	4	3	-	-	952,582	2,411,632	334,378	15,365	4,941	76,829	-	-
2006	41	11	8	5	10	6	-	1	623,120	2,104,645	228,610	4,460	10,442	44,426	-	690
2007	40	10	10	6	10	3	-	1	666,856	2,466,686	175,326	3,823	9,155	46,291	-	754

Body Maker

Year	Number of Firms								Real Value Added (2000 Rp. million)							
	All regions	Jakarta	West Java	Banten	East Java	Central Java	Suma-tra	Others	All regions	Jakarta	West Java	Banten	East Java	Central Java	Suma-tra	Others
1990	102	9	37	27	5	15	8	1	2,907	3,261	3,236	1,183	5,745	5,595	991	284
1991	104	11	27	30	6	21	8	1	5,379	5,492	5,606	1,665	39,080	2,854	1,514	123
1992	110	12	29	31	7	16	10	5	4,545	9,130	5,748	1,549	16,926	3,229	2,133	524
1993	119	9	32	35	7	19	12	5	3,748	11,936	3,857	1,564	11,995	3,661	2,175	961
1994	114	8	29	34	7	19	13	4	4,845	23,256	4,710	1,787	10,820	3,455	7,119	799
1995	118	7	31	33	10	21	11	5	4,225	21,784	3,410	1,704	9,841	4,291	3,095	919
1996	123	8	36	33	10	21	10	5	4,589	16,307	3,543	1,521	11,786	6,158	6,859	1,648
1997	101	7	27	27	9	19	9	3	3,477	1,469	2,741	1,618	9,075	7,358	6,525	366
1998	70	4	20	15	8	13	9	1	3,540	743	966	778	2,897	3,956	37,437	40
1999	78	5	23	18	9	14	8	1	2,602	446	843	789	2,660	6,392	14,067	172
2000	63	5	19	18	8	13	-	-	2,340	547	1,193	1,318	2,447	6,058	-	-
2001 *	66	5	19	18	9	14	1	-	6,753	2,147	6,564	5,395	5,384	11,753	161	-
2002	66	5	18	21	10	12	-	-	2,794	1,544	3,311	2,018	4,323	2,625	-	-
2003	68	5	22	19	10	12	-	-	3,840	870	3,593	2,752	5,125	6,181	-	-
2004	63	4	19	17	11	12	-	-	3,418	921	1,716	1,597	2,902	9,998	-	-
2005 *	57	2	17	14	11	8	4	1	4,453	1,007	3,015	3,817	4,560	11,670	2,063	272
2006	83	6	23	24	10	13	6	1	3,267	2,446	2,987	3,121	4,233	5,352	2,740	627
2007	78	7	21	22	8	13	6	1	3,418	2,915	3,352	3,383	5,371	4,404	3,774	664

Source: Statistik Industri

Notes:: - Incomplete database because of under-enumeration, Batam is not included*

- *Deflator: WPI (2000)*

Thailand provides more favourable FDI policy compared to Indonesia. Firstly, Thailand provides income tax breaks and equal treatment for foreign and domestic investors while since 1974 Indonesia has discriminated against foreign investors with a 49% ownership limitation for all joint ventures. Thailand also applied foreign ownership limitation in 1977 but it only applied to domestic-market joint ventures and foreign investors had an option to set up business without getting approval from the BOI but they were not eligible for investment promotions. Indonesia removed the limitation of foreign ownership in 1994. The different policies resulted in a very different outcome. With full ownership, a foreign carmaker is willing to bring the latest technology and improve managerial practices and close supervision of assembly/production by bringing in foreign technicians and managers.

Import substitution policy adopted by both countries in the beginning of automotive sector development imposed a high tariff for CBU and a lower tariff for CKD. However Thailand accompanied the high tariff with a conducive investment environment which successfully attracted foreign carmakers to establish car assembly in Thailand. Implementation of import substitution in Indonesia combined the high tariff with a deletion program which requires local manufacturers to decrease imported input and increase the use of domestic products. Thailand also implemented Local Content Requirement for the automotive sector with the establishment of an Automotive Development Committee which consists of all stakeholders in the automotive sector. Therefore there was extensive consultation between government and the private sector in the policy making process. Thailand was the first ASEAN country to liberalize its automotive sector in 1991 and gained the first mover advantage in attracting foreign car makers to establish car assembly plants in Thailand. Indonesia lifted the import ban on CBU in 1995 and still imposed a high tariff and trade liberalization started later in Indonesia (1999).

Both the deletion program in Indonesia and LCR in Thailand cannot encourage the development of domestic parts manufacturers. Although domestic parts manufacturers cannot develop as much as expected in Thailand, foreign parts manufacturers have significant roles in supplying car assemblers in Thailand because of the favourable FDI polices. In 1993, the Indonesian government replace the deletion program and the Thai government removed the LCR in 1998.

Foreign investment policy and trade liberalization are necessary conditions for participation in globalization but are not sufficient unless they are accompanied by a conducive overall economic environment for doing business. Thailand improved infrastructure and industrial estate development which attracted foreign investors to establish plants outside the Bangkok area. Thailand's index on Doing Business is higher than Indonesia. Meanwhile Indonesia's automotive sector is highly concentrated in the Jakarta area because of infrastructure development outside Jakarta is relatively poor.

The labour market in Thailand reflects the underlying supply and demand condition with wage growth and differentials driven by productivity. Meanwhile the implementation of a minimum wages policy in Indonesia is one concern raised by foreign investors since it discourages workers to increase their productivity since they will earn the minimum wages regardless of their productivity.

Policy environment in Thailand is relatively more stable and predictable than in Indonesia. The National car policy that was announced in 1996 upset foreign investors in Indonesia since it was implemented while Indonesia was supposedly moving toward more liberalized economy. This decision also surprised the domestic industry since there was no consultation with stakeholders before it was implemented. Meanwhile, the Thai government consulted their plan to have Thai vehicle with the stakeholder before reaching an agreement to modify the LCR and started a 'one-ton diesel engine project for one-ton pick-up which now becomes the major export in Thailand.

8.3 Determinants of Firm Participation in the Automotive Global Production Networks

This section uses the firm-level analysis explained in Chapter 5 to analyse the role of firm characteristics in determining a firm's decision in the automotive global production network. Before analysing the estimation results based on an adaptation of Roberts and Tybout's model (1997) to the Indonesian automotive sector, a descriptive analysis is conducted to provide a better understanding of the Indonesian automotive sector.

8.3.1 Descriptive Analysis

The firm-level analysis uses the annual manufacturing survey of medium-and-large scale establishments with at least 20 employees (*Statistik Industri,* or SI). The survey is conducted by the Indonesian Central Board of Statistics (*Badan Pusat Statistik)*. The automotive sector is further classified into three sub-categories: (i) auto parts, (ii) assembly and (iii) body maker. The list of commodities in the automotive sector is provided in Appendix 2.2.

Table 8.6 presents some characteristics of exporting and foreign firms. The number of exporting firms has an increasing trend over time with several sharp declines in 1998, 2001, 2003 and 2005. The proportion of firms in the automotive sector conducting export is small, with only 10 percent of overall automotive firms exporting their products. The assembler subsector has the highest proportion of exporting firms (16 percent) while only 2 percent of firms in the body-maker subsector are do exporting and 16 percent of firms in the auto parts subsector. The smaller proportion of exporting firms in the auto parts subsector is caused by low competitiveness as well as the domestic firms' lack of international connections. The assembler subsector has a higher proportion of exporting firms because it consists of a small number of firms all of which are foreign owned (in joint ventures with large Indonesian enterprises). Some principals have decided on Indonesia for the base production of several models (mainly commercial vehicles) and from there to export to subsidiaries in other countries.

During the crisis, proportion of exporting firms to total firms declined with different magnitude between auto parts and assembly subsector. In auto parts, the proportion only declined slightly from average 11 percent to 10 percent. Meanwhile, a decline in assembly subsector is larger from 22 percent before the crisis to only 10 percent during the crisis, but then rebound to 15 percent after the crisis.

Foreign equity is relatively high in the automotive sector especially in assembly subsectors. The proportion of foreign firms to total assembly firms increased from 11 percent in 1990 to around 43 percent in 2009 and it reached its highest in 2000 with almost 60 percent of assembly firms was foreign firms.

Characteristics of Exporting and Non Exporting Firms

For automotive firms, exporting firms are only a small proportion compared to non-exporting ones. The exporting firms are older and larger with a higher Capital /Labour (K/L) ratio and a higher value of output, labour productivity and quality compared to non-exporting firms. These characteristics are the same across different time periods, except for the K/L ratio in the pre crisis period where exporting firms have a lower ratio.

Older firms in the automotive sector concurs Jovanovic's (1982) argument that firm learn and gain experiences and thus improve their efficiency over time. Older firms have more experience and knowledge and these factors are important for their participation in global production network.

Auto parts are more specialized than electronics parts and components therefore economies of scale are important for a firm be competitive. With fragmented market of car in Indonesia, a larger firm can reach economies of scale easier than a smaller firm, and exporting firms in automotive sector are older than non-exporting firms.

Table 8.6: Exporting and Foreign Owned Firms: Number of firms, Real Value Added and Average Number of Employment, 1990 - 2007

Year	Exporting Firms											
	All Automotive			Auto Parts			Assembly			Body Maker		
	No. of Firms	Real VA (2000 Rp. million)	Average No of Employ-ment	No. of Firms	Real VA (2000 Rp. million)	Average No of Employ-ment	No. of Firms	Real VA (2000 Rp. million)	Average No of Employ-ment	No. of Firms	Real VA (2000 Rp. million)	Average No of Employ-ment
1990	10	146,683	884	8	96,401	734	2	347,812	1,484	-	-	-
1991	15	217,617	927	12	50,138	731	3	887,534	1,714	-	-	-
1992	30	172,872	879	22	85,213	923	3	1,083,464	1,720	5	12,216	183
1993	23	104,125	675	21	108,907	683	1	54,867	653	1	52,964	530
1994	32	58,612	785	27	64,974	870	1	92,811	1,003	4	7,121	154
1995	37	55,493	886	33	58,822	943	1	103,321	1,133	3	2,939	177
1996	51	212,845	954	44	165,827	933	2	1,718,292	1,622	5	24,428	868
1997	33	70,563	765	30	77,377	835	-	-	-	3	2,417	60
1998	7	66,421	1,581	6	77,021	1,835	-	-	-	1	2,822	56
1999	45	71,190	492	43	73,187	499	-	-	-	2	28,268	338
2000	52	211,221	597	46	78,050	383	6	1,232,193	2,235	-	-	-
2001*	27	78,235	391	23	41,842	394	2	552,601	559	2	22,384	194
2002	56	311,677	717	50	41,144	523	6	2,566,121	2,339	-	-	-
2003	40	392,128	965	34	50,871	620	6	2,325,918	2,922	-	-	-
2004	48	361,137	835	40	55,627	526	6	2,517,741	3,145	2	1,505	74
2005*	50	415,664	723	45	35,712	450	4	4,793,347	3,942	1	2,777	101
2006	94	172,324	586	87	38,053	478	4	3,206,039	2,749	3	21,252	846
2007	65	106,310	623	62	42,551	509	3	1,423,987	2,970	-	-	-

Year	Foreign Firms											
	All Automotive			Auto Parts			Assembly			Body Maker		
	No. of Firms	Real VA (2000 Rp. million)	Average No of Employ-ment	No. of Firms	Real VA (2000 Rp. million)	Average No of Employ-ment	No. of Firms	Real VA (2000 Rp. million)	Average No of Employ-ment	No. of Firms	Real VA (2000 Rp. million)	Average No of Employ-ment
1990	23	202,475	732	20	197,405	684	2	347,812	1,484	1	13,189	193
1991	26	115,157	869	23	87,438	809	2	440,456	1,872	1	102,093	242
1992	28	107,413	714	23	82,521	682	2	482,807	1,644	3	47,992	341
1993	32	159,752	549	29	170,712	555	1	54,867	653	2	53,280	410
1994	39	217,922	614	34	241,696	632	1	92,811	1,003	4	47,127	366
1995	40	235,230	824	35	257,309	765	2	125,439	2,317	3	50,832	515
1996	48	223,159	762	43	234,998	696	2	221,586	2,494	3	54,516	563
1997	64	122,939	597	58	86,006	559	4	696,971	1,308	2	27,448	256
1998	68	71,806	484	61	74,161	481	4	53,615	673	3	48,179	288
1999	73	99,421	475	65	103,602	440	5	76,503	761	3	47,024	751
2000	78	211,922	593	65	112,900	375	13	707,032	1,686	-	-	-
2001*	90	188,997	596	75	183,338	649	9	351,208	460	6	16,415	145
2002	75	321,791	682	62	59,758	509	12	1,701,833	1,599	1	7,312	416
2003	93	271,561	673	76	60,759	484	16	1,289,246	1,590	1	9,550	416
2004	101	280,746	679	82	59,313	491	18	1,304,570	1,551	1	9,490	416
2005*	86	380,583	765	69	59,964	538	15	1,905,372	1,880	2	6,022	232
2006	130	237,160	633	113	53,017	483	16	1,552,399	1,730	1	1,474	47
2007	129	252,443	703	111	63,655	492	17	1,499,880	2,113	1	1,561	47

Source: Statistik Industri

Notes:

- **: incomplete data because of under – enumeration*
- *Exporting firm: firm which exports any of its product*
- *Foreign firm: firm with any foreign ownership*
- *Deflator using WPI(2000)*

Table 8.7: Performance of Exporting and Non-Exporting Firms, 1990 – 2007

All Automotive

Variable	All Period Exporter	All Period Non Exporter	Pre Crisis Exporter	Pre Crisis Non Exporter	During Crisis Exporter	During Crisis Non Exporter	Post Crisis Exporter	Post Crisis Non Exporter
Age (year)	14	13	13	11	13	12	16	15
Number of workers	730	223	865	203	653	216	687	243
Factor Intensity: K/L ratio	61,679	24,595	21,367	21,878	67,873	19,292	79,811	30,430
Real VA (2000 Rp. million)	196,580	42,436	136,849	37,295	123,946	41,086	253,889	47,100
Real Output (2000 Rp. million)	397,155	90,537	318,241	91,061	289,405	82,379	477,046	94,308
Real Wages/Worker (2000 Rp.000)	5,967	4,662	4,498	3,488	5,442	4,010	6,921	5,905
Labour Productivity: VA/Worker (2000 Rp.000)	157,210	76,614	117,776	59,474	116,870	79,934	192,301	88,159
Labour Productivity: Output/Worker (2000 Rp.000)	368,059	169,761	266,432	149,060	273,377	159,772	455,128	190,871

Auto Parts

Variable	All Period Exporter	All Period Non Exporter	Pre Crisis Exporter	Pre Crisis Non Exporter	During Crisis Exporter	During Crisis Non Exporter	Post Crisis Exporter	Post Crisis Non Exporter
Age (year)	14	12	13	11	13	12	15	14
Number of workers	617	227	868	218	601	222	501	235
Factor Intensity: K/L ratio	63,834	23,129	21,535	10,936	68,065	23,284	82,605	31,319
Real VA (2000 Rp. million)	64,103	36,512	98,960	45,136	76,166	47,425	42,610	25,643
Real Output (2000 Rp. million)	173,041	88,992	244,620	114,498	170,272	92,677	138,993	71,219
Real Wages/Worker (2000 Rp.000)	6,033	4,826	4,290	3,362	5,404	4,171	7,117	6,069
Labour Productivity: VA/Worker (2000 Rp.000)	97,522	76,511	101,852	73,660	101,677	96,845	93,879	68,069
Labour Productivity: Output/Worker (2000 Rp.000)	254,125	178,078	228,543	185,889	240,088	186,671	271,759	168,882

Assembly

Variable	All Period Exporter	All Period Non Exporter	Pre Crisis Exporter	Pre Crisis Non Exporter	During Crisis Exporter	During Crisis Non Exporter	Post Crisis Exporter	Post Crisis Non Exporter
Age (year)	22	15	17	15	25	15	23	14
Number of workers	2,399	685	1,485	954	2,235	735	2,814	606
Factor Intensity: K/L ratio	64,803	87,951	35,210	226,998	109,896	23,266	66,917	76,068
Real VA (2000 Rp. million)	1,990,455	339,751	792,015	375,969	1,232,193	137,970	2,639,787	387,268
Real Output (2000 Rp. million)	3,524,823	558,908	1,647,380	816,444	3,015,136	327,360	4,440,319	559,928
Real Wages/Worker (2000 Rp.000)	6,145	7,489	7,436	5,424	5,891	5,639	5,652	8,514
Labour Productivity: VA/Worker (2000 Rp.000)	987,237	355,573	431,234	260,406	493,202	115,029	1,316,020	445,713
Labour Productivity: Output/Worker (2000 Rp.000)	2,006,558	663,722	958,660	711,567	1,095,569	341,199	2,642,844	740,407

Body Makers

Variable	All Period Exporter	All Period Non Exporter	Pre Crisis Exporter	Pre Crisis Non Exporter	During Crisis Exporter	During Crisis Non Exporter	Post Crisis Exporter	Post Crisis Non Exporter
Age (year)	8	13	6	11	6	14	16	17
Number of workers	344	126	385	133	152	105	397	130
Factor Intensity: K/L ratio	11,445	17,737	8,068	28,091	21,852	5,079	7,738	10,129
Real VA (2000 Rp. million)	14,200	3,746	15,193	4,072	11,102	2,885	14,289	3,771
Real Output (2000 Rp. million)	34,153	7,926	41,350	8,857	25,748	5,950	24,263	7,684
Real Wages/Worker (2000 Rp.000)	4,381	3,672	4,306	3,580	5,781	3,175	3,501	4,142
Labour Productivity: VA/Worker (2000 Rp.000)	40,999	24,925	39,135	23,908	57,057	16,709	33,149	31,901
Labour Productivity: Output/Worker (2000 Rp.000)	109,300	54,580	118,019	54,289	139,147	38,047	67,298	65,751

Source: Statistik Industri

Notes: Deflator: CPI (2000) for wages and WPI (2000) for value added and output

Exporting firms in different subsector have different factor intensity. In auto parts subsector, exporting firms generally have higher K/L ratio than non-exporting firms which implies that exported goods of this subsector is more capital intensive. On the other hand, exporting firms in assembly and body maker subsectors had lower K/L ratio than non-exporting firms. This concurs with the feature of assembly process, the main activity in these two subsectors, which is highly labour intensive and generally becomes the entry point for the automotive sector in a country.

However, during the crisis period, exporting firms in assembly subsector had higher K/L ratio than non-exporting firms, but this is not because there were a structural change in this subsector, but it was just because many assembly firms did not export their products during the crisis.

These differences raise the question as to whether a decision of export is affected by the firm characteristics. To answer this question, the next section discusses the results from the firm-level analysis.

8.3.2 Estimation Results and Discussion

Methodology for the firm level estimation is discussed in detailed in Chapter 5, and this section reports and discusses the estimation results of Equation 5.28 carried out using a random effect probit model. A random effect probit model is used to estimate the equation because of the short panel data used in this research (period 1990-1996 for the pre -crisis period and 2001-2007 for the post-crisis period). The main hypothesis is that a "good" firm becomes exporter. The export decision in current period is a function of firm characteristics such as age, labour quality, labour productivity, ownership status, size, export status in the previous period and economy-wide variables such as locational spillover effect. Because of the small number of assembly and body maker firm which makes it not possible to conduct probit estimation for this analysis, the automotive sector is only categorized into two subsectors, namely auto parts and assembly subsectors. The assembly subsector includes both assembly and body maker firms.

The estimations are conducted in two models, the first one is the standard probit model and the second is the Wooldridge model to control for the initial condition problem (as explained in detail in Chapter 5). The analysis is conducted for both the pre and post crisis period. However, the results for both the whole period and the crisis period are provided in Appendix 8.3 for comparison. Because of the small number of observation for assembly subsector, the estimation for this subsector can only be conducted for all period. Since non-linearity of the probit specification makes economic interpretation of the coefficient difficult, the results are reported in their marginal effects of a change in the independent variables on the probability of exporting.

Most firms do not participate only in export or import, but do both. As explained earlier in Chapter 7, because of different productivity advantages between exporter and importers, then only taking into account the exporter advantages when importer advantages are larger may overstate the productivity of exporters. Therefore the estimations are also conducted for exporting firms that also import at the same time. The second, forth, sixth and eight columns in the result tables (Table 8.8 and Table 8.9 as well as Appendix 8.2) take into account this feature by adding the lag of imports to the exports regression (Muuls and Pisu, 2009). This allows the interaction between the export and import decision to be analysed and how import in the previous period affect export in the current period to be investigated.

Pre Crisis Period (1990 – 1996)

For the auto parts subsector (Table 8.8), the results for the pre crisis period using the standard probit model (without correcting for the initial condition model) reveal that size of firm, labour productivity, foreign ownership, and locational spillover affect the export decision. Being a very large firm increases probability to export by 10%. Smaller firms are less likely to export because of the economies of scale factor. With a smaller number of employees, these are usually domestic firms which focus on producing low-technology products for replacement in the domestic market. Meanwhile, very large firms are usually either foreign owned or large domestic firms which have more access to technology as well as the international market and therefore they a have higher probability to export. In addition to size, the other firm characteristics that affect the decision to export is labour quality.

Firms with lower labour productivity, have a higher probability to export. This explains the nature of the Indonesian auto parts subsector, where Indonesia is more competitive in low-skilled labour intensive products.

As expected, foreign ownership has a positive effect on a decision to export. This concurs with Sjöholm (2003) and Ramstetter and Takii (2005) studies that argue that foreign ownership increase a probability to export. This is because MNCs by definition have an international network and frequently this MNC is not only familiar with its home country conditions, but also has information on other markets.

Locational spillover variables are positive and significant for exporter which highlights that being in the same region location (province) with other exporters increases the probability of a firm to export. This result confirms the agglomeration effect in the automotive sector. As mentioned in the previous section, the automotive sector is clustered on the Java because of the pull of the market factor as well as the economics of agglomeration.

The second and fourth columns in Table 8.8 show the estimation results of including import sunk cost into the export equation to see whether being both exporter and importer have any impact. Import sunk cost which is measured by the import status at previous period, has positive and significant coefficient. This implies that the international experience in purchasing imported inputs in the previous period raises the probability to export in the current period.

The Wooldridge model is used to correct for the initial conditions problem which arises because the start of the sample period is not the same as the start of the process that generates the export decision. Since the stochastic process cannot be observed from its start, it is impossible to treat y_0 (the first observation of the dependent variable in the dataset – initial status of export) as fixed. The Wooldridge model includes the initial status of export and the average of the other explanatory variables as independent variables. The variables for the average of firm-level characteristics are included to control for any unobserved individual effect. However, their estimated coefficients do not contain meaningful economic implications thus they are not reported in the table.

Once the initial status of export is included, the coefficients for the initial status are positive and significant but the coefficient for foreign ownership becomes insignificant. This implies that the initial export status captures the superior performance of foreign ownership between exporters and non-exporters.

It can be concluded that the decision to export by auto parts firms in the pre crisis period depended on labour productivity, foreign ownership, the size of firms, import decisions in the previous period and being in the same location as other exporters. It also appears that exports and imports are closely relate: most internationally trading firms do both at the same time, and importing in one period raises the probability to export in the next period.

Table 8.8: Random Effect Probit Estimation: Marginal Effect – Auto Part Subsector, Pre Crisis and Post Periods, 1990 – 1996 and 2001 – 2007

	Auto Parts							
	Pre Crisis - Probit		Pre Crisis - Wooldridge		Post Crisis - Probit		Post Crisis - Wooldridge	
	Exporter	Exporter and Importer	Exporter	Exporter and Importer	Exporter	Exporter and Importer	Exporter	Exporter and Importer
L1lnAge	-0.016	-0.018	-0.016	-0.019	0.016	0.016	0.039**	0.040**
	(0.012)	(0.012)	(0.016)	(0.015)	(0.014)	(0.014)	(0.019)	(0.019)
L1lnRWages	0.011	0.007	0.009	0.005	-0.012	-0.014	-0.011	-0.013
	(0.009)	(0.008)	(0.008)	(0.008)	(0.012)	(0.012)	(0.011)	(0.012)
L1lnProd	-0.015*	-0.016**	-0.017*	-0.017*	0.018*	0.016	0.003	-0.001
	(0.008)	(0.008)	(0.009)	(0.009)	(0.010)	(0.011)	(0.012)	(0.012)
L1FRGN	0.057**	0.039	0.044	0.040	0.104***	0.104***	0.030	0.034
	(0.027)	(0.025)	(0.058)	(0.052)	(0.031)	(0.032)	(0.083)	(0.085)
Small	-0.031	-0.023	-0.010	-0.003	-0.034	-0.032	-0.034	-0.032
	(0.041)	(0.041)	(0.039)	(0.039)	(0.057)	(0.059)	(0.057)	(0.058)
Large	0.017	0.011	0.014	0.012	0.102**	0.099**	0.092**	0.089**
	(0.028)	(0.028)	(0.026)	(0.026)	(0.043)	(0.045)	(0.044)	(0.044)
Vlarge	0.093**	0.085**	0.084***	0.074**	0.156***	0.153***	0.136***	0.132**
	(0.036)	(0.035)	(0.031)	(0.030)	(0.048)	(0.050)	(0.051)	(0.051)
L1EXP	0.019	0.011	0.010	0.004	0.072***	0.074***	0.055**	0.056**
	(0.020)	(0.019)	(0.018)	(0.017)	(0.022)	(0.023)	(0.023)	(0.023)
L1IMP		0.078***		0.061***		0.037		0.038
		(0.023)		(0.019)		(0.030)		(0.028)
share_dloc_fix_EXP	0.490***	0.524***	0.404***	0.421***	0.549***	0.554***	0.512***	0.506***
	(0.069)	(0.075)	(0.057)	(0.058)	(0.137)	(0.138)	(0.132)	(0.131)
EXP_0			0.138***	0.131***			0.105***	0.106***
			(0.020)	(0.018)			(0.031)	(0.031)
Number of observations	802	802	796	796	700	700	692	692

*Notes: Statistical significance (two-tailed test) denoted as: *** p<0.01, ** p<0.05 and * p<0.1*

Post Crisis Period (2001-2007)

The estimation results for the post crisis period are presented in Table 8.8. The factors determining the export decision are different from the pre-crisis period. In the standard probit model, the decision to export depends on labour productivity, foreign ownership, firm size, sunk cost and locational spillover. Unlike in the pre crisis period, in the post crisis period, labour productivity positively affects the probability to export which means that a firm with higher labour productivity will more likely to export. This change implies higher competition in the export markets. Only firms with higher labour productivity can export, in contrast to the pre crisis period where a firm with lower labour productivity was more likely to export.

Being a foreign owned firm increases the probability to export by 10 percent. While being a large firm, increase the probability by 14 percent and being a very large firm, increases the probability even more or about 16 percent. These coefficients are larger than in the pre-crisis period. The larger impact of foreign ownership in the decision to export is related to the deregulation that took place after the crisis in order to liberalize the automotive sector.

The coefficients for export sunk costs (measured by the export status at previous period) are positive and significant in the post crisis period and this is consistent with previous empirical results, such as by Roberts and Tybout (1997) for Colombian manufacturing plants and Bernard and Jensen (2004) for US manufacturing plants. Sunk costs are defined as a sunk irreversible investment faced by a firm in order to enter the export markets. These costs may include the cost of international marketing, establishing a distribution system, gathering information about the export market, hiring employees with specific language training, and a combination of R&D spending to improve product quality in order, for example, to conform to the standards and safety regulations of a target country. The positive and significant coefficient of export sunk cost means that there is a barrier to entry to the export market and not all firms are able to incur the sunk cost.

The coefficient for locational spillover is positive with larger magnitudes than for the pre-crisis period. This implies that being an exporter in the same location as other exporters increases the probability to export. The larger coefficient for the spillover variable reflects the higher agglomeration effect in the auto-parts subsector.

The inclusion of import sunk cost into the exporter model hardly changes the result, which means that being an importer in the previous year does not increase the probability to be an exporter the following period.

The estimation results from the Wooldridge model reveal that the initial export status increases the probability to be an exporter. After controlling for the initial export status, labour productivity and foreign ownership become insignificant while age of the firm positively affects the probability to export. As discussed earlier, age can be considered as a proxy for firm efficiency (Roberts and Tybout 1997) therefore an older firm has more knowledge and experience about the sector and it increase its probability to export.

It can be concluded that, for the post-crisis period, the factors affecting firms' decisions to export during the post crisis period were different to the pre-crisis period. Foreign ownership, size, sunk cost and locational spillover effect determined firm's decision to export. The changes in factors that affect the decision to export were influenced by both domestic and international environment. Domestically, the government undertook further deregulation in order to attract more foreign investment. Liberalization in the automotive sector in the IMF structural adjustment program had significant impact on the development of automotive sector. Furthermore, liberalization on the investment sector and a bilateral partnership agreement with Japan gave positive impact on the automotive sector development.

All period (1990 – 2007)

Because of the small number of observations in the assembly subsector, it is not possible to estimate this subsector in different periods; therefore the estimations are only conducted for all periods as shown in Table 8.9. Unlike the auto parts subsector, using the standard probit model reveals that a decision to export in the assembly subsector depends on labour productivity, firm size, sunk cost and locational spillover. Higher labour productivity will increase a firm's competitiveness and in turn will increase the probability to export. Firm size has positive effect on the decision to export. Being a very large assembly firm increase its probability to export by 3 percent.

The coefficient of sunk costs is smaller than that for the auto parts subsector in the post crisis period. This implies that once firms in the assembly subsector entered the export market, it was more likely for them to stay in the market because of the higher sunk cost. Regarding the location spillover, being in the same location with other exporters affect the probability of firms in the assembly subsector to also export.

The coefficient of import sunk cost in the exporter model is positive and significant which implies that being an importer in the previous period, increases the probability of a firm exporting in the current period. This is because once a firm import, it already established a connection with international markets and this will reduce information cost needed to be able to export (export sunk cost).

The results from the estimation using the Wooldridge model reveal that initial export status has an impact on decision to export and once this variable is controlled, then the impact of labour productivity and export sunk cost become insignificant.

Therefore it can be concluded that the decision to export by assembly firms depended on labour productivity, size of firm, sunk costs (both export and import) and locational spillover. Since most of the assembly firms destine their product to serve domestic market, therefore this model cannot provide a satisfactory result.

Table 8.9: Random Effect Probit Estimation: Marginal Effect – Assembly Subsector, All Period, 1990 – 2007

	Assembly			
	All Period - Probit		All Period - Wooldrige	
	Exporter	Exporter and Importer	Exporter	Exporter and Importer
L1lnAge	-0.009 (0.006)	-0.010 (0.006)	-0.009 (0.010)	-0.006 (0.011)
L1lnRWages	-0.004 (0.003)	-0.004 (0.003)	-0.004 (0.003)	-0.003 (0.004)
L1lnProd	0.010** (0.005)	0.007* (0.004)	0.002 (0.004)	0.001 (0.004)
L1FRGN	0.012 (0.012)	0.008 (0.012)	-0.010 (0.014)	-0.006 (0.016)
Small	-0.016 (0.018)	-0.019 (0.019)	-0.001 (0.022)	-0.008 (0.022)
Large	0.009 (0.013)	0.012 (0.013)	0.017 (0.018)	0.017 (0.016)
Vlarge	0.028* (0.015)	0.026* (0.015)	0.041* (0.021)	0.041** (0.020)
L1EXP	0.045** (0.021)	0.044** (0.020)	0.014 (0.011)	0.017 (0.011)
L1IMP		0.028*** (0.010)		0.024** (0.010)
share_dloc_fix_EXP	0.091** (0.042)	0.092** (0.042)	0.100** (0.049)	0.108** (0.049)
EXP_0			0.084*** (0.016)	0.081*** (0.016)
Number of observations	1,031	1,031	1,024	1,024

*Notes: Statistical significance (two-tailed test) denoted as: *** p<0.01, ** p<0.05 and * p<0.1*

8.4 Insights from the Firm Survey

To supplement other findings, fieldwork was undertaken and interviews were conducted with twelve auto parts companies and car assemblers. The respondents were selected from the Directory of GIAMM (Indonesia Automotive Parts & Components Industries Association). Interviews were conducted with managers of these firms using a structured interview to ensure consistency of questions and increase the reliability and credibility of the research data.

As the automotive sector is concentrated in Jakarta Greater area, the twelve interviewed firms are located in the Greater Jakarta area which includes Jakarta, Bogor (south of Jakarta), Tangerang (west of Jakarta), Bekasi, Cibitung and Cikarang (east of Jakarta). The selection of the firms to be interviewed was not based on random sample but on the availability of the firm management. Appendix 8.3 lists major features of the firms. Based on ownership, 3 firms are 100 percent domestic and 2 firms are 100 percent Japanese owned. The rest are joint ventures between Indonesia and Japan. Ownership shares are: 5 joint ventures with a foreign majority (Japan - more than 50 percent equity ownership), one joint venture with a domestic majority, and one joint venture with equal ownership. This structure of ownership reflects the high dependency of the Indonesian auto parts industry on Japanese technology as discussed earlier.

The auto parts industry can be classified based on their position in the value chain as depicted in Figure 8.1. Six interviewed firms are Tier 1 suppliers that supply directly to the car assemblers; 3 firms are Tier 2 suppliers that supply the Tier 1 firms; one firm is a Tier 3 supplier which supplies Tier 2 firms. In addition two interviewed firms are car and motorcycle assemblers. Most of the Tier 1 suppliers are joint venture firms with one foreign firm and two domestic firms. Tier 2 suppliers are JV and foreign firms while the Tier 3 supplier is a domestic firm.

Location of firms is highly correlated with the time of establishment. Two firms established in the 1970s are located in the Cakung area which is near Tanjung Priok port, the biggest port in Indonesia. Four firms which were established in the 1980s are located in Cakung and Pegangsaan Dua (the area next to Cakung), one of them is located in Cibitung which is the newest industrial park in West Java. This firm relocated from its initial plant in Cakung in 2000s. Firms established in the 1970s and 1980s were a result of the deletion program while firms established after 1993 were the result of the incentive program and the effect of the period of rapid economic growth on the demand for cars (Thee, 2005a).

Firms that were established in the 1990s and 2000s are located in several areas in West Java: Bekasi, Cikarang and Cibitung which are new industrialized parks established jointly by firms from Japan, Korea and Indonesia. The industrial parks in West Java have better infrastructure compared to older industrial parks in Jakarta since electricity and water are privately managed by the industrial parks themselves although the location is quite far from Tanjung Priok port. To overcome the congested traffic, to and from the port, they usually arrange their deliveries either early in the morning or late at night. Some firms in the Jakarta area planned to relocate their firms to West Java area before the global financial crisis in 2007 but they have temporarily postponed their planned relocation until the Indonesian automotive sector rebounds.

The firm size is different between Tiers. The two assembler firms have more than 5,000 workers; Tier 1 suppliers' workers range between 500 – 2,000. Tier 2 suppliers have fewer workers: 67-1,000 workers while the only Tier 3 supplier is relatively large with 300 workers.

The main products of interviewed firms includes break and wheel systems, metal base (stamping and die), electrical generating sets, electric ignition, transmission shafts, mufflers, and seats; one firm is an assembler for cars and one is an assembler for motorcycles. Most products are for the domestic market. Six of the interviewed firms were dedicating all their production to the domestic market. Another five firms sell more than 80 percent of their products domestically and the last one sells less than 80 percent of their products domestically. As mentioned earlier, the import dependency of the Indonesian auto parts subsector is relatively high. The interviews confirm this postulate with seven of these firms having a high import ratio (where more than 50 percent of their input are imported) and five of these firms having less than 50 percent imported input.

The production network is not limited to intra firm relations, and also captures inter firm relations both on source of input as well as market orientation. Since most of the interviewed firms are a subsidiary of Japanese firms, five sell all their products to their parent companies in Japan which then distribute the product to their subsidiaries worldwide. Two of these firms sell the majority of their products within their group and two sell less than 50 percent of their product within their group. Only three firms sell all into the domestic replacement market. Five firms procure the majority of their inputs from within their group and four firms procure less than 50 percent from within their group. Some Japanese firms have global procurement systems which enable their subsidiaries to find the cheapest and most reliable suppliers for their production. The other three firms all procure their inputs from other sources. The imported inputs vary from raw materials, such as aluminium, steel sheet, sub components such as engine parts, electronics parts, and engines and carburettors.

This information confirms that foreign ownership and import sunk cost affect a firm's decision to participate in the global production networks.

Another purpose of the interview was to verify the estimation results where factors affecting a country's participation in global production networks are openness of FDI policies, infrastructure conditions, labour costs, trade openness and exchange rate. In the interview, six firms confirmed exchange rate as the most significant variable. Since most of the input is imported and the market is mostly domestic, the recent appreciation of the Rupiah raised problems. Three firms argued that government regulation affects their performance especially the frequent policy changes which actually work to confuse government officials in the field and delays administration processes. FDI policies are not considered as a major problem for any of the 12 firms since the interviews were undertaken with existing firms and so may provide biased answers. The answers might have been different if the interview was conducted with potential foreign investors. This is a sample selection bias, by definition, since firms that decided not to invest in Indonesia or left Indonesia are not included.

Infrastructure conditions are an important factor in the estimation results. Interestingly, the interviews revealed that some of these firms consider the lack of adequate roads to be such an intractable problem, that they have been forced to incorporate traffic jam delays into their delivery lag times. This clearly lowers their competitiveness due to the inflexibility caused by the inability to make or receive deliveries outside of the very early morning or late at night in order to avoid traffic.

Electricity is another factor which arose during the interviews. All firms raised concerns about the unreliability of public electricity especially in 2008 when there were many blackouts in the Jakarta Greater Area without any prior warnings. One firm reported that they had to pay gasoline of $6,000 per day for their own generator.

Three firms mentioned labour condition as one factor affecting their performance especially the quality of human resources. One firm explained about their own personnel recruitment system where the recruitments are undertaken not only in Jakarta but also in other big cities in Java. They believe that if recruitment is only conducted in Jakarta, potential workers from outside Jakarta would have less opportunity to apply. They reported that the system works well and the cohesiveness of workers is very good.

The interview also asked about future challenges faced by firms. Most stated competition as a big challenge. This was not only competition from existing firms in the same industry but also competition from potential new firms. This included not only competition in quality but also in maintaining customer satisfaction with good after sales services, availability and the affordability of spare parts and wide networking of maintenance and service stations.

All of the interviewed firms are members of a production network either as a subsidiary or as an arm-length firm of a Japanese car maker. The reasons for joining such a network vary. Some of the firms already have a long term relationship with a Japanese car maker and therefore joining the production network is natural. All these firms have some sort of Japanese connection. Either they share the same brand, or the owner of Indonesian firm is a colleague of a Japanese businessman. Several firms join a production network because there is limited supply in Indonesia for specific products and so they are invited by their Japanese counterpart to join the production network. One firm said that the reason they can supply to a Japanese car maker is because they have strong competitiveness or a unique product.

However some firms admitted it is not easy to join a Japanese network since they set strict and demanding requirements for suppliers. It takes a long process to get supplier or vendor approval from a Japanese principal. On average, it takes six months for this process and another year for product development and testing. Japanese principals have a vendor development program which regularly evaluates vendors on delivery rate, service rate and quality. Another difficulty in joining a production network is the low margin obtained by suppliers since the principal requires cost efficiency for all stages of production.

Although it is difficult to join the production networks, once a firm is in the production network, it can obtain many benefits such as a certainty of product market, quality maintenance, easier access to the latest technology needed for product development and access to global procurement systems which provide the cheapest and most reliable suppliers. However some firms mentioned some limitations in joining a production network such as a restriction to sell the product to a general market for a certain period and low profit margin because of cost efficiency requirements by the principal.

In conclusion, semi-structural interviews with 12 automotive firms in Indonesia conducted during fieldwork confirm the macroeconomic and firm-level analysis results. Exchange rates, infrastructure condition, openness of trade and investment policies affect their decision to export and import. In addition, foreign owned firms with large numbers of workers and located in the industrial parks are more likely to export.

8.5 Concluding Remarks

The automotive sector in Indonesia is lagging behind because of heavy government intervention in the sector. The government who had an intention to developed this into a competitive sector through a highly interventionist policy regime has failed to do so, and instead made the sector inefficient and uncompetitive. The frequent change in policies towards the automotive sector created uncertainty for both domestic and foreign investment.

The proportion of firms in the automotive sector conducting export is small, with only 10 percent of all automotive firms export their products and the assembler subsector has the highest proportion of exporting firms. The smaller proportion of exporting firms in the auto parts subsector is caused by low competitiveness as well as the domestic firms' lack of international connections.

The exporting firms are older and larger with a higher K/L ratio and a higher value of output, labour productivity and quality compared to non-exporting firms. These characteristics are the same across different time periods, except in the pre crisis period where exporting firms have a lower the K/L ratio.

Firm-level analysis was conducted to analyse whether firm characteristics affect a firm's decision to export. During the pre-crisis period, a firm's decision to export depended on firm size, labour productivity, foreign ownership, import sunk and location spillover. In the post crisis period, the factors affecting firms' decisions to export were foreign ownership, firm size, sunk cost and locational spillover effect determined firm's decision to export. The changes in these factors were influenced by both domestic and international environment. Domestically, the government undertook further deregulation in order to attract more foreign investment. Liberalization in the automotive sector in the IMF structural adjustment program had significant impact on the development of automotive sector. Furthermore, liberalization on the investment sector and a bilateral partnership agreement with Japan gave positive impact on the automotive sector development.

In order to confirm the results from both the macroeconomic and firm-level analyses, fieldwork was conducted in Indonesia with semi-structured interviews with twelve automotive firms. These interviews confirm both analyses. Exchange rates, infrastructure conditions, labour condition, competitiveness, openness trade and investment policies all affect their decision to export. In addition, foreign owned firms with large numbers of workers and located in the industrial parks are more likely to export. It also reveals the difficulty in joining a network because of the strict and demanding requirements set by suppliers and the long process involved in getting supplier or vendor approval from a Japanese principal. Another difficulty in joining a production network is low margin obtained by suppliers since the principals require cost efficiency for all stages of production.

Comparing Indonesia with Thailand, which successfully became a major for automotive production for regional and global market, it can be concluded that Thailand's rapid development is a result of combination between a change in global automotive sector and favourable policy environment set by government.

Appendix

Appendix 8.1: Indonesia: Car Production Volume by Category, 2005 – 2011*

Category		2005		2006		2007		2008		2009		2010		2011*	
		Unit	MS (%)	Unit	MS (%)	Unit	MS (%)	Unit	MS (%)	Unit	MS (%)	Unit	MS (%)	Unit	MS
Sedan Type	CC < 1.5 (G/D)	2,595	0.52	898	0.30	502	0.12	2,681	0.45	77	0.02	-	-	208	0.03
	1.5 < CC < 3.0 (G)/2.5 (D)	3,622	0.72	1,065	0.36	897	0.22	2,991	0.50	2,084	0.45	3,900	0.56	2,618	0.43
	CC > 3.0 (G) / 2.5 (D)	11	0.00	45	0.02	171	0.04	251	0.04	206	0.04	181	0.03	160	0.03
Subt Total		**6,228**	**1.24**	**2,008**	**0.68**	**1,570**	**0.38**	**5,923**	**0.99**	**2,367**	**0.51**	**4,081**	**0.58**	**2,986**	**0.49**
Passenger Car 4X2 Type	CC < 1.5 (G/D)	185,485	0.37	131,817	0.45	192,278	0.47	285,125	0.47	264,447	0.57	358,838	0.51	311,027	50.77
	1.5 < CC < 2.5 (D)	138,212	0.28	65,526	0.22	89,487	0.22	106,937	0.18	71,600	0.15	100,491	0.14	67,721	11.05
	2.5 < CC < 3.0 (G)	2,637	0.01	6,333	0.02	20,569	0.05	23,935	0.04	10,198	0.02	17,923	0.03	15,512	2.53
	CC > 3.0 (G) / 2.5 (D)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Subt Total		**326,334**	**0.65**	**203,676**	**0.69**	**302,334**	**0.73**	**415,997**	**0.69**	**346,245**	**0.74**	**477,252**	**0.68**	**394,260**	**64.35**
Passenger Car 4X4 Type	CC < 1.5 (G/D)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1.5 < CC < 3.0 (G)/2.5 (D)	-	-	192	0.06	969	0.24	5,236	0.87	2,978	0.64	13,029	1.85	16,794	2.74
	CC > 3.0 (G) / 2.5 (D)	28	0.01	445	0.15	4,335	1.05	4,267	0.71	582	0.13	2,162	0.31	3,137	0.51
Subt Total		**28**	**0.01**	**637**	**0.22**	**5,304**	**1.29**	**9,503**	**1.58**	**3,560**	**0.77**	**15,191**	**2.16**	**19,931**	**3.25**
Bus	GVW 5 - 10 Ton (G/D)	1,235	0.25	831	0.28	889	0.22	1,788	0.30	1,038	0.22	2,076	0.30	2,038	0.33
	GVW 10 - 24 Ton (G/D)	1,194	0.24	423	0.14	787	0.19	1,168	0.19	1,290	0.28	2,030	0.29	1,501	0.25
	GVW > 24 Ton (G/D)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Subt Total		**2,429**	**0.49**	**1,254**	**0.42**	**1,676**	**0.41**	**2,956**	**0.49**	**2,328**	**0.50**	**4,106**	**0.58**	**3,539**	**0.58**
Pick Up / Truck	GVW < 5 Ton (G/D)	99,536	0.20	49,964	0.17	51,931	0.13	84,917	0.14	54,550	0.12	101,648	0.14	106,155	0.17
	GVW 5 - 10 Ton (G/D)	57,599	0.12	32,969	0.11	40,209	0.10	66,120	0.11	45,487	0.10	80,809	0.12	70,228	0.11
	GVW 10 - 24 Ton (G/D)	3,969	0.01	3,321	0.01	3,070	0.01	5,162	0.01	4,432	0.01	6,608	0.01	5,548	0.01
	GVW > 24 Ton (G/D)	4,587	0.01	2,179	0.01	5,544	0.01	10,050	0.02	5,847	0.01	12,813	0.02	9,998	0.02
Subt Total		**165,691**	**0.33**	**88,433**	**0.30**	**100,754**	**0.24**	**166,249**	**0.28**	**110,316**	**0.24**	**201,878**	**0.29**	**191,929**	**0.31**
PRODUCTION TOTAL		**500,710**	**1.00**	**296,008**	**1.00**	**411,638**	**1.00**	**600,628**	**1.00**	**464,816**	**1.00**	**702,508**	**1.00**	**612,645**	**1.00**

Source: GAIKINDO data

Notes: **: until September 2011*
4X2: two-wheel drive
4X4: four-wheel drive

Appendix 8.2: Random Effect Probit Estimation: Marginal Effect – Auto Part Subsector, All Period (1990 – 2007) and Crisis Period (1997 – 2000)

	Auto Parts							
	All Period - Probit		All Period - Wooldridge		Crisis - Probit		Crisis - Wooldridge	
	Exporter	Exporter and Importer	Exporter	Exporter and Importer	Exporter	Exporter and Importer	Exporter	Exporter and Importer
L1lnAge	-0.014* (0.008)	-0.015* (0.008)	-0.003 (0.010)	-0.003 (0.010)	-0.027** (0.013)	-0.027** (0.013)	-0.015 (0.022)	-0.008 (0.023)
L1lnRWages	0.007 (0.006)	0.005 (0.006)	0.005 (0.006)	0.003 (0.006)	0.017 (0.012)	0.015 (0.012)	0.017 (0.013)	0.014 (0.013)
L1lnProd	0.001 (0.006)	-0.003 (0.006)	-0.004 (0.006)	-0.007 (0.006)	-0.000 (0.009)	-0.005 (0.010)	-0.006 (0.014)	-0.010 (0.015)
L1FRGN	0.080*** (0.017)	0.071*** (0.017)	0.037 (0.034)	0.040 (0.035)	0.040 (0.025)	0.028 (0.026)	0.004 (0.076)	0.017 (0.078)
Small	-0.022 (0.027)	-0.019 (0.028)	-0.024 (0.027)	-0.022 (0.028)	-0.001 (0.041)	-0.010 (0.044)	-0.020 (0.049)	-0.038 (0.054)
Large	0.036* (0.021)	0.031 (0.022)	0.027 (0.020)	0.024 (0.020)	0.003 (0.036)	-0.013 (0.038)	-0.002 (0.039)	-0.020 (0.041)
Vlarge	0.101*** (0.025)	0.096*** (0.025)	0.081*** (0.023)	0.078*** (0.023)	0.077* (0.042)	0.060 (0.042)	0.077* (0.045)	0.059 (0.046)
L1EXP	0.022* (0.013)	0.022* (0.013)	0.008 (0.011)	0.008 (0.012)	0.027 (0.024)	0.022 (0.024)	0.024 (0.026)	0.020 (0.026)
L1IMP		0.063*** (0.016)		0.052*** (0.015)		0.077*** (0.030)		0.082** (0.033)
share_dloc_fix_EXP	0.537*** (0.057)	0.571*** (0.057)	0.498*** (0.054)	0.525*** (0.056)	0.371*** (0.102)	0.396*** (0.103)	0.386*** (0.107)	0.413*** (0.111)
EXP_0			0.117*** (0.017)	0.115*** (0.017)			0.023 (0.031)	0.010 (0.031)
Number of observations	1,990	1,990	1,949	1,949	488	488	461	461

*Notes: Statistical significance (two-tailed test) denoted as: *** p<0.01, ** p<0.05 and * p<0.1*

Appendix 8.3: Major Features of Interviewed Firms (listed according to date of interview)

No	Location	Status	Establishment date	# workers	Main products	Tier
Firm A1	Pegangsaan Dua	Indonesia: 100%	1982	950	Rear Axle Propeller Shaft	Tier 1 supplier
Firm A2	Pegangsaan Dua	JV: Japan: 51%, Indonesia: 49%	2006	260	Transmission Assy	Tier 2 supplier
Firm A3	Pegangsaan Dua	JV: Japan: 74%, Indonesia: 26%	2005	67	Differential Manufacture	Tier 2 supplier
Firm A4	Cakung	Indonesia: 100%	1986	1,000	Mufflers Exhaust Pipes Other parts	Tier 1 supplier
Firm A5	Cibitung	Japan: 100%	2001	900	Rotor CDI Starting Ignition Coil	Tier 1 supplier
Firm A6	Cibitung	JV: Japan > 90%, Indonesia: < 10%	2002	664	Seat and Car Interior	Tier 1 supplier
Firm A7	Tangerang	Japan: 100%: - 70% Mitsuba - 30% Honda group	2001	1,868	Automotive Electrical System: - Brake System - Relays - Starter for motorcycle - Horn - IC generator - fuel pump	Tier 1 supplier
Firm A8	Pegangsaan Dua	JV: Japan 50%, Indonesia 50%	1971	14,000	Motorcycle	Assembler
Firm A9	Cakung	JV: Japan 65%, Indonesia: 35%	1973	732	Automotive Component	Tier 2 supplier
Firm A10	Cibitung	JV: Japan 70%, Indonesia: 30%	1980	9,000	Car	Assembler
Firm A11	Pegangsaan Dua	JV: Japan 35%, Indonesia: 70%	1981	1,352	Brake Manufacturer	Tier 1 supplier
Firm A12	Tambun Bekasi	Indonesia: 100%	1997	300	Dies and Stamping	Tier 3 supplier

Chapter 9: Conclusion

9.1 Summary

Over the last two decades, trade in parts and components has increased faster than that of manufactured goods. This rapid growth was made possible by technology development and innovations in telecommunications and transportation. These developments enabled firms to fragment their production process into smaller segments in which components of production or assemblies can be relocated to different places. Trade and investment liberalization in many developing countries made relocation to other countries possible. This creates global production networks. In addition, these production blocks have a tendency to be concentrated in close proximity to take advantage of pool of workers with specialized skills, availability of specialized inputs and services and technological spillovers.

However, Indonesia, as the largest economy in Southeast Asia, seems to have missed out on the opportunity to reap gains from the global production networks. Indonesia's export value of parts and components is far below that of other ASEAN-5 countries.

The purpose of this thesis has been to examine determinants of a country's participation in global production networks through their export of parts and components using an analytical framework developed through a careful survey of the relevant theory. Furthermore, these determinants were evaluated against Indonesia's situation to shed a light on why Indonesia has been left behind. Firm level analysis has also been conducted to determine what factors affect the export decision by a firm. The insights from the firm survey supplement the results from both the macro and firm level analysis.

This thesis starts with a literature survey on the global production networks and firm heterogeneity. Based on the fragmentation theory by Jones and Kierzkowski (1990), there are three contributory factors that enable product fragmentation. First is the development in production technology that enabled slicing of the production process into different tasks with different factor proportion characteristics; second is trade liberalization and third is advancement in communications and transportation that have contributed to a decline in the cost of service links. However, traditional theory is still relevant in the global production networks since the principle of specialization according to comparative advantage is still a basis for a decision on the location of production blocks. The service link costs are not just communications and transportation costs but also include trade and investment costs. Openness of trade and FDI policies, especially in developing countries, is an important factor determining participation in the global production networks. Since the 'just-in-time' technology developed by the Japanese production networks has proven effective in holding down production costs, infrastructure development is obviously a crucial prerequisite for global production network participation.

The second part of the literature survey is on the theory of firm and international trade. Although both old the trade theory (Ricardian and Heckscher-Ohlin theories) and new trade theory (Krugman) include firms in the analysis, they do not specifically discuss an individual firm's decisions on export and import. This lacuna has led to the development of heterogeneous firm trade theories such as Bernard *et al.* (2003) and Melitz (2003). With the existence of fixed costs, which are referred to as sunk-costs, a firm that has a productivity level below the zero-profit productivity cut-off will make a negative profit and choose to exit from the industry. A firm with a productivity level between the zero-profit cut-off and the export productivity cut-off will stay in the industry but will only serve the domestic market. A firm with a productivity cut-off above the export productivity cut-off will stay in the industry and serve both the domestic and export markets. The productivity of a firm depends on characteristics such as size, age, ownership, location and factor intensity.

Chapter 3 maps and analyses the trend of parts and components trade in the electronics and automotive sectors in Asia. These two sectors have been selected because they are the most dynamic, largest and fastest growing industries in the world. Both sectors are also significantly fragmented in the production process and this allows more countries with different levels of income and technology to participate by specializing in their niche markets. In fact, the electronics sector has become an engine of growth in some Asian countries while development of the automotive sector has not been as rapid. Electronics parts and components trade increased from around $147 billion in 1988 to more than $1.2 trillion in 2010, while auto parts trade increased from $110 billion to $680 billion over the same period. The annual growth of electronics parts and components is 12 percent and for auto parts and manufactured goods is 10 percent each.

The different growth rates in the trade of electronics parts and components and auto parts is due to their different characteristics. The electronics sector has a discrete production process with different scale, skills and technology requirements. It varies from a simple assembly process with only unskilled labour requirement to a sophisticated high technology production process with a very high skilled labour requirement. Electronics parts and components are usually small and light making it possible to transport them using air freight instead of sea or land transportation modes. This type of transportation saves time and with the high value-to-weight ratio of parts and components, it is still economical to transport to distant locations.

With technological development, fragmented products have become more similar and useful in a range of industries. An example is the use of computer chips not only in computers but also in other electrical goods such as toasters, and laser devices. It is therefore easier for the electronics sector to achieve economies of scale. Government intervention is not as intense in the electronics sector as it is in the automotive sector and trade and investment barriers are also lower in the electronics sector or do not even exist.

The automotive sector also has a discrete production process, but a narrow range of standardized parts which can only be used by specific types, making it more difficult for auto parts producers to reach economies of scale. The component maker subsector is more technologically advanced than the assembly subsector. The assembly process is labour intensive in both the automotive and electronics sectors. In contrast to electronics parts and components, auto parts are heavier and larger, making it less economical to trade to distant locations. Since vehicle development is concentrated in a few design centres, the automotive production networks are nested within the global organization and structure of the largest car maker firms. This leads to a higher degree of agglomeration compared with the electronics sector. Auto parts have more intense government intervention and are less traded compared to the electronics sector. The local content requirement for domestic production of automotive products and the tariffs on final products remained relatively high until recently.

There is an increase of trade intensity among Asian countries compared to trade between Asian countries and other countries. In the 1970s and 1980s the Asian parts and components trade was dominated by Japan and the US, but in the last two decades the pattern has changed with the share of developing East Asian countries accounting for more than 80 percent of the regional trade. The rise of China has been the dominant factor behind this structural change.

The policy toward the electronics and automotive sector in Asian countries affects participation in the global production networks. In the electronics sector, government support in Taiwan and Korea in terms of providing a sound education system and incentives for the private sector to engage in research and development activities have been successful in developing this sector. Thailand's automotive sector has grown rapidly in the last twenty years becoming a major hub for automotive production for regional and global markets. This rapid development is the result of the combination of a change in the global automotive sector and the favourable policy environment set by the Thailand government. On the other hand, the heavy government protection in the automotive sector, as in the Malaysia, has not been successful because domestic production is still too small, making auto parts firms less internationally competitive because they cannot reach economies of scale. The Malaysian auto parts industry remains small scale, inefficient and lacking in technological competencies.

For exports of electronics parts and components, Indonesia's position is below all the other ASEAN-5 countries (Malaysia, the Philippines, Singapore and Thailand) with an export value much lower than the other ASEAN-5 countries. Indonesia's export value was only $122 million in 1990, while each of the others was more than $3 billion. Although Indonesia was in 9th position, its low value of exports indicates low participation in the global electronics production networks. In the automotive sector, Indonesia's export of auto parts ranked 9th for the period 1990 - 2010, with a substantial increase from only $112 million in 1990 to almost $5 billion in 2010. Thailand also experienced a substantial increase in export value from $312 million in 1990 to almost $14 billion in 2010.

Chapter 4 provides a backdrop for further analysis on why Indonesia is lagging position behind the other ASEAN-5 countries. Trade, industrial and investment policies have changed over time, starting with a very liberal regime in the late 1960s but becoming more protective during the oil boom. In this period (1972-1981) Indonesia adopted an inward looking import substitution policy which initially applied only to consumer goods but was subsequently expanded to intermediate and capital goods. With the 1982 fall in the oil price, the government no longer had the option of maintaining the expensive import substitution policy and from 1983 shifted trade policy to outward looking export promotion. The major deregulation was undertaken during the 1983 – 1996 period which resulted in 5 percent economic growth over that period.

The high economic growth stopped abruptly when the Asian financial crisis hit Indonesia in 1997, contracting the economy by 14 percent in 1998. The financial crisis impacted Indonesia severely. It was worsened by the political crisis resulting in regime change. Since the government was powerless to deal with this crisis, in spite of political difficulties and the unpopularity of the IMF, the government signed an agreement with the IMF in 1998. The structural adjustment in this package included several trade liberalization programs on the export and import side, domestic trade, the removal of the *BULOG* (*Badan Urusan Logistik* – food logistics bureau) monopoly on the importation of sugar and for wheat flour distribution, and elimination of the clove marketing board (*Badan Penyangga Produksi Cengkeh – BPPC).* The special privilege of the national car, whereby no import duties and luxury tax levied, was also eliminated. In spite of this, there was still an increase in protectionist sentiment in the form of import-licensing agreements.

As a result of free and fair parliamentary (1999 and 2004) and presidential (2004) elections, new democratic politics complicated the policy making process. Although the government continued to pursue liberalization in trade and investment, it failed to provide certainty to investors.

Since this research focuses on the electronics and automotive sectors, Chapter 4 covers the historical development and policy regime of both sectors. The electronics sector is relatively new and only began to develop in the 1970s with a simple assembly process. The government provided protection in terms of non tariff barriers with the purpose of developing domestic supporting industries, but this was not successful since these supporting industries still could not meet the domestic demand for parts and components, let alone serve export markets. In the late 1970s, several foreign components firms established production bases in Indonesia. However, because of the unfriendly business environment, two big companies left Indonesia in the mid 1980s. Development of the electronics sector was promising until the financial crisis shattered this hope when a number of domestic and foreign companies were forced to cease their operations. Afterwards, compared to neighbouring countries, Indonesia's business environment was less attractive for foreign investors in the electronics sector.

In comparison with the electronics sector, the automotive sector commenced production earlier, in 1928, with a very simple assembly firm. The automotive sector was heavily protected until the IMF agreement in 1998. Frequent changes in policies toward the automotive sector created uncertainty for both domestic and foreign investors which in turn hampered the development of the automotive sector especially auto parts manufacturers. Because of the large domestic market and the oil boom, development of assembly activities began in the early 1970s. However, they were not internationally competitive due to the inefficiency of domestic auto parts suppliers, and the hopelessly fragmented market, so production was oriented to the domestic market. On the other hand, Thailand, which also has a large domestic market, has successfully developed its automotive sector to become the regional automotive hub because of its friendly investment and business environment.

The analytical framework to examine the factors affecting a country's participation in the global production networks is developed in Chapter 5. The analysis is conducted at two levels, macroeconomic and firm level. The macroeconomic model is developed based on the Jones and Kierzkowski's fragmentation theory. Participation in the GPN is measured by the real export value of parts and components. The hypothesis is that this participation depends on relative costs as well as service link costs. Relative costs are measured by the relative real wages and real exchange rate. The service link costs are measured by the trade cost, infrastructure condition, trade openness and FDI openness. The data cover 98 countries with a share of manufactured exports of higher than 0.01 percent. This benchmark is used to make sure there is no sample selection bias and that all countries in this dataset export parts and components. The countries are categorized into developed and developing countries using the IMF classification of countries. The period covered in this analysis is 1988 to 2007. The initial point, 1988, is selected because it is the first year the UN COMTRADE database commenced reporting under SITC Revision 3. The end point 2007 is selected since this is the latest year for which data for most of the variables are available. Moreover data for 2008 – 2009 are liable to have been affected by the global financial crisis.

The analysis is conducted for two sectors. The classification of the sectors is based on Athukorala's (2011) list with some modifications. The electronics sector is classified further into three subsectors, consumer electronics, industrial electronics and electronics components. For the automotive sector, the list has been modified by including other parts and components considered to be auto parts by the Japan Auto Parts Industries Association (JAPIA) and the Indonesian Automotive Parts and Components Industries Association (GIAMM).

The unbalanced panel data are estimated using the least square dummy variable method. The aim of the macroeconomic level analysis is to answer the question about the determinants of a country's participation in the global production network and why is Indonesia left behind.

The firm level analysis is based on Roberts and Tybout's (1997) model on how firm heterogeneity affects a firm's decision to export. The data are from 1990 – 2007 using the rich database, the annual manufacturing survey of medium-and-large scale establishment (*Statistik Industri – SI)* conducted by the Indonesian Central Board of Statistics. The survey cover all manufacturing establishments with 20 or more employees. The data cover the period 1990-2007 which includes the crisis period between 1997–2000. Because of concern about data quality for the crisis period, the analysis focuses on the pre and post crisis period, i.e. 1990–1996 and 2001–2007. The hypothesis is that a "good firm" will become an exporter. The binary dynamic model using the random effect probit model is used to estimate factors affecting a firm's decision to export.

Chapter 6 provides the results and analysis of the macroeconomic model. Because of different characteristics, analysis is conducted separately for the three subsectors in the electronics sector. For the electronics components subsector, all variables in the model significantly affect the decision to export. The most important variable for developed countries is trade openness, followed by real wages (which reflects the quality of labour required by the subsector), infrastructure conditions, trade cost and real exchange rate (which reflects a country's competitiveness). On the other hand, the variable that affects the participation of a developing country is infrastructure, followed by real wages and real exchange rate.

For consumer electronics, factors that significantly affect participation are similar in both developed and developing countries. Infrastructure conditions and real wages are the most important factors followed by real exchange rate in developed countries, and in developing countries FDI openness. Meanwhile, for industrial electronics, trade openness, infrastructure and real wages are significant factors for developed countries while trade costs, real wages and FDI openness are significant for developing countries.

For the automotive sector, the analysis is conducted only on auto parts, since the final assembly product is less traded. Similar to the electronics sector, infrastructure is the most important determinant for developed and developing countries. Not all developed countries with good infrastructure will participate in automotive production networks (Australia for an example). However a country is more likely to participate in automotive production networks if its infrastructure quality is better. For developed countries other determinants are trade openness and real wages, while real wages is another determinant in developing countries.

Better infrastructure increases participation because it affects communications and coordination costs. Reliable infrastructure is necessary to guarantee delivery from one production block to another in the same country as well as that delivery for export from warehouse to port can be done on time. This is crucial for both the electronics and automotive sector where just-in-time delivery is important.

A positive effect of real wages on the participation in the global production network in both developed and developing countries differs from the existing studies. Existing studies found different effects of real wages on developed and developing countries. Either real wages are not significant, or positively affect participation in developed countries, and negatively affect participation in developing countries. This positive and significant link between real wages and participation suggests participation in the global production networks requires higher skilled labour that produces higher value parts and components.

The trade openness measure only affects the participation of developed countries and cannot pick up trade barriers in developing countries providing export zones work efficiently in these countries and many of the firms participating in the global production network are located in these export zones. For the electronics sector, 70 countries representing 97 percent of world trade in information technology products have signed the Information Technology Agreement

(ITA) under the WTO. The ITA provides for participants to completely eliminate duties on IT products covered by the agreement. Indonesia has signed the ITA since 1996 and has scheduled to eliminate all tariffs in IT products by 2005. However some imported electronics components and parts for consumer and industrial electronics are still subject to import barriers.

FDI openness positively affects participation in developing countries which concurs with the expectation that a country with a more open FDI regime will attract more foreign investment in the form of establishing the production blocks which will in turn increase participation. Trade cost negatively affects participation and this concurs with existing studies, although they use different variables to represent trade cost.

The estimation for Asian countries with an additional country dummy variable for ASEAN countries (Indonesia, Malaysia, Thailand and Philippines) reveals that Indonesia is left behind in participation in electronics components and industrial electronics, but not in consumer electronics and auto parts subsectors. From this estimation, the most important determinant for Asian countries' participation is the infrastructure condition for both the electronics and automotive sectors. Another determinant is FDI openness for electronics components and real exchange rate for industrial electronics. Because of the limitation in the methodology and data availability for quantitative analysis on the macroeconomic level for Indonesia, the analysis is conducted based on the available qualitative data.

The main reason why Indonesia has been left behind in participation in the global production network is its poor infrastructure condition, especially port management and roads, which affects the certainty of the just-in-time delivery requirements in both sectors. The second reason is the relatively restrictive investment regulation directed towards foreign investment, especially the ownership restriction which discourages foreign companies from bringing the newest technology to Indonesia. Trade and custom barriers also affect Indonesia's trade openness, since cumbersome procedures and unreliable officials in the field delay export and import processes. The final reason is the low competitiveness because of Indonesia's relatively more expensive but low quality products. In addition to these factors

The next analysis is at the firm level with two case studies, on Indonesia's electronics and automotive sectors. Chapter 7 discusses the Indonesian electronics sector especially on parts and components for electronics and electrical goods. Owing to the small number of firms in the industrial electronics subsector, the electronics sector is only categorized into the electronics components and consumer electronics subsectors for the firm level analysis.

The Indonesian electronics sector is dominated by electronics components in terms of the number of firms, and real value added as well as the number of workers. The export share of the electronics sector is less than 20 percent, with the largest export share occurring in the pre crisis period (1990 – 1996). The export share of electronics components is higher than that of consumer electronics, which is mainly import substituting. As expected, the import share of this sector is much higher than its export share which implies high dependency on imported inputs. This is because most firms are assemblers with a simple modification-of-production capability. With an under-developed domestic support industry, most of the input is imported.

The foreign ownership is higher in the electronics sector than in the automotive sector with the average foreign ownership at more than 20 percent of equity. Foreign ownership is lower in consumer electronics subsector owing to the existence of local electronics firms since the 1970s. Foreign ownership increased significantly during the crisis period because of a FDI fire-sale of Indonesian companies due to the excess capacity and a drastic fall in assets prices as a result of the real exchange rate depreciation.

The highest concentration of electronics firms is in West Java province, followed by Jakarta and Banten. Outside Java, electronics firms are concentrated in Batam Island to take advantage of the special economic zone established in the late 1980s and its proximity to Singapore. Although the firms are mainly concentrated in West Java province, their real value added is lower than firms in Jakarta, Banten and Batam Island.

There are different characteristics for exporting firms in the pre crisis and post crisis periods. For the electronics components subsector, the exporting firms in the pre crisis period were younger, larger and "better" firms (in terms of higher real value added and output, and higher labour productivity and quality) with a higher L/K ratio. In contrast, during and after the crisis periods exporting firms had a lower L/K ratio. This reveals that older firms that were less labour intensive had more experience and knowledge about the sector and so survived the crisis. On the other hand, the newer more labour intensive firms that could export prior to the financial crisis could not survive the significant drop in demand during the crisis for electronics components in the international market.

In contrast, the performance of exporting firms in the consumer electronics subsector was different between the crisis and non crisis periods. During the crisis period, these exporting firms were young, larger and "better" firms with a higher L/K ratio. In the pre and post crisis periods, exporting firms were older, larger and "better" firms with a lower L/K ratio. It reveals that these less labour intensive older firms decided to temporarily switch their products from export markets to domestic markets and then switched back to the export markets in the post crisis period.

The estimation results from the firm level analysis reveal that in the pre crisis period, a firm's decision to export is affected by firm characteristics, sunk cost (both export and import sunk cost) and locational spillover. Firm characteristics that affect the decision are different in the electronics components and consumer electronics subsectors. In the electronics components subsector, foreign ownership and firm size are important. In consumer electronics, instead of foreign ownership, factor intensity is an important determinant as well as firm size. In the pre crisis period, a more capital intensive firm had a lower probability to export than a labour intensive firm, which implies that the exported parts and components of consumer electronics are labour intensive goods.

Foreign ownership has a positive impact in the electronics components subsector which implies that being a foreign firm increases the probability to export. This is because foreign firms or joint-venture firms were indeed established to serve the export market. The size of the firm relates to economies of scale where a larger firm may be associated with lower average, or marginal costs, providing a separate mechanism for size to increase the likelihood of exporting. It is easier for a larger firm to reach economies of scale and become more competitive, enabling participation in the global production networks.

A positive sunk cost means it is costly for firms to start exporting their output, so that once they have entered the market, they tend to stay unless there are major events that force them to exit, such as occurred during the 1997 financial crisis. Coefficients for the locational spillover variable are positive and significant, which means that being in the same location (province) with other exporters increases the probability of a firm to export their product. This result confirms the agglomeration effect in the electronics sector where the pool of skilled labour, better infrastructure, proximity to airport/port are all factors that pull firms to the same locations.

In the post crisis period, there is a change in determinants of firm's decision to export compared to the pre crisis period. Firm size and factor intensity affect the decision to export in the electronics component subsector. The negative coefficient on capital intensity means that being a more capital intensive firm decreases the probability to export. This suggests that, after the crisis, exports of electronics components are more labour intensive goods. Sunk cost and locational spillover are still important. Foreign ownership becomes insignificant in determining the export decision which implies the performance gap between foreign and domestic firms is smaller. This suggests that both foreign and domestic firms have the same probability to export. Whether this narrow gap is a result of technology spillover from the foreign firms to domestic firms or the fact that the good foreign firms left Indonesia after the crisis is an interesting topic that it is beyond the scope of this research. The firm interviews reveal that there was evidence of technology spillover from the principal to the subsidiary firms in Indonesia through regular trainings and upgrading for employees.

In the consumer electronics subsector, the decision to participate in the global production networks only depends on labour quality. This result reflects higher competition in the export market for electronics consumer parts and components where only firms with higher labour quality can join the global production networks. This implies that consumer electronics in Indonesia changed their production mode from simple assembly to more complicated ones which require higher-skilled labour.

To supplement the results from the macroeconomic and firm level analysis, fieldwork was undertaken and the interviews were conducted with six electronics firms in the Greater Jakarta area (includes Jakarta and Banten provinces). Labour condition and infrastructure provision are important determinants in their competitiveness which in turn affects their participation in the electronics global production networks. A high import share and low export share of the interviewed firms is consistent with the low competitiveness of the parts and components electronics industry in Indonesia which cannot fully support the domestic electronics sector let alone compete in the international market.

Chapter 8 discusses the Indonesian automotive sector. The composition of the Indonesian automotive sector has changed over time. The proportion of auto parts firms has increased from 60 percent in 1990 to 80 percent in 2007. The assembly subsector is highly concentrated as a result of government protectionist policies. This sub sector relies on FDI and all assemblers are joint-ventures with a small number of very large Indonesian firms. Almost all assemblers are owned by one of the three largest automobile enterprises in Indonesia: Astra, Indomobil and Krama Yudha. The auto parts firms are less concentrated, because in general they are more labour intensive and less dominated by the large firms and have low economies of scale. Some of these firms are not owned by the large automotive companies. Because of the lower barriers to entry and in response to rising domestic demand for cars, the auto parts industry grew rapidly over the past two decades to serve an increase demand for auto parts both for production and replacement, except during the period 1997-1999 because of the financial crisis.

The export share of the automotive sector is relatively low and the auto-parts subsector has the largest export shares compared to other subsectors because some of these firms are affiliated with foreign principals which have a global procurement system which controls procurements among affiliated firms. Auto parts firms that do not have foreign affiliation find it more difficult to export their products because they do not have any international networks. The automotive sector in general still depends heavily on imported inputs. The average import share is around 20-35 percent with the highest import share in the assembly subsector because of the relatively low quality of the domestic auto parts industry which cannot fulfil the strict requirements set by the car makers. This low quality also hampers domestic auto parts firm to export.

However, the import share of auto parts firms declined in the post crisis period. This reflects the localization policies adopted by car makers requiring their suppliers to procure domestic sub components as much as possible to repress production costs as well as an improvement in the domestic sub components industry. Furthermore, there was a significant change in trade policy in 1998-1999 as a result of the IMF policy packages.

The automotive sector depends heavily on foreign ownership, especially in the assembly subsector. The removal of ownership restrictions for foreign investment in Indonesia in 2004 is reflected in the higher foreign ownership share in the automotive sector. Firms in the assembly subsector are dominated by MNCs and have higher real wages, higher labour productivity and higher labour quality compared to other subsectors.

Most car assemblers are located in the Jakarta Greater area with a small number of firms in Surabaya, East Java to take advantage of its proximity to the market. Because of the size and weight of auto parts, the auto parts firms are usually located near car assemblers to save on transportation costs and ensure 'just-in-time' delivery. Therefore the auto parts firms are also concentrated in the Jakarta Greater area and Surabaya.

For overall automotive firms, exporting firms are only a small proportion compared to non-exporting ones. Exporting firms are older, larger and "better" firms (a higher value of output, labour productivity and labour quality) with a higher Capital/Labour (K/L) ratio. These characteristics are the same across different time periods, except in the pre crisis period where exporting firms have a lower K/L ratio.

Exporting firms in the auto parts subsector have the same characteristics as all automotive firms. The only different characteristic of exporting firms in the assembly subsector is that they had a lower K/L ratio in the pre crisis period which implies that exporting firms were labour intensive firms. During and after the crisis, the characteristics of exporting firms in this subsector were the same as for all automotive firms.

The firm level analysis result reveals that, in the pre crisis period firm size, ownership, labour productivity, and locational spillover increase the probability of auto parts firms to join the global production networks. Foreign ownership has a positive effect on the probability to export. Very large firms in the auto parts subsector are usually foreign firms, or domestic firms that have access to technology as well as the international market and therefore have a higher probability to export. Labour productivity has a negative effect on the probability to export which implies that a firm with high productivity labour chose to serve the domestic market instead of export markets. The locational spillover positively affects the decision to export because of the pull of market factors as well as the economics of agglomeration.

After the crisis, the determinants of a firm's decision to export are similar to the pre crisis period. In the post crisis period, labour productivity, foreign ownership, size, sunk cost and locational spillover affect the decision to export. Being a large or a very large firm increases the probability to export which means that the economies of scale can be reached before firm size becomes very large. This implies an increase in the productivity of auto parts firms after the crisis which was influenced by development in the global market. This is consistent with a positive effect of labour productivity on the probability to export in this period compared to a negative effect during the pre crisis period. Export sunk cost becomes a determinant after the crisis, which means that there are fixed costs to be borne by a firm to be able to export.

The interviews were conducted with twelve auto parts firms located in the Greater Jakarta area and the results confirm the macroeconomic and firm-level analysis results. Exchange rates, infrastructure condition, openness of trade and investment policies all affect their decision to export and import. In addition, foreign owned firms with large numbers of workers and located in the industrial parks are more likely to export. Firms revealed it is difficult to join the production networks but once in the production networks, it can obtain many benefits. The benefits include a certainty of product market, quality maintenance, easier access to the latest technology needed for product development and access to global procurement systems which provide the cheapest and most reliable suppliers. However some firms mentioned some limitations in joining a production network such as a restriction to sell the product to a general market for a certain period and a low profit margin because of cost efficiency requirements by the principal.

In conclusion, the findings from the macroeconomic level analysis confirm the theory that in the global production network trade, the service link variables are more important in determining a country's participation in the global production networks compared to the relative cost. Infrastructure condition, trade openness and FDI openness are the three factors that determine a country's participation in addition to labour quality.

From the firm level analysis, a firm's decision to join the global production networks through its export of parts and components depends on its ownership status, size, labour quality, sunk cost and locational spillover. Interviews with firms reveal that another factor that discourages joining the global production network is the long process to get supplier or vendor approval from the principals. This implies that the quality of products produced d by a firm does not comply with the principal's requirements so the products need to be improved. In addition, a local supplier only has a small margin because the principal requires cost efficiency at all stages of production.

Indonesia is left behind in the global production networks because its firms are not competitive and the investment and business environment is not supporting production network development which requires a low service link costs as well as the high quality labour that suits the technology requirements.

9.2 Policy Implications

Since the global production networks require certainty in investment, low service link costs and economies of scale, some policy implications can be drawn the above findings to increase Indonesia's participation in the global production networks.

Infrastructure is a crucial factor to attract production blocks into a country. Indonesia's major infrastructure was built during the oil boom era in 1970-1980s and there has been no major improvement since. Especially after the 2001 decentralization which made things more complicated because there is no clear division of labour on who will build and maintain the infrastructure in a region. Since it is not possible to improve infrastructure conditions throughout Indonesia, the special economic zones can be used as a short term solution to attract more investment. China has shown the success of the special economic zones along its coastal regions. Although the Indonesian government has begun this initiative and invited local governments to propose special economic zones in their regions, low capacities in local government was meant that only several local governments responded to the initiative. Therefore private sector involvement is necessary to complement the government funding. To attract this investment the government should provide certain incentives such as the certainty of land tenure and ownership status of foreign investors.

Investment policies especially towards FDI are important to attract foreign investment to Indonesia and increase Indonesia's participation in global production networks. Although the government has improved its investment policies, the lack of clear implementation regulations and consistency between central and local governments in interpreting such policies discourage foreign investment. Foreign investors are confused on which interpretation they should follow during the investment approval process as well as during their operation. With more intense competition from neighbouring countries, both central and local governments have to provide efficient investment procedures with clearer, more consistent and simplified procedures at the lowest possible cost.

Once foreign investors have invested in Indonesia, they still need certainty and security of their investments, especially for investment in footloose industries such as electronics. Past experience on the closure of several big electronics firms in Indonesia should provide clear examples to the government of how it failed to provide such certainty to foreign investors. This experience should provide comprehensive understanding for the government on how vulnerable is this kind of investment to foreign investor's expectations.

Although Indonesia has made good progress in trade policies in terms of lower average tariffs, a resurgence of nationalist sentiment which is manifested through non-tariff barriers discourage participation in global production networks. Technical ministries should base their non-tariff barriers decisions on analytical studies which clearly outline the costs and benefits of such policies instead of ad-hock decisions triggered by nationalist sentiment. This transparent and systematic process will increase business confidence on Indonesia.

Indonesia's business environment should be improved to increase its participation in global production networks. As mentioned by one firm during the interview, the long process of obtaining a tax refund which took 2-3 years and with only 80 percent of refund, is one example of less attractive business environment in Indonesia compared to neighbouring countries. Other complaints concern tax collection, licensing processes and contract enforcement. The government should seriously abolish red tape bureaucracy which is a major barrier to business practices.

Improved labour skill is crucial in attracting a higher technology production processes to Indonesia which in turn would create more productive jobs. Matching between industry needs and the school curriculum is necessary as for example carried out by the Taiwanese government to improve its electronics sector. However, if the public education system is not able to provide such vocational training, the government could adopt Korea's policies during the 1980s that provided incentives for firms that conduct research and development and human resources development. However, with the limited government funding, the government should set priority industries based on certain and transparent criteria.

9.3 Limitations and Suggestions for Future Research

There are three limitations in this research which need to be addressed in future research. The first limitation is on variable selection. The available data are not best proxies for variables discussed in the theory. For example, in measuring trade openness of a country, the available data are either tariff rates or the ratio of total trade to GDP which are too aggregated for this type of study. Both measurements have their limitations and they affect the reliability of results. The ideal measurement is effective rate of protection (ERP) which includes both tariff and non-tariff barriers as well as other domestic protection. Future research can focus on calculating ERP for countries and use this measurement to determine whether domestic protection hampers participation in global production networks.

The second limitation concerns the quality of *Statistik Industri* data provided by *BPS.* Although this dataset is good compared to other developing countries, some inconsistencies appear in the data. This inconsistency is due to data collection processes, quality of field surveyors, and data imputation process. Some adjustments and intensive data cleaning process are needed to ensure consistency of the data. Future research can focus on the weaknesses of this dataset and how to improve it especially on the data collection and imputation process. The result can then be used by *BPS* to improve their data and it turn will enrich studies on Indonesia's manufacturing sector.

This research conducted fieldwork only in Indonesia because of funding limitations. This may provide biased results especially on the foreign investors' perception on Indonesia's investment climate. Since the interviews are conducted with the "surviving" foreign firms, they could not survey exiting firms on why they left Indonesia, and potential investors which choose other countries over Indonesia. Future research can focus on international fieldwork which gathers information from both potential investors and exiting firms from Indonesia. This may include firms from major investing countries such as Japan, Korea, the US, China as well as European Union. This kind of research can provide more complete information on perception of Indonesia's investment climate.

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