State role in the innovation process: A comparison of Vietnam to East Asian countries

A Research Paper presented by:

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(Vietnam)

in partial fulfilment of the requirements for obtaining the degree of
MASTER OF ARTS IN DEVELOPMENT STUDIES

Major:

Economics of Development

(ECD)

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The Hague, The Netherlands
December 2018

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This document represents part of the author's study programme while at the Institute of Social Studies. The views stated therein are those of the author and not necessarily those of the Institute.

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List of Acronyms

BOK	Bank of Korea
EDB	Economic Development Board
EPB	Economic Planning Board
ETRI	Electronics Telecommunications Research Institute
FDI	Foreign direct investment
GDP	Gross domestic products
GNP	Gross national product
HCI	Heavy and chemical industrialization
IES	International Enterprise Singapore
KIST	Korea Institute of Science and Technology
MCI	Ministry of Commerce and Trade
MNCs	Multinational corporations
MTI	Ministry of Trade and Industry
NIF	National Investment Fund
R&D	Research and Development
SBV	State Bank of Vietnam
SOEs	State owned enterprises
TFP	Total Factor Productivity

Chapter 1. Introduction

It is undeniable that industrial revolutions have been the main source of world propensity for hundreds of years. At the early of 17th century, before the industrial revolution, the income gaps in term of GDP per capita between regions over the world were not too much different, the income of richest region (Western Europe) was slightly more than double to poorest region (Africa). However, in the 2001, the gaps became much larger when the average income of richest region (US and Australia, Canada, New Zealand) was over 16 times that of Africa. In contrast to the prediction of the hypothesis of global convergence, there is the quick increasing of the income gaps. High sustainable growth has just occurred in a few countries which successfully industrialized and listed in innovation group. In other words, the industrialization and technological innovativeness are the critical source for the prosperity of rich countries during two recent centuries (Castaldi et al 2009). All successful East Asia countries in 20th century, including Japan, South Korea, Taiwan, Singapore, have developed their economy based on the process of innovation and industrialization (Ohno 2014).

As the master of fact, the technological change is the heart of the industrialization, which have been researched by many economists for a hundred of year. However, many developing countries now are facing with issue of growth slowing down relating to congestion of technology progress, many economies cannot mobilize and transform technology to increase productivity. This phenomenon is commonly known as "middle income trap" which raises a debate about state policy for promoting technology progress in economics. There are two opposite lines of thought about the technological change and the industrialization for developing countries environment. The first one is new growth theory in main stream economic which works on the classical assumptions of invisible hand and comparative advantage of country's factor endowments; the other is innovation theory (generally be known as Marx-Schumpeter theory) which works on the arguments of business cycle and competitive advantage of innovation. This study reviews these two schools of theory based on industrialization process of successful developed economies in East Asia, then assesses the role of government in the innovation process of Vietnam. There are two reasons for choosing cases of successfully developed East Asian countries. Firstly, Vietnam has linked to East Asian production network with massive amount of investment from Japan and Korea corporations. Secondly, East Asian region are generally known as miracle developments based on the industrialization process.

Vietnam's economy is a lower middle-income economy which has been oriented to develop towards industrialization path since 2001. However, Vietnam industrialization process in recent years has encountered bottlenecks due to the slowdown of technology progress. In 2018, Vietnam communist party stated that: "technological level is backward, slow to be renovated; product quality, labour productivity of the industry is low; industrial development is not closely linked with other economic sectors and too much dependence on cheap labour"[1]. In the same year, Vietnamese government launched a master plan of economic reform to promote technology transformation towards high technology in 2035. In the context of Vietnam, the research objective is to assess the role of government in the process of innovation and technological change.

The study aims to analyse the industrialization strategy and innovation process at country level, in order to find out the underlying cause of slow technological progress in Vietnam. This research paper reviews innovation theories and the industrialization process of successful East Asian countries to find out the role of government in the innovation process and innovation determinants in current literature. From that, the paper assesses the state role in the innovation process of Vietnam. I examine the industrialization policies of some East Asian countries and

[1] Communist Party of Vietnam (2018). *Resolution No. 23-NQ/TW*

its achievements, then compare with Vietnam to assess the effectiveness of Vietnam's policy in the innovation process.

The content of the research paper is divided into 5 chapters. Chapter 2 examines the theory debate about the innovation and technological change between new growth model and innovation theory, then come up with innovation process and industrialization policy of some successful industrialized economies in East Asia region. Chapter 3 outlines the background of Vietnam economy and state policy since 2001. Chapter 4 is the analytical part which focuses on assessing the state role in the industrialization process of Vietnam, in comparison with Singapore and Korea. Chapter 4 combines three methods to assess the effectiveness of Vietnam's industrialization strategy in the process of innovation and industrialization including: descriptive statistics, productivity decomposition by sector, and historical approach. Chapter 5 is the conclusion chapter which includes key findings, policy recommendations, and limitations.

Chapter 2. Literature review:
Process of innovation and technological change, the role of government in successful industrializing economies at East Asia region

Innovation had been ignored in the mainstream economics for a long time because of the assumption of "innovation is manna from heaven", meaning it is the random phenomenon. The concepts of innovation have raised the attention in mainstream only after the appearance "endogenous growth theory" which latterly developed to "new growth theory". Developing based on the endogenous growth model of Romer (1990), new growth models treat intellectual capital (usually known as a knowledge factor) as the endogenous determinant of growth, which drives the innovation process and technological change of an economy. In the work of Romer (1986, 1990), innovation (new knowledge) is defined as "horizontal innovations": the invention of new items or components which generate new varieties of products in market, for example micro-processors. In new growth theory, more new varieties of products are created (more new knowledge is created and accumulated), more innovative and more productive an economy is. Therefore, R&D activity is the source of innovation. The diversity of capital goods and specialization of labour directly influence the effectiveness of innovation process, since these factors increase R&D productivity.

Under discussion of neoclassical and new growth theory, developing economies are lagged in the industrialization process. They should be developed their industry based on the comparative advantage of labour intensive production and country's factor endowment, such as processing manufacturing, mining. New growth economists argue that the comparative advantage of a country is dynamic and strongly influenced by accumulation of core innovation factors (new knowledge and human capital). Developing countries can gradually shift their production method from labour intensive activity to knowledge intensive production. In new growth theory, the technology progress must be freely done by private sector via private R&D activities under invisible hand mechanism of market because the government hardly pick winners. If the government intervene in to R&D market of innovation, they will distort the market and create crowding out effect. The role of government in innovation process is limited, which is just about fixing problems of market failures and nudging private sector, then private sector is expected to do much of the rest to facilitate innovation, boost up the technological progress. However, a weakness of mainstream theory is that it cannot clearly explain the rapid technology change and industrialization under state orientation towards high tech industries in Singapore, Taiwan, South Korea, China.

Inspired by Marx's idea of technological competition through technological innovation, Schumpeter (1934) defines the innovation as "new combinations of existing resources", meaning that innovations can be new products, new sources of input, new producing processes, new market, or new distribution system, which is usually known as Marx-Schumpeter innovation theory. Single innovation is a result of integrating/upgrading process of interrelated innovations, which requires many conditions of successful commercialization such as knowledge about market and production, labour skills, machinery and equipment, distribution network, effective and sufficient finance, etc. Commercial innovations usually are developed based on the available knowledge of products, market, or producing process (Fagerberg, 2004). If a firm can imitate products or processes from other companies, then produces goods or applied the processes successfully in new context for the first time, this imitator can be treated as an innovator as well. The process of technology imitation in developing countries environment can be treated as innovation process which latterly can facilitate technological shift for these economies.

Under the innovation theory, the innovation process in developing countries is imitation, modification, production existing innovations from advanced countries with input costs

advantage. The role of government in innovation process is not just fixing market failures and encouraging private investment. The government should establish a national innovation system which support domestic manufacturers absorb foreign technology, generate their own innovations, and scale up to mass manufacturing, in order to promote the technology shift in industrial sector and economy. Manufacturing sector is expected to be the core driver of the industrialization and innovation process.

Technological absorption in manufacturing sector is one of the cornerstones of technological transformation and the industrialization (Schröppel and Mariko, 2003). Ohno (2009) introduces "competitive ladder" concept to describe dynamic competitive advantage of developing countries (also called as low tier economies). He argues that low tier economies can absorb new technologies or new producing processes in non-traditional manufacturing sectors via FDI from high tier economies, then generate innovations. As the result of innovation/imitating process, low tier economies can accumulate industrial capacity, move up the technology ladder, then produce higher technological products and have better competitive advantage in global market.

When developing countries can totally internalize advanced technology in modern industries, in order to generate their own innovations, mass manufacture innovations, and directly compete at international markets, these economies come to the stage of technological shift. The technological shift in modern sectors occur when domestic manufacturers have the full ability of using advanced technology to produce final products and sale it at international markets.

Despite of big debate on the role of government in the literature, the empirical researches of testing the linkage between the government interventions and innovation process are still scarce. Most of researches focus on specific policy instruments of fiscal interventions and non-fiscal interventions such as R&D subsidies, tax incentive, public expenditure, infrastructure, state researches institutes, regulations. The most common instruments are R&D subsidy and tax incentive, for example the studies of Aerts and Czarnitzki (2004); Almus and Czarnitzki (2003); Hall and Van Reenen (2000), Chudnovsky (2006). These studies find a significant role of the government in accelerate firms' innovation.

At country level, Wang (2018) combines descriptive statistics and negative binomial estimation to analyse the impact of government innervation on the process of technology adoption and innovation. Wang uses descriptive statistics to compare economic overview, state policy, and industrialization process between Singapore and Hong Kong, then imply econometric estimator to compare the innovativeness of industrial sector between two countries. The author concludes that state intervention in Singapore is more innovative than laissez-faire policy in Hong Kong.

The story of successful industrialization in East Asia countries shows a critical role of government in the innovation process by promoting manufacturing activity, especially in high-tech sectors. Under industrialization vision and regulations of governments, East Asian tigers (South Korea, Taiwan, Singapore) quickly catch-up advanced technology and successfully industrialize although their economies took off quite late compared to Western countries. At the early stages of industrialization based on the advantage of cheap labour and/or natural resources, governments of successful East Asian countries shaped the economy with the vision of nurturing domestic manufacturers to export products, fostering industries into the process of adopting and internalizing technology from high tier economies, in parallel with upgrading human capital, building industrial infrastructure.

China's industrialization is a similar story to East Asia Tigers. Chinese government intervened deeply into the innovation process by forcing FDI companies interact with domestic firms to support innovative sectors accumulating new knowledge, internalizing technology to create

their own innovative products. China government applied regulations which were totally opposite to neoclassical advice: (i) fostering manufacturing driven growth pattern, which accounts for about 60% of productivity growth in China; (ii) underdeveloped legal framework for property rights which allows domestic firms imitating technology; (iii) exchange rate is controlled by government (Lakhera, 2016).

The process of innovation and technological shift in Asian Tigers and latterly China can be divided into 4 main stages (figure 2.1). In these two first stages, first entrants will adopt transferred new knowledge from foreigners, then test and produce innovative products in non-traditional/modern sectors. Foreign corporations play a central role in transferring new knowledge and innovation to low tier economies. Two last stages are diffusing innovation among domestic manufacturers, internalizing advanced technology to generate incremental and radical innovation, scaling up to mass manufacturing for having the economies of scale. Domestic firms turn to be the core engine in two last stages.

The last stage of innovation process is extremely crucial for technological shift which usually

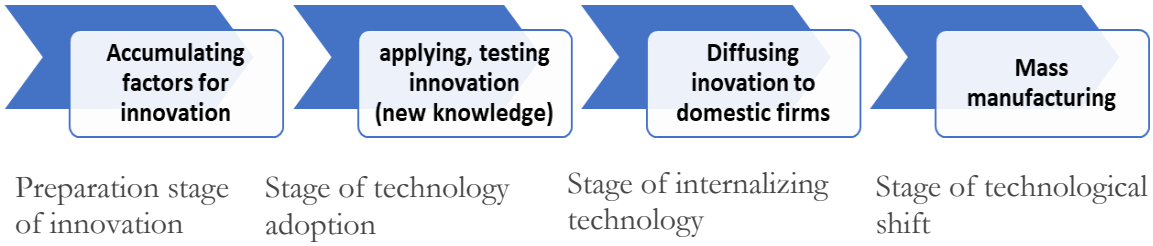

Figure 2.1: Process of innovation and technological shift in successful East Asian economies

the most difficult stages for low tier economies to basically finish their process of innovation and industrialization, since generating own innovation is much more difficult than imitating technology. To implement mass manufacturing, firms in developing countries need to sale their products at international markets. They must develop their own product with ***radical innovations*** (really competitive price or new useful functions) and compete with other manufacturers at global markets.

In case of successful industrialized East Asian countries, the governments support manufacturers have cost and price competition at the beginning of industrialization. The government help domestic manufacturers imitate foreign technology and insert into global value chain via system of state funding, logistic and infrastructure projects, state R&D institutions. At the ending phrase of industrialization, the government support local enterprises generate radical innovations and compete directly with multinational corporations in global market.

2.1 Innovation determinants and public interventions

Because developing countries are lagging regions in the industrialization process compared to advanced countries, they lacked many innovation factors to develop high-tech sector. Outdated technology is the background for the debate of state role in the industrialization process between new growth economists and innovation economists. New growth economists are stick with the assumption of comparative advantage determined by factor endowments of countries. New growth economists suggest developing countries industrialize base on dynamic comparative advantages relating to the accumulation of core innovation factors (new knowledge and human capital). To gradually promote technological progress and move up the value chain, developing countries should accumulate these innovation factors via R&D activity

and education investment. Stick with the assumption of perfect market, new growth economist suggest that government should not orient innovation factors and economy because they will distort the accumulation process of innovation factors.

In the innovation theory, the product innovation can be divided into two levels based on its complex and difference comparing to the existing setup. The first level of production innovation is "*incremental innovation*" which is a series of small upgrades on available goods, services, or processes. The second level is "*radical innovation*", which can be a new type of machinery; a cluster of integrating innovations like iPod or iPhone; or technological revolutions such as internet and artificial intelligence (Freeman and Soete, 1997). Innovation theory suggests that developing countries at first should not immediately focus on basic R&D activities to generate new radical innovations but focus on imitating foreign technology to generate incremental innovations. The role of state orientation become important, because the government can activate innovation process by creating national innovation system to absorb and internalize technology from advanced countries, then support domestic companies develop incremental innovations and sale cheaper products at international markets. After activating the technological internalization process, the government should continuously upgrade technology in successful innovation sectors by extending the domestic R&D network and connect to global R&D network to create radical innovations and become the technology leaders.

In the innovation process, the innovative determinants are not separate but strongly complementary to each other, thus the lack of any factor will block or slow down the development of whole innovation system. The insufficiency of the innovative determinants, which was called as "bottleneck" by Rosenberg (1982), is the main reason of the long-time lag between invention and commercial innovation and delay in innovation development. Therefore, the government must take a proactive role in nurturing domestic firms to develop their capacity during the whole innovation process, and address potential issues of "bottleneck" effect. There are four determinants of innovation process which are in debate between new growth theory and Marx-Schumpeter innovation theory including: knowledge factor, market force, public finance, and institutional structure.

The successful industrialization of East Asian economies are inseparable from government interventions to the innovation process via public institutions and policy instruments.

2.1.1 Knowledge factor

There are two different approaches to new knowledge and state role in the innovation process. New growth economists assume that new knowledge meaning new inventions or new commercialized products in trade. Within neoclassical framework, government should not establish any regulation which can influence R&D markets, since neoclassical economists are stick with the assumptions of perfect market. The problems of factors allocation are belonged to private sector, the invisible hand will automatically allocate resources and put the factors into the right direction. New growth theory abandons the law of diminishing returns for accumulated factors, so there is a space for government to properly intervene into the R&D market to boost the speed of accumulation of knowledge factor and human capital. For example, the government can boost the accumulation speed by spending on education and basic science R&D, which was mentioned by Dasher et al (2015): "Universities have played a crucial role in transforming government investments into scientific knowledge, which is then taken by industry and applied towards commercial ends". The government should indirectly influence knowledge factor by creating a good business environment and providing basic science knowledge via a system of public research infrastructure of basic science, encouraging private investment on applied R&D, improving intellectual property rights.

Meanwhile, innovation theory extends the scope of new knowledge definition to the change of context and integrating functions. Under innovation theory, by opening the economy for

interacting with external sources, developing economies can adopt new knowledge transferred from multinational corporations (MCs), then produce existing products with lower inputs costs and sale at domestic and international markets. This imitating process is also a type of innovation. By using Generalized Least Squares and Tobit model for the sample of American manufacturing sector during 1975-1977, Cohen and Levinthal (2000) concluded that the ability of absorbing outside knowledge, called "absorptive capacity", is a determinant of innovative capacity of firms.

At the beginning of innovation process, first entrants in new sectors must take high risk of adopting/testing new technology in non-traditional sectors. However, their return will be shared quickly to other domestic firms if they successfully develop innovations, consequently, the investment incentive is not high in innovative sectors. New growth economists argue that government in should develop a legal system of intellectual property right to increase the incentive of entrepreneur. However, the legal system just should be developed in advanced countries (global technology leaders) but not in developing countries which must absorb existing advanced technology to accelerate imitating process of innovation. In low tier economies, innovation diffusion among domestic firms is the corner stones of internalizing new knowledge and generating own innovation for each country, which drives technological transformation/shift later. The right vision and regulations of government become crucial in the early stages of innovation process, which ought to reduce the risk of innovation investment, increase the investment incentive, force foreign companies to transfer technology, and allow for the imitating innovation among domestic firms at the same time.

Thus, government have two main roles in the knowledge adoption process: 1) intensifying the interactions of economy with foreign knowledge, 2) reducing the risk of testing innovation. In fact, East Asian governments decided to create a system of technology leverage with state bureaus and state institutes of technology to support technology acquisition and technology adaptation under national vision of export-oriented manufacturing (Mathews and Cho, 2007). It is clear that the governments in Japan, Korea, and Singapore did not let the market driven R&D activities but shaped the R&D activities toward high-tech manufacturing activity to promote technological internalization.

Wang (2018) analyses effectiveness of state interventions on the innovation absorptive capacity of domestic firms in Singapore by comparing with Hong Kong. Since 1980s, Singapore government has deeply intervened to the R&D market to transform the economy into innovation led economic development. Hong Kong, in contrast, has followed the laissez-faire arguments. He uses the descriptive statistic and negative binomial estimation to analyse two cases. In the negative binomial estimation, the author uses forward patent citations to measure technological significance and subsequent economic value as the dependence variable. The dummy independent variable is local firm in the period during 1980-2013. He conclude local enterprise of Singapore rapidly catch up and grow faster than foreign counterparts. Meanwhile the local enterprises of Hong Kong did not improve their performance for last two decades. State supporting enterprises of Singapore effectively improved their innovation performance. Singapore also have higher performance than Hong Kong in innovation output.

2.1.2 Market force

According to Dosi (1982), there are two approaches to the main determinant of innovation and technical change including 'demand pull' and 'technological push'. The role of market force in the technological progress is the core debate between mainstream economists and Schumpeterian economists. Under traditional framework, innovative progress and technical change are autonomous or semi-autonomous factors. Neoclassical economist treats technology as exogenous factor, new growth economists treat technology progress as accumulated factor which is driven by R&D activities. In new growth theory, innovation and technology progress

are independence on market due to traditional assumptions of neoclassical economics such as general equilibrium, optimizing behaviours, perfect market.

In innovation theory, market signal is crucial in directing innovations because of two main reasons: 1) The change of customer patterns of demand drives innovation process of firms because of profit seeking mechanism, 2) innovation is successfully commercialized inventions. In fact, the growing of income will change patterns of demand, increase the desire of customers about new products, then innovative firms develop innovative products to serve the expected demand of customers. Xerox successfully developed mouse and PC, but this company fail to commercialize these inventions because they could not see the potential opportunities from the market (Rogers 1995). Basis knowledge of technology is crucial in innovation process (which can be transferred from multination corporations), but the role of market force is undeniable (can be oriented by government). Without right market orientation, new ideas/patterns cannot successfully commercialize to become innovation, and then will not scale up to mass manufacturing, transform technology for firms and economy as well. Therefore, the government again must take role in orienting domestic companies in both of domestic and international markets to take full advantage of market force (especially global market force) to facilitate innovation process. In fact, the industrialization process of East Asian countries is strongly influenced by export strategy of the government.

Thangavelu and Owyong (2003) analyse the impact of export performance on productivity of manufacturing sector in Singapore. They use the generalized method of moments and fixed effect estimator to run the regression between total productivity growth and export growth. They conclude that export growth significantly increases the productivity of manufacturing industries. Besides that, The results also indicate that export growth had stronger impact on innovation with the sample of FDI intensive firms.

2.1.3 Public investment and fiscal policy

Both of mainstream and heterodox economists agree that public infrastructure investment is crucial for innovation, the more radical changes of innovation, the greater investments on extensive infrastructure required. However, the approach to the public funding and public capital in innovation process is different between economics school of thoughts. Under assumption of perfect market with invisible hand mechanism and perfect knowledge, new growth economists stick with traditional perspective that capital and innovation are effectively autonomous factor, and hence capital market will find the best way to allocate sufficiently capital into applied R&D activities. Any intervention of the government will distort the market, reduce the performance of the R&D activities in private sector, create crowding out effect to private investment, hence reduce the national ability of innovation. New growth economists believe that the role of government is just limited in basic science research, creating liberalizing and monitoring capital market, ensure the transparency of economy, nudging private investment, improving intellectual property rights.

In contrast to new growth economists, innovation economists have different perspective that every phase of innovation process require different types of capital containing different types and levels of risk, since the market is imperfect and the knowledge between firms and countries is different. Hausmann and Rodrik (2003) deny the assumption of orthodox economics that knowledge of high tech production is common knowledge. They argue that modern technology is "tacit" for developing countries, meaning that firms in low tier economies do not easily adopt and apply this technology into production process. Because the social gained from innovative sectors is much more than the loss of investments, government should orient resources towards these new sector to kick off the innovation process.

At the beginning of second stage in the innovation process (figure 2), domestic entities face with two serious problems: high risk of testing imported technology, and uncertainty profit

return. Thus, domestic entrepreneurs have low incentive of investment in new modern sectors. However, the social return of technology learning is much higher than private return, as suitable technology is discovered and diffused to whole sector. Therefore, government should use proper instruments to support domestic firms invest into new modern sectors to promote innovation including state subsidies, public credit and investment, tax holiday, and export subsidies.

Aerts and Czarnitzki (2004) apply treatment effect analysis to test the crowding out effect of state R&D funding on R&D activity in Flanders. Two authors use hybrid propensity score matching to classify the treatment and control groups, then run the Probit estimation. They reject the crowding-out hypothesis in the sample of innovation firms. Almus and Czarnitzki (2003) imply nonparametric matching to classify treatment and control groups, then run the Probit estimation for the sample of Eastern Germany. Almus and Czarnitzki concluded that state supported firms have higher R&D intensity on control group. Chudnovsky (2006) use the difference in difference estimator the sample of Argentina and has similar conclusion about significant role of government in firm innovation process.

In last stage of innovation process which lead to the technological shifts in modern sectors, domestic firms need massive amount of investment to scale up their production process to mass manufacturing for having the economies of scale and compete at international markets. Traditional economists argue that venture capital will take the main role in this stage. However, even in advanced countries like US, venture capital and stock market investors still cannot have enough capacity to pump tremendous amount of capital into new business activities due to high risk and long duration of investments. The investments in mass manufacturing stage in new sectors also does not take just a couple of years but takes place within the period of 5 - 10 years, consequently the uncertainty of this stage increase to extremely high level (Ghosh and Nanda 2010). Tremendous amount, too long time of investment, high level of uncertainty are the reasons why the final stage of innovation process is usually called "Valley of Dead".

Because new modern sectors usually contain high risk/uncertainty and lack of capital supply, the government in developing countries must find effective interventions to reduce the risk of domestic entrepreneurs, remain the sufficiency and stabilization of long term investment for innovation. Government should support domestic manufacturers, at least until they have the first successions of mass manufacturing. When the risk of investment in new modern sectors declines and domestic market accumulates enough innovation factors (capital, knowledge, global market force), government can let the invisible hand operates freely.

In the development of modern industries in Japan, Korea, Singapore, preferential credits, low tax and subsidies for export, public R&D funds were the common state instruments to support export manufactures. Demonstration project also is considered as effective instruments to overcome Valley of Dead and promote innovation in emerging industries. Zhou et al (2015) use structural equation model to assess the impact of China demonstration projects on electronic vehicle sector. They conclude that the demonstration projects improve the innovation process in electronic vehicle sector via improving the product information, technology application, and technological diffusion.

2.1.4 Institutional structure and innovation system

Generally, economists in both of mainstream and heterodox economics agree that institutional structures play a central in supporting and promoting advanced technology in the innovation process. Perez (1983) argued that technological revolutions such as the ICT revolution nowadays, or electricity a century ago, worked on extensive organizational and institutional change. However, orthodox and heterodox economists again have different approaches to government intervention via institutional system. Within neoclassical framework, government should not establish any regulation which can influence factors markets, since neoclassical

economists are stick with the assumptions of perfect market, the invisible hand will automatically allocate resources and put the factors into the right direction. Endogenous growth model suggests that the government can properly intervene into the economy to boost the speed of accumulation of innovative determinants such as knowledge factors, human capital. However, government just can indirectly influence innovation process by creating a liberalized business environment and providing basic science knowledge via a system of public research infrastructure, basic science research institutions, education, taxes regulations.

Because orthodox economics treats innovation as the homogenous thing, technology as autonomous/semi-autonomous factor, they miss two crucial disadvantages of the laissez-faire: "too little investment and entrepreneurship in the first period, and too much production diversification in the second" (Hausmann and Rodrik, 2003). The innovation theory argues that developing country government need to construct a national innovation system to orient the innovation processes of key industries into right paths, which have three crucial characteristics:

(1) Addressing bottlenecks by supporting (both of direct and indirect ways) innovative sectors accumulate enough knowledge, capital, labour qualification.
(2) Opening economy enough for interactions of domestic firms with external sources, especially market force from advanced countries environment, in parallel with nurturing innovative firms in non-traditional sectors.
(3) Unifying national resources toward strategic innovation sectors.

National innovation system is an important structure for innovation process that generates certain patterns of interactions, outcomes, or constrains which will facilitate innovative inertia for domestic firms in specific path of innovation (Fagerberg, 2004). The innovation system has two advantages that: 1) it unifies internal resources to remain the sufficiency of innovative factors in important innovative sectors, especially knowledge and investment; 2) it led participants within the system towards consistent direction, which quickly boosts up the speed of innovation process. Schumpeter (1939) argued that the process of innovation diffusion is an adaptive, active and creative process and tend to "concentrate in certain sectors and their surroundings, or clusters". The innovation system is extremely critical to channelling resources into innovative clusters to active the innovation process in new modern industries. Regulations, state R&D projects, state funds, and subsidies are considerable instruments for developing countries governments to construct a national innovation system toward specific innovation paths.

Lin and Ho (2008) applied the regression analysis to investigate the determinants of green innovation in logistics industry in Taiwan. They conclude that government intervention (finical support, direct training, regulations) is one of key determinants to adopt green innovations. Fernández-Ribas (2009) use multivariate probit model and average treatment effect to analyse the impact of state support on firm innovation in Spain. The governance system of state support is broken down into three level including sub-nation, national, and supranational level. To generate treatment and control group, the author uses propensity score matching method with participation determinants consisting scale, patents, copyright, training, past R&D performance, foreign investment, technology level. Fernández-Ribas concluded that sub-national program changed the innovation attitude of firms; national program accelerated product innovation; supra-national progress helped firms generate incremental innovation and scale up.

In the industrialization process of Japan, Korea, Singapore, the governments always promulgated master plans for the economy which focused on channelling national resources to some priority groups of industry and nurturing domestic manufacturers transform technology. As argued above, these governments always tried to intervene into manufacturing sector via regulations, public institutes, state instruments to shift the economy toward high tech

manufacturing and knowledge intensive industries, rather than let the market freely orient industry.

2.2 State policy for innovation determinants, the practice in the industrialization process of Korea and Singapore

Japan, Korea, Singapore, China were typical cases of rapid industrializing countries in East Asian region. However, the industrialization of these countries took place in different times. Japan experienced an industrialization revolution very early, which took place in 1980s (Gordon, 2003). Since late of 19th century, Japan economy became more and more mechanized. The industrialization process of Singapore and Korea started in mid 1960s, basically completed in late-1980s and early-1990s when Singapore and Korea became high-income countries. China kicked off its economic reform and innovation process of industrial sector in early 1980s. Although China have big success for several decades, but it hasn't finished the industrialization process and become high-income country.

Vietnam government started an economic reform and activated very first step of innovation process in late since early 1980s. Thus, to assess the state role in the process of innovation and industrialization at Vietnam, I choose Korea and Singapore for comparing with Vietnam. Next session reviews the state interventions of Korea and Singapore and impact of these interventions on four innovation determinants.

2.2.1 Knowledge factor

Korea policies

Korea government established many public institute and group domestic companies into joint research projects to improve national capacity of advanced technology absorption from foreign countries. For example, Mistry of Commerce and Industry (MCI) start a plan of unifying national resources in electronic industry by forcing electronic producers as a group namely Korea Electronics Industry Cooperative in 1967. Korea Institute of Science and Technology (KIST) was founded in 1966 to formulate plans and strategies of importing and internalizing technology then transferring to domestic firms to accelerate innovation process in key industries. KIST accounted for 83.9% of Korean R&D expenditure and played an important role the R&D policy in the period of 1970s. KIST successfully transferred advanced technology from foreign countries to domestic entities via joint researching projects with private companies when advanced technology was too risky and costly for Korean's firms (Kim and Yi, 1997).

Since 1973, in step of plaining for the development of high tech industries, Korean government established National Council of Since and Technology and enacted a series of laws and policies to boost technology transferring process. In the year of 1974, MCI announced a six-year plan of technology development in electronics components sector to create a channel for technology transfer from multinational corporations to domestic firms and upgrading domestic capacity of technological absorption in modern industries. In 1976, the Electronics Telecommunications Research Institute (ETRI) was founded and funded by government with the aim of adopting new knowledge, generating innovations, and transferring modern technology to firms in electronics, telecommunications and media manufacturing sectors. In 1980s, many public institutes of R&D were founded to enhance the national researching system (Park and Leydesdorff, 2010).

Singapore policies

Different with the industrialization process of Korea or Japan with use the domestic companies interacting with foreign sources, the process of Singapore mostly depended in foreign companies at two first stages of innovation process, and even in the stage of internalizing

technology, foreign companies remained a significant role in Singapore economy. After the independence in 1960s, Lee government immediately set up a national system of attaching FDI to pursue the vision of export led growth for economy. To push up the technology transferring process from, the government applied a non-precedent policy of immigration that liberalized immigrant system for professional employees and managers of MNCs. Attracted by low wage of labour and low operation cost, MNCs quickly came to Singapore to settle down their manufacturers and activate the innovation process in manufacturing export sector. (Huff, 1995)

Singapore government set up the system of technology leverage for transferring technology by co-operating MNCs to adopt transferred skills, mostly through labour training including on work training and sending technicians to MNCs headquarters. The industrial training required massive amount of public investment which was financed by Skills Development Fund. The government also established three state training institutes to enhance the absorptive capacity namely Philips, Tata and Brown-Boveri. The Skills Development Funds financed for these institutions and monitoring there activities about advanced training and upgrading technology level. In 1980, Economic Development Board (EDB) lunched a plan of increase the R&D quality in priority industry, which emphasized on the role of multinational corporations (MNCs) in technology transfer. The semiconductor and electronics industry were in the top priority in the list. Since 1986, the government change the orientation of technology policies from being dependence on MNCs to strong engagement of domestic companies. Via Local Industry Upgrading Program, the government encouraged MNCs be closer with domestic suppliers by entering long-term contracts to help domestic manufacturers improve their technology level and product quality. (Mathews and Cho, 2007)

2.2.2 Market force

Korea policies

During the period of 1960s, which is the beginning of the process of innovation and industrialization, Korea's economy made use of almost resources to pursuit industrialization vision under export-led growth economic regime. The government setup economy extensively depends on state vision and goals. For example, the government set goals for private firms, allocate capital, financially disciplined poorly performing companies and rewarded successful companies. To achieve goals of the industrialization, the government did not focus much on the state-owned enterprises but supported big family business groups which known as Chaebols. For receiving support of the government, the Chaebols must demonstrate their working ability to achieve economic goals set by government, develop modern technology, and effective compete at domestic and global markets. The Chaebols were like "Quasi – state owned enterprise" which received massive amount of national resources, and if the Chaebols did not perform well to achieve set goals, they would lose government support (Lim, 2001).

In 1962 the Economic Planning Board (EPB) was established with the missions of choosing and planning key industries, monitoring these targeted industries. EPB hold a meeting every month between Chief executives of big companies and government to ensure the progress of plans mostly relating to export performance. In 1965, MCI announced a new plan for export-oriented industries that thirteen export industries will be focused and supported by government. In the plan, one of most important missions of Korea government was that they needed to attract international corporations in electronics and semiconductor industries to invest in operating in Korea. After the enacting of "Electronics Industry Promotion" law in 1969, MCI announced an eight-year plans of promoting electronics industry focusing on promoting domestic investment and absorbing foreign technology, consequently several large firm and chaebols had joined this sector. Since 1970s, the government implement a national strategy of promoting modern industries which was named as "Heavy and chemical industrialization (HCI)". The HIC plan emphasized on encouraging, protecting, and nurturing

domestic firms, especially Chaebols, to quickly adopt technology and expanding scale up to the point of economies of scale to compete at global market. Since 1980s, MCI focused much on Semiconductor industry. (Stern et al, 1995)

Singapore policies

Due to the small size of country, Singapore hardly followed the industrialization via nurturing domestic firms liked Japan and Korea. Thus, the government applied a different industrial strategy that they built up industrial estates for strategic industries with investment incentive policy to attract MNCs came in and set up their export manufactures. By that way, Singapore industry could quickly insert into global supply chain (Mathews and Cho, 2007). During 1970s, Singapore economy received a huge amount of foreign capital which had activated the accumulation of large foreign reserves. During 1980s, foreign investment coming to Singapore was larger than any developing countries (Henke and Boxill, 2000).

The proportion of manufacturing export quickly raised from 12.7% of GDP in 1966 to nearly 47.1% of GDP in 1979. In 1983, Mistry of Trade and Industry established International Enterprise Singapore (IES) to 1986 support domestic companies connect with international markets and ensure Singapore export to foreign markets was not restricted. In 1992, the total trade (import + export) of Singapore was more than 350% of GDP, foreign companies accounted for 74.2% of GDP and 84.5% of export. During the industrialization process, the government always try to enhance the competitiveness of manufacturing sector which was stated as the engine of economic development. In parallel with MNCs, the government also established State Owned Enterprises to lead the innovation process in modern sectors, which is essential for economy to improve export capacity and transform technology (Huff, 1995). In early 1990s, Singapore was the host of 4000 MNCs with more than half of Fortune 100 companies (Findlay and Wellisz, 1993).

2.2.3 Fiscal policy

Korean government fiscal policies:

State financial control was the most important instrument of Korean government to shape economy toward export manufacturing industries. After coming to power in 1961, Park government quickly nationalized commercial banks and totally controlled al type of credit institutions, then pour money into chosen firms in strategic industries. Other firms not engaged in the economic development plans hardly had the access to preferential credit and subsidies. Since 1964, the government had implemented an export promotion plan via export credit projects and put pressure on banks to provide credits. With the establishing of short term credit system for export manufacturing industries, state licensed firms could easily access to the referential short-term loans (Lee, 1999). The credit system latterly expanded to imported raw material, intermediate good for export manufacturing. In 1972, the "Regulation of Export Financing" was enacted to consolidate all policy instruments of promoting export via financial system. According to Cho and Kim (1995), the major share of export loans was provided by Bank of Korea (BOK) with low interest rate compared to normal credit. The size of export credit as the share of GNP had continuously increased since 1960s, from 0.3% in 1963 to 4.7% 1980. Firms must achieve the export goals set by the government last year to receive the favourable loans from export promoting credit system.

To promote export in heavy industry, government tried to support domestic firms by direct financial subsidies and loans because the credit to new industries which were out of ability of private banks because of huge amount, long time of paying back, and high risk. In 1973, National Investment Fund (NIF) was established to channel national resources to strategic industries. Massive amount of state funding, especially long-term funding, was poured into building industrial clusters which supported the development of six key industries. Major share

of NIF loan was low interest rate loans to HIC which continuously increased from about 50% to 70% in the period 1974-1981. Besides funding from NIF, the government also revised the Banking Act and BOK to edited credit policy with more preferential conditions that allow banks to expand the gestation period up to maximize 10 years and increase the amount of loans to domestic companies in heavy and chemical industry. (Lee, 1998)

The five-year plan of Promotion of the Semiconductor Industry (1982-1986) was setup to promote semiconductor industry with $400 million of public budget was funded by NIF and Electronics Industry Promotion Fund. In 1981, Ministry of Trade and Industry (MTI) launched a plan of promoting 4 high tech export sectors including VLSI semiconductors, computer manufacturing, communications equipment, electronics component. The 1981 plan required a huge amount of capital (hundreds of millions of dollars) which contain high risk of investment for first entrances trying to enter these modern sectors. Therefore, Korean's government took proactive role in reducing risk of investment and providing long term capital by arranging state funds, guaranteeing loans, building new infrastructure to drive down the transport cost, and sometime ensuring output markets for producers. To make a big push in semiconductor industry, the government had forced state controlled banks provide finance. $350 million of low cost credit was supplied by government under the terms of 1982 plan. (Mathew and Cho, 2007)

Singapore government fiscal policies

Because the industrialization of Singapore was heavily dependent on SOEs and MNCs, but not private companies liked Korea, the public funding mostly were allocated into training programs and public R&D institutes. The government also applied tax incentive policy and some preferential credit programs. In 1961, Economic Development Board of Singapore (EDB) was established with $100 million budget to attract MNCs. EDB set up a plan of FDI promotion in export-oriented industries via tax holidays, tariff protection, industrial estates. In 1967, the government enacted the Economic Expansion Incentives Act which reduced the company tax from 40% to just only 4% of profits for export manufacturing products (Mathews and Cho, 2007). In 1976, the government established "Spring's local enterprise finance scheme" to improve the absorptive capacity of domestic companies though fixed interest rate loans. In 1970s, "Skills Development Fund" was established to finance for the training programs and R&D activities of upgrading technology. With massive amount of saving in Post Office Savings Bank which was larger than total saving in commercial banks in mid 1980s, the government used this capital to lend for government boards, SOEs, provide low interest rate for investments of infrastructure and public goods (Huff, 1995).

During the period 1960s – 1980s, the government of Singapore followed the strategy of remain low costs of input for industrial development via controlling labour wage, public investment in industrial clusters, training programs. The public investment in infrastructure mostly focused on logistic system, road and transit system, telecommunications to reduce the transaction costs of export manufacturers. The industrial cluster were controlled by Public Utilities Board to ensure the effective inputs costs of power, water, gas, and utilities. The government also promote the English education for citizens with the purpose of enhance the communication between foreigner and domestic workers. (Mathews and Cho, 2007).

Chapter 3. Understanding the Vietnamese economy and the industrialization strategy adopted

Since the reunification of country in 1975, Vietnamese government had set the vision of "industrialization and modernization" for the economy. At first, Vietnam Communism Party developed a centralized economy based on the strategy of developing heavy industry and state control under state subsidy mechanism, which latter created the economic crisis in 1980s. In middle of 1980s, the Communism Party decided to restructure the economy toward market economy which allowed for interaction between private entities and connection with international economies. The economic transformation was named as "Doi Moi", which made a big push to economy, especially private sectors, activated the very first step of innovation process in Vietnam associated with industrialization goals. Started with status of the one of poorest countries over the world in late 1980s, Vietnam reached the low middle-income status in 2005 with current US$ 1.100 income per capital. After "Doi Moi" in 1986, Vietnam economy successfully transformed from basic agricultural economy to basic assembly manufacturing and processing economy in 2000s. However, until 2017, Vietnam economy has been trapped in basic production and cannot make the next move in the innovation process that active the process of internalizing foreign technology and knowledge to accelerate endogenous technology, thus could not prepare to generate a technological shift in the future. This part reviews the current conditions of Vietnam economy, the failure of the government in shaping the economy toward modern industries during 2001-2015, the changes in current policies and development goals.

3.1 The industrialization strategy in Vietnam during 2001-2015

Like Korea, and Singapore in 1960s-1990s, Vietnam's economy has developed under industrial orientation and control of the state. In 2001, Vietnamese Communist Party announced a master plan of industrialization with mission of developing the economy basically become a basically modern economy in 2020. Within the plan, export-oriented industrialization would be the core engine of the economic modernization. In fact, the exports to GDP ratio continuously increased from 55% in 2001 to 90% in 2015 (World Bank, 2018). The export structure also shifted out of agriculture products and services toward industry with the major share of electronic manufacturing activities. In 2016, total share of agriculture products and services was just 17%, the share of electronics product rapidly increased from just 2% in 1996 to 37% of total export (CEPII, 2018).

However, Vietnamese government could not reach the important targets of economic development in 2015. For example, within the Vietnam Sustainable Development Strategy 2011-2020[2], three most important targets for industrialization and economic modernizing were not reached in 2015, including: average GDP growth during 2011-2015, the labour productivity, Total Factor Productivity (TFP) contribution to growth (see more at table 3.1). Industry indicators during the period 2011-2015 also were not achieved including industry value-added annual growth (8%), proportion of industry in GDP (40%), labour's shift from agriculture to industry (agriculture labour reduced to 30%). In 2015, the five-year average growth rate of industry value added were just 7.22%, proportion of industry in GDP were 33%, labour share of industry activity just accounted for 22.74% of total workers while it was 44% for agriculture[3].

Manufacturing in Vietnam until 2015 was mostly basic assembly activities based on advantage of low labour wage and natural resources. For example, the share of medium and high-tech

[2] Government of Vietnam (2012), *Decision No. 432/QD-TTg*

[3] Calculated from Vietnam statistical year book 2015, average growth rate is overlapping growth rate

activities in total value-added manufacturing was around 25% in 2012, which much lower than other East Asian countries such as Thailand with 46%, China with 41%, Korea with 60%, Japan with 56% (UNIDO, 2018). The Vietnamese employee compensation per year and per hour worked were also much lower than other countries in Asian production network. During the period 2011-2015, the average compensation of Vietnamese worker was just about one-third of worker in Thailand and China, one-thirteenth of worker in Korea (Table 3.2). Until 2017, there wasn't an appearance of big domestic corporation in high tech manufacturing sectors. According to Vietnam Report Top 500 companies in 2016 (VNR500, 2016), within top 10 biggest companies, there were only two manufacturing companies including Samsung Electronics Vietnam with 100% FDI, and Binh Son Refining and petrochemical company (state own enterprise). Even that, most of Binh Son products are old technology Petro which were A92, A95, E5 Ron 92, Diesel DO, and were produced mainly for domestic market[4]. Among top 100 biggest companies in 2016, Truong Hai Auto Corporation (THACO) was the unique automobile manufacturing company. However, in 2018, THACO just could only assembly manufacture 3 types of vehicles including passenger car, truck, and bus with low and moderate price for domestic market. The internalization ratios of manufacturing were quite low, which were just about 16-25% for car, 30-45% for truck and bus[5].

The government had tried a bundle of solutions to promote technological change, mostly via supporting SOEs and FDI companies to lead key industries, liberalizing financial and banking system in early 2000s. However, the government still have not achieved significant results in the industries yet. The excessive liberalization of banking and financial system in late 2000s lead to the establishing of many weak commercial banks, then put Vietnam into a deep financial distress in 2011. During the period 2011-2015, the State Bank of Vietnam (SBV) must bail out and force merging many commercial banks to deter the bankruptcy of banks and banking crisis, especially, three commercial banks were acquired by SBV with "zero VND" including CB Bank, Ocean Bank, GP Bank.

Most of Vietnam's SOEs failed to reach the government goals of modernizing technology and generating technology spill over effect to strategic industries. SOEs had been expected to be the leaders in the industry, the core engine of technological transformation as well as the modernization of economy in this period. Until 2016, most of biggest companies in Vietnam were SOEs, nine of top biggest companies were SOEs. However, SOEs had not perform effectively though used major share of national resources provided by government, the contribution of SOEs to GDP and employment was low compared to private companies (ADB, 2015).

FDI companies also did not have strong impact on the technological internalization process of Vietnam. FDI companies in automobile sectors had just implement a small part of internalization process despite these companies were supported by the government with tariff and tax policies. In 2016, after nearly 15 years of development of automobile industry, the localization ratios were only 15% for car of 9 seats, and 30% for cars of 10 seats (or more), which were far behind the target of above 60% for all type of cars in 2020 (Truong, 2017). In 2016, at the closing section of 11th Congress, National Assembly Chairman of Vietnam had to state that "country cannot achieve the mission of becoming a basically modern-oriented industrialized country in 2020"[6].

[4] BSR (2018), <https://bsr.com.vn/en/gasoline.chtml>

[5] THACO group (2018), < http://www.thacogroup.vn/en/about-us/Overview-Introduction/>

[6] National assembly of Viet Nam (2016), *Resolution No. 142/2016/QH13*

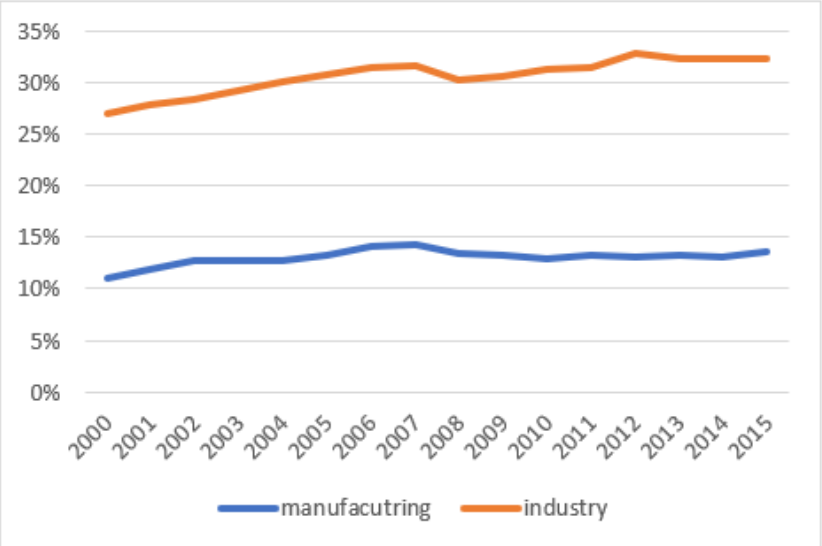

Figure 3.1: The share of manufacturing and industry in GDP (%)
Source: APO database 2017

Under innovation theory, the failure of modern-oriented industrialization goals and mission during the period 2001-2015 can be explained that Vietnam economy had been stuck in the stage of technology adoption for 15 years but cannot facilitate next stage in the innovation process. The economy has not really activated the stage of technology internalization to promote endogenous technological change in modern industries which later could drive the industrialization and economic growth. Looking at the manufacturing data before 2015, although industrial sector accounted for around 30% of Vietnam's GDP, the share of medium and high-tech activity in manufacturing value added was low (25%), the share of manufacturing in GDP was also too low with just 14% (figure 3.1).

Manufacturing sector did not drive the economic development for Vietnam economy in the period of 2001-2015. Companies in modern industries, especially automobile industry, just used the government supports to manufacture and assemble products mostly for domestic market. In the Automotive Industry Development Strategy promulgated at the middle of 2014, the target of manufactured car for domestic markets in 2020 was 227.500 units, while the target for export was just 20.000 units[7]. Thus, modern industries lost one of key determinants in innovation process which made a significant contribution to the successful industrialization of East Asian countries: global market force. In fact, even under "Export-import strategy 2011-2020", Vietnamese government just set targets of export and labour productivity for basic manufacturing activities such as: mineral, mechanics, furniture, textiles, footwear, building materials, petrochemicals, rubber.

Regarding to high tech manufacturing, the government just set out the tasks of "provide incentives for the development of and investment in support industries with a view to meeting domestic demand and participating in global supply chains for mechanical manufacturing, electronics and information, auto parts, high technology."[8]. As the result, manufacturing share to GDP was just about 13% in 2015, the overlapping (average) growth rate of labour productivity in manufacturing activities also remained below the growth of national labour productivity during the period 2001-2015 (table 3.3). Thus, manufacturing sectors, which was core engine of innovation process and industrialization in East Asian countries, encountered

[7] The government of Vietnam (2015), *Decision No. 1168/QD-TTg*
[8] The government of Vietnam (2011), *Decision No. 2471/QD-TTg*

the "bottleneck". The loss of development momentum of manufacturing exports and modern industries make the innovation process of industry and the economy obstructed.

3.2 The post-2015 period

Since 2016, the Party and the government of Vietnam have been fully aware of failures in industrialization strategy in the period 2001-2015. Therefore, at the beginning of the year, the Party lunched a master plan of economic reform for the period 2016-2020 which focused on shifting out of labour intensive economy toward high-tech manufacturing with high value added. The plan of reform was built up based on five main targets: stabilizing public debt, reducing bad debt and interest rate in the financial system, supporting private enterprises to become the main engine of economic development, improving the quality and quantity of innovation activities of domestic enterprises, narrowing the gap of technology and national competitiveness with Asean-4 countries[9].

To achieve the goals set by the Party, the government lunched a plan of "restructuring national industry in the period 2018-2020, considering to 2025" with the mission of modernizing economic structure and economic zones in the orientation of improving productivity, quality and value added, accelerating international economic integration[10]. The plan of restructuring industry focuses on channelling national resources toward 5 key industries to promote technological shift including: 1) processing industries (for agriculture, forestry, fisheries products); 2) new energy and renewable energy industry; 3) mechanical industry; 4) Chemical Industry; 5) Electronic industry. For the first time since "Doi moi", government set the goals for innovation index of industry and manufacturing such as: growth rate of industry, labour productivity growth of industry, industrial competitiveness index, proportion of manufacturing in exports, proportion of high-tech manufacturing in manufacturing actives, the growth rate of manufacturing value added.

In 2018, Ministry of Industry and Trade launched a new development plan of mechanical industry to 2025 with the vision to 2035, the mechanical engineering was stated as the cornerstone industry and strategically significant for the rapid and sustainable development of economy, thus it must have the appropriate support from the state. Within the plan of mechanical engineering, high quality human resource, advanced technology, and global competition are three core-based factors to development mechanical engineering. Government only picked six types of mechanical products as the strategic catalogues including dynamics equipment, automobile, lifting equipment, industrial equipment and electrical equipment, agricultural machines, High-end metal and composite products used in aviation.

With the master plan of reform, the Party and the government shift the direction of the industrialization toward the third stage of innovation process which is technology internalization. The role of private companies under support of government now become the core engine of innovation process and the industrialization, which is expected to lead the high value-added export, insert domestic manufacturing sectors into global supply chain, establish national branches and innovations to compete at international markets. The new master plan shows a clear vision of the government that channelling the national resources to some modern manufacturing sectors with high value added, which will generate spill over effect to industry and whole economy. The role of export now is not limited in balancing the trade balance but also the dynamics of technological innovation, which is similar to the innovation process in successful East Asian countries.

[9] Communist Party of Vietnam (2016), *Resolution No. 05-NQ/TW*
[10] The government of Vietnam (2018), *Decision No. 598/QD-TTg*

Chapter 4. Analysis

4.1 Research methodology

At country level, strategy of industrialization and innovation system are very complex, the role of government is mixed at different levels, regions in country also are divergent. Therefore, there are very few studies assessing overall impact of government policy on the innovation process at country level. This research is the rare studies about the relationship between state role and innovation process of Vietnam. My research strategy is similar to Wang (2018) that I compare the difference in economic structure, industrialization strategy, innovation determinants, and innovation effectiveness between countries, in order to assess the role of Vietnamese government in the innovation process.

As I mentioned in the literature review part and the Vietnam economic background, the industrial structure of Singapore, Korea, and Vietnam was dominated by government vision and plans. Therefore, the industrial structure is the manifestation for industrial strategy of each country in specific periods. The effectiveness and innovativeness of industrial structure can be treated as a proxy for the impact of industrialization strategy on the innovation process. According to Harrison (1999), labour productivity or GDP per worker are effective indicators to assess the relative overall productivity of a country, which are the shortest overall for the competitiveness of production. Thus, the growth rate of manufacturing productivity, industrial productivity, and national productivity can be treated as the practical yardsticks for the increase of technology, industrial innovativeness, and global competitiveness of a country in the innovation process.

Apergis et al (2008) empirically asses long-run linkages between technology absorption and labour productivity by using co-integration analysis and panel-based unit root test for 21 manufacturing industries in European. They conclude that the impact of innovation and technology transfer on labour productivity is statistically significant and quantitatively important. Hall (2011) assess the effectiveness of using aggregate productivity growth as the indicator for innovation at country level. By using simple univariate regressions, he concludes that innovation and labour productivity is statistically significant. The correlation becomes more statistically significant when he applies robust methods including "Least Absolute Deviations" and "Least Median of Squares".

Because the root of innovation is firms activity but not economy or industry, and hence the aggregate analysis contain lots of heterogeneity problem. Criscuolo (2009) uses firms data to evaluate the link between innovation and labour productivity. He implies Crepon-Duguet-Mairesse model to analyse the innovation-productivity link in the sample of 18 countries. The author find out the strong linkage between innovation and productivity, which is consistent with macro evidences.

At country level, patent data cannot capture all innovation, the R&D expenditure measures input rather than innovative output (Criscuolo, 2009). Thus, I use value added as the proxy for the effectiveness of knowledge factor at country level. Zeghal and Maaloul (2010) emphasize that intellectual capital (knowledge factor) is considered as the main source of value creation (value added) in knowledge economy. They analyse the role of value added as an indicator for knowledge factor, its impact on the performance of firms. They calculate value added per invested monetary unit by resource (VAIC) and use as the proxy for the knowledge factor, then run the regression with firms performance indicators with the sample of high-tech industry, traditional industry, and services in United Kingdom. The authors conclude that VAIC is an effective indicator to assess and manage intellectual capital of companies.

In this analysis part, the labour productivity growth and value added are the proxy variables for the innovativeness and knowledge factor to assess state role and the industrialization process

of Vietnam, in comparison to Korea and Singapore. Because labour productivity growth is the proxy for the innovation process, the sectoral contributions to the aggregate productivity growth describe the tendency of economic restructuring and innovation status of an economy.

The industrialization strategy of Vietnam had a tendency of following arguments of new growth theory, while Korea and Singapore industrialization was much like the innovation theory. The industrialization strategy of Vietnam before 2015 was much dependent on comparative advantages with unskilled labour, and natural resources. Regarding to R&D market, the Vietnamese government let the market freely operated, and just applied some limit interventions via basic science research, tax incentives, developing intellectual property rights. Meanwhile, Singapore and Korea government established technology institutions, used state funds and state institutes to drive the R&D market and industrial sector toward high-tech manufacturing. The comparison between Vietnam and two East Asian tigers will lead to the answers for the debate between new growth theory and innovation theory in the aspect of industrialization based on comparative advantage vs industrialization based on promoting manufacturing towards high-tech activity; free R&D market vs state oriented R&D to absorb foreign knowledge.

In section 4.2 I assess the industrial structure and its impact on innovation process of Vietnam, in comparison with Singapore and Korea via collected statistics. In section 4.3, I applied Generalized Exactly Additive Decomposition to decompose the aggregate productivity growth. In section 4.4, I use the historical approach to assess innovation determinants and state policy of Vietnam in comparison with experience of some East Asian countries. State policy and its achievements in each country will be analysed to evaluate the impact of state policy on innovation determinants.

There is a note that Korea's GDP per capita was over US$1000 (constant 2010 price) in 1963. Vietnam economy reached that level in 2005. However, Singapore GDP per capita passed the level of US$ 3000 in 1960, even before separating from Malaysia (World Bank, 2018). Therefore, in this analysis part, I much focus on comparing the economic structure and the innovation process of Vietnam to Korea.

4.2 State policy, industrial structure, and innovation process of Vietnam, in comparison with Korea and Singapore

In fact, Korea and Singapore must experience a certain period of processing production and assembly manufacturing before shifting toward high tech manufacturing and knowledge intensive industries. These first Asian latecomer economies started to manufacture product innovations of Japan and western countries by importing necessary input for assembling simple products in mid-1960s. In early 1970s, Korea and Singapore tried to promote high-tech manufacturing, and then successfully shift their production method to design and manufacture electronics products such as display terminals, computer components, cameras, monitors, especially semiconductors in early 1980s (Hobday, 1995). The industrialization strategy of Vietnam before 2015 was different from Singapore and Korea. While Singapore and Korean government tried to shape economy towards high-tech manufacturing export master plans and national institutions during 1970s-1980s, Vietnamese government had not much attention in shaping economy toward these sectors before 2015. Instead, Vietnamese government tried to "exploit comparative advantages for developing mechanics, furniture, textiles, footwear, construction materials, petrochemical products, rubber products, and supporting industries for high-tech products"[11]. The industrialization strategy of Vietnamese governments was much depend on the comparative advantages of unskilled labour and natural resources.

[11] The government of Vietnam (2011), *Decision No. 2471/QD-TTg*

The difference in industrialization strategy were clearly visible though industrial structure. Compared to Singapore and Korean in 1970s, overall industrial structure of Vietnam economy in the period 2005-2015 was quite similar, the proportion of industry was around one-third of GDP (Figure 4.1). Excluding the contribution of resources exploitation activity, the share of industry in GDP had remained unchanged at around 23% for over ten years, while this share in Korea and Singapore continuously increased to over 30% in 1980. Figure 4.2 shows a critical different between Vietnam and first latecomer economies in industrial activity. Industrial activity of Vietnam was much depended on natural resources which accounted for on average 30% of industrial value added. Meanwhile, mining and quarrying activity accounted nearly 0% of industry value added in Singapore and just around 5% of industry value added in Korea during 1970s. The manufacturing contribution to industry value added of Vietnam was just around 40-45%, much lower than that number of Korea and Singapore (65-80%). In 2015, the proportion of manufacturing value added in GDP of Vietnam was just about 14% (figure 3.1), even smaller than the number of Singapore and Korea in 1970 which was about 17% (Word Bank, 2018). Thus, Vietnam economy did not have a structural shift toward manufacturing as what happened in Singapore and Korea in 1970s.

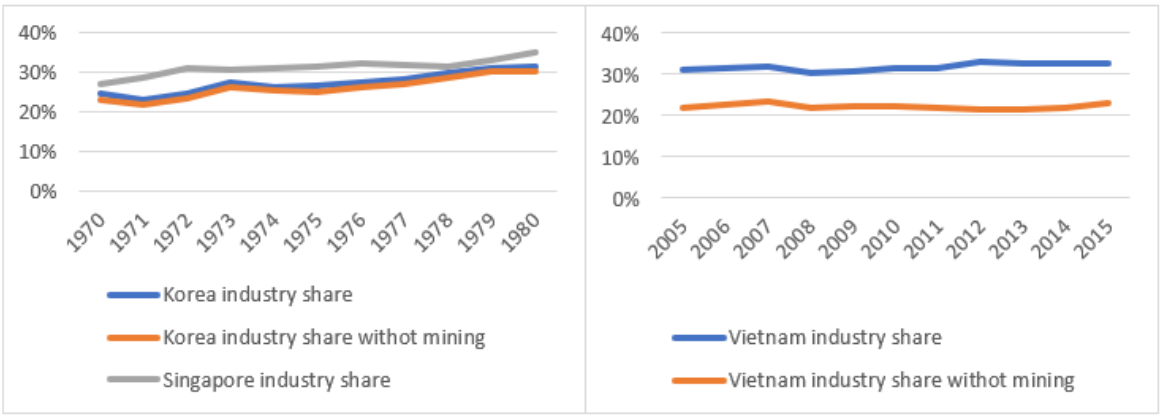

Figure 4.1: Industrial share in GDP of Singapore, Korea and Vietnam (include construction)
source: APO database 2017, using current domestic currency

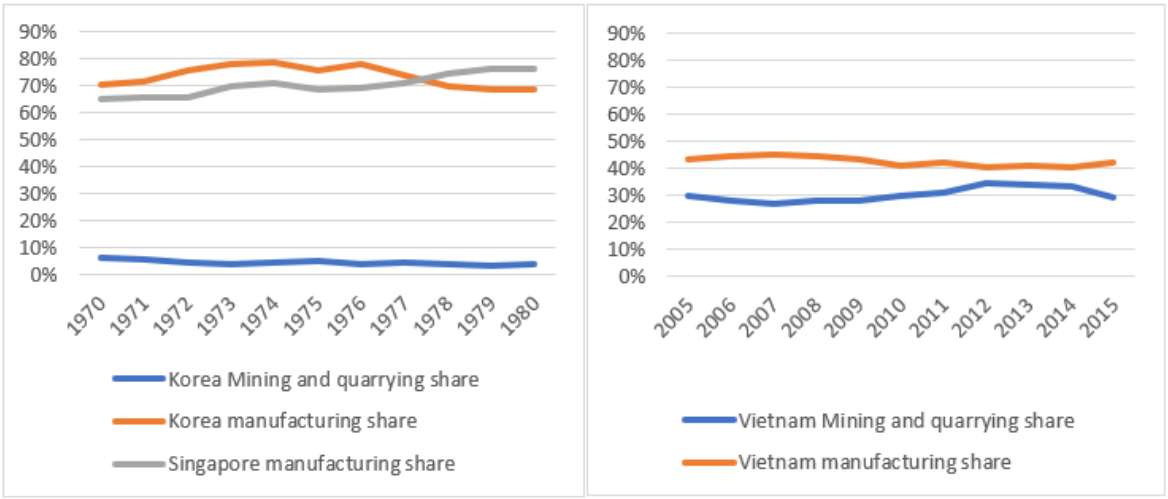

Figure 4.2: Share of Manufacturing, Mining and quarrying in Industry value added of Singapore, Korea, and Vietnam
source: APO database 2017, using current domestic currency

In 2009, the productivity level of Vietnam reached the status of Korea in early 1970s, with the GDP per person employed of Vietnam passed the threshold of US$ 8000 (constant 2011 PPPs prices). However, Table 4.1 (appendix) shows that both of GDP growth and productivity growth of Vietnam were much lower than Korea in 1970s. During the period of 2009-2015, the average growth rate of labour productivity in Vietnam was just 4.41%, much lower than the growth rate of 6.17% in Korea in 1970s. The low growth rate of Vietnam labour productivity shows that Vietnam's economy was less competitive and less effective than Korea. The different in industrial structure between Vietnam and Korea may be the cause of that economic growth and productivity growth of Vietnam was much lower Korea in take-off phase of both.

To assess the impact of industrial sector on innovation process of Vietnam, I compare the data of labour productivity growth of industry, labour productivity growth of economy, the share medium and high-tech manufacturing industry between Vietnam and Korean. At the first look, the trend line of labour productivity growth by sector in Vietnam and Korea was very different (figure 4.3). In the take-off period from mid-1960s to early 1980s, Korea had the trend line of labour productivity growth of industry at higher level than the trend line of entire economy. The correlation between industry productivity growth and aggregate productivity growth (economy) was quite high at 0.74. Meanwhile the trend line of labour productivity growth in Vietnam industry was always below the trend line of entire economy during 2001-2017. The correlation between industrial productivity and aggregate productivity in Vietnam was at just 0.24, extremely low compared to Korea. Figure 4.4 compares medium and high-tech manufacturing sector of Vietnam to Korea in take-off period of both countries. The share of medium and high-tech activity in total manufacturing value added of Korea rapidly increased from 28% to 38%. Meanwhile, this share of Vietnam remained constant at around 23-25% of total manufacturing value added.

The statistics show that industry of Vietnam was less effective and less innovative than Korea, since level of productivity growth was low and share of medium and high-tech sectors remain constant at low level. Besides that, Vietnam's industry has not locked into the path of manufacturing led industrialization. Because Vietnamese government built industrialization strategy based on comparative advantage, the industrialization of Vietnam was trapped in natural resource activity for too long, which caused low level of industrial productivity and the failure of modern oriented industrialization vision.

Compared to Korea take-off period, there are two weaknesses in the structure of industry in Vietnam: too much dependence on natural resources industry and too little medium and high-tech manufacturing activity. In comparison to Korea during 1970s, Vietnam industry structure before 2015 was less favourable for manufacturing development. Vietnam economy also was less effective and less competitive in the innovation process (low aggregate productivity growth). The ineffectiveness of the innovation process in Vietnam was predicted to be due to lacking manufacturing dynamics as an innovation engine to promote technological change. Section 4.2 will decompose labour productivity growth by sector to analyse the impact of manufacturing on the innovation process of Vietnam, in comparison with Singapore and Korea.

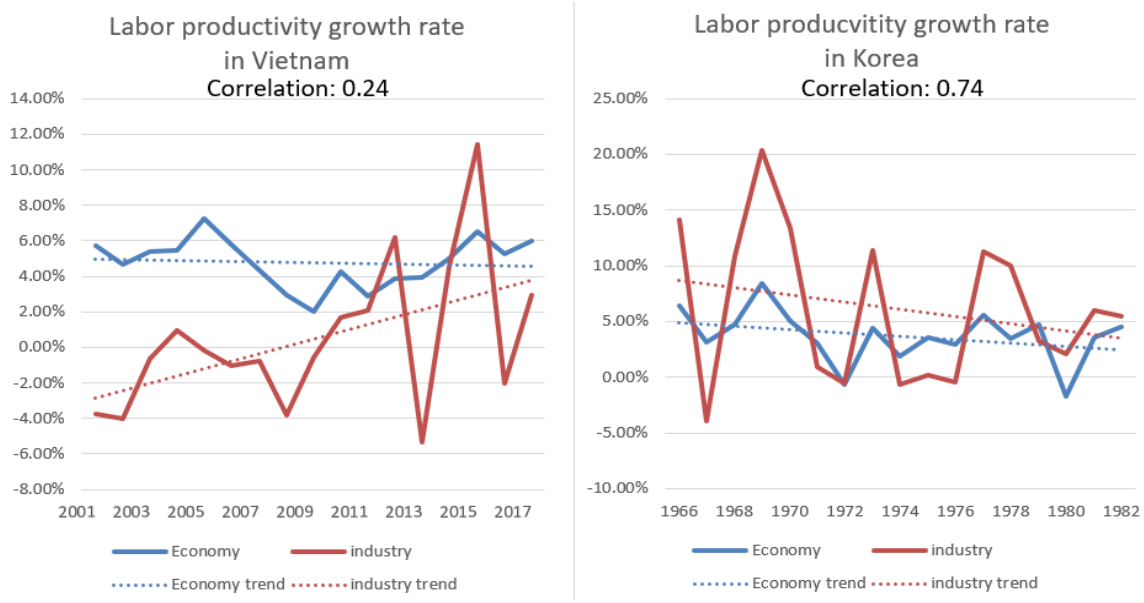

Figure 4.3: labour productivity growth rate by economy and industry in Korea and Vietnam
Source: GGDC 10-Sector Database, APO database 2017, Statistical yearbook of Vietnam 2017

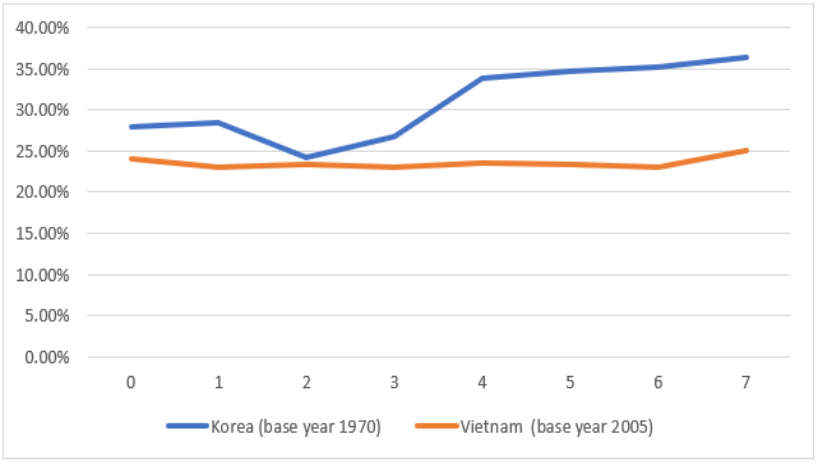

Figure 4.4: Share of medium and high-tech manufacturing sectors in total manufacturing value added in take-off period of Vietnam and Korea.
Source: GGDC 10-Sectors Database, UNIDO database

4.3 Labour productivity decomposition by sectors

4.3.1 Empirical model

There are three common methods to decompose the labour productivity growth by economic sectors including traditional formula (TRAD decomposition) developed by Denison (1962), the formula of Centre for the Study of Living Standards (CSLS decomposition) in the report of Sharpe (2010), Generalized Exactly Additive Decomposition (GEAD) developed by Tang and Wang (2004). According to Avillez (2012), although the TRAD, CSLS, and GEAD share the same assumption that "real output is calculated in constant prices using fixed-base Laspeyres quantity and Paasche price indexes at both the aggregate and sectoral levels, hence real aggregate output is equal to the sum of real sectoral output", each decomposition methods have different formula for sectoral contribution to aggregate productivity growth. In the sample test, Avillez proved that although TRD, CSLS and GEAD have the similar results for aggregate labour productivity growth, the results for sectoral contributions are different, and GEAD is more effective to explain the contribution of sectoral labour productivity and structural change

to the aggregate growth[12]. Therefore, I apply the GEAD method to decompose the labour productivity growth in Vietnam, Singapore, and Korea. GEAD equation is as below:

$$G_t = \sum_i \left[\frac{Y_{t-1}^i}{Y_{t-1}} G_t^i + \frac{Z_{t-1}^i}{Z_{t-1}} (p_t^i l_t^i - p_{t-1}^i l_{t-1}^i) + \frac{Z_{t-1}^i}{Z_{t-1}} (p_t^i l_t^i - p_{t-1}^i l_{t-1}^i) G_t^i \right] \quad (1)$$

In which, at time t

$$Z_t = \frac{X_t}{L_t}; \quad Z_t^i = \frac{X_t^i}{L_t^i}; \quad G_t = \frac{Z_t - Z_{t-1}}{Z_{t-1}}; \quad G_t^i = \frac{Z_t^i - Z_{t-1}^i}{Z_{t-1}^i};$$

$$P_t = \frac{Y_t}{X_t}; \quad P_t^i = \frac{Y_t^i}{X_t^i}; \quad p_t^i = \frac{P_t^i}{P_t}; \quad l_t^i = \frac{L_t^i}{L_t};$$

G_t: aggregate labour productivity growth; G_t^i: sectoral labour productivity growth;

Y_t: nominal aggregate output; Y_t^i: nominal sectoral output;

X_t: real aggregate output (constant price); X_t^i: real sectoral output (constant price);

Z_t: real aggregate productivity; Z_t^i: real sectoral productivity;

L_t: total labour input; L_t^i: sectoral labour input;

P_t: price index of aggregate output; P_t^i: price index of sectoral output;

p_t^i: relative price index of each sector;

l_t^i: share of sectoral labour in total labour input;

In the equation (1), the first component is within sector productivity growth effect (WSPGE), the second component is static structural reallocation effect (SSRE), the third component is dynamic structural reallocation effect (DSRE). WSPGE measures the contribution to growth of aggregate labour productivity relating to the increase of labour productivity of each sector. SSRE measures the effects that resources shift from relatively low productivity sectors to relatively high productivity sectors and vice versa. DSRE measures the effect that resources shift out of sectors where productivity reduce and vice versa. WSPGE is the pure contrition of sector to aggregate productivity growth, the aggregate productivity growth will equal to total sum of WSPGE if there are no movement of resources and labour among sectors. The sum of SSRE and DSRE represent for the impact of resources movement (including labour) among sectors.

4.3.2 Data and sample

Data was collected from APO database 2017. To compare the economic structure in labour productivity growth in the take-off periods, Vietnam total sample is the period 2006-2015 broken down to 2006-2010 subsample and 2011-2015 subsample. Total sample for Korea and Singapore is period 1971-1980 broken down to 1971-1975 subsample and 1976-1980 subsample.

[12] The growth rate in this part is calculated as the arithmetic average of annual rates

4.3.3 Results

Table 4.2 (appendix) contains the results of decomposition labour productivity by industry of Vietnam during 2006-2015 with two subsamples. With the whole sample, Vietnam aggregate productivity grew with 3.95% per annual. In the period 2011-2015, aggregate labour productivity was 4.51% per annual, faster than period 2006-2010 with 3.4% per annual.

On average, industrial sector accounted for about 37% of aggregate labour productivity growth in all three samples. However, during period 2006-2010, the industrial sector had negative WSPGE, meaning that the productivity of industry was decreased. The source of industrial contribution to aggregate productivity growth came from resources shift toward industry (SSRE + DSRE = 1.4%). In contrast, during 2011-2015, industrial sectors kicked off its labour productivity growth with WSPGE of 1.46% (the highest WSPGE among three sectors), the impact of resources move turned into small (SSRE + DSRE = 0.06%). Results of 2011-2015 sample indicates that industrial sector became more effective and innovative than before. The resources also shift from agriculture sector towards industry and services.

Regarding to manufacturing activity (Table 4.3, appendix), the contribution of manufacturing industry to the aggregate productivity growth also increased by time from 12% (2006-2010) to 17% (2011-2015). Meanwhile, the contribution of agriculture and non-manufacturing industry reduced. Agriculture contribution accounted for 17% of aggregate productivity growth during 2006-20015, then reduced to just 10% of the growth. Non-manufacturing industry contribution to productivity growth decreased from 26% (2006-2010) to 21% (2011-2015). Especially, WSPGE of manufacturing rapidly increase from 0.45% (2006-2010) to 0.82% (2011-2015), meaning that innovation process in manufacturing industry become more effective and more competitive. By using labour productivity growth as the proxy for innovation, the decomposition results of Vietnam during 2006-2015 shows that manufacturing sector positively influence the innovation in industry and have increasingly important role in the innovation process. However, the sum of SSRE and DSRE was always negative. It means that the resources had a trend of moving out of manufacturing industry in Vietnam, which reduced the contribution of manufacturing to aggregate productivity growth. This phenomenon did not occur in the take-off periods of Korea and Singapore.

Table 4.4 and 4.5 show the result of labour productivity decomposition by sector in Korea, and Singapore. In the period 1971-1980, the contribution of industrial sector to aggregate productivity growth in Korea and Singapore were 48% and 64%[13]. Manufacturing contribution to aggregate productivity growth was 34% for Korea and 59% for Singapore. Especially, the manufacturing contribution was 99% of aggregate productivity growth during 1976-1980 in Singapore. Thus, the impact of industrial sector and manufacturing industry on the aggregate productivity growth in Korea and Singapore were stronger than in Vietnam. The sum of SSRE and DSRE for Korea and Singapore were positive during 1971-1980, meaning that resources flowed into manufacturing sector and strengthen the impact of manufacturing industry on the aggregate productivity growth and national innovation.

Although Vietnam and Korea had similar productivity level in the take-off periods (Table 4.1), the productivity growth of Vietnam industry was 0.75% and just half of Korea with 1.51%. Besides that, growth of manufacturing productivity in Korea was also over 2.3 times in Vietnam. The results of decomposition labour productivity in Vietnam (2006-2015), Korea and Singapore (1971-1980) point out four main tendencies of Vietnam industrialization:

1. Medium share of industrial contribution on aggregate productivity, but it was still lower than Korea and Singapore in take-off periods.

[13] Industrial sector or industry = manufacturing industry + non-manufacturing industry

2. Vietnam manufacturing sector had some impact on growth of industrial productivity in Vietnam, but much less than Korea even when Vietnam reached the productivity level of Korea.
3. Resources moved into industrial sector but flowed out of manufacturing sector in Vietnam. This phenomenon was opposite to manufacturing sector of Korea and Singapore.
4. Manufacturing sector in Vietnam contributed to aggregate productivity growth at low level. Meanwhile, manufacturing sector strongly contributed to the aggregate productivity growth of Korea and Singapore.
5. Even with similar productivity level, Vietnam manufacturing productivity grew with much lower speed than Korea.

In the section 4.1 and 4.2, data about industrial structure and labour productivity growth by sector show that the industrialization strategy of Vietnam had certain achievements about technological innovation. However industrial structure of Vietnam was less favourable for manufacturing, the contribution of industrial sector and manufacturing industry (in %) to aggregate labour productivity growth also less than Singapore and Korea in the take-off periods.

The findings indicates that industrialization strategy of Vietnam was less effective and less innovative than industrialization strategy of Korea. Despite of similar productivity level, the manufacturing productivity growth, industrial productivity growth, and speed of innovation process (represented by aggregate productivity growth) of Vietnam had been much lower than Korea. Lower speed of innovation process in Vietnam proved the critical role of government in orientating industrialization and technological change. The difference in choosing strategic sectors for industrialization process leads to the different in industrial structure, manufacturing innovativeness, and innovation effectiveness.

In the context of Vietnam, the argument of new growth theory about comparative advantage has certain achievements in the process of innovation and industrialization. However, in the comparison of Vietnam with Korea and Singapore, the argument of innovation theory about promoting manufacturing toward high-tech activity under state orientation is better. In next section, I will evaluate the effectiveness of free R&D market and state orienting R&D.

4.4 Assessing innovation determinants and state role of Vietnam

4.4.1 Export structure and knowledge factor of Vietnam

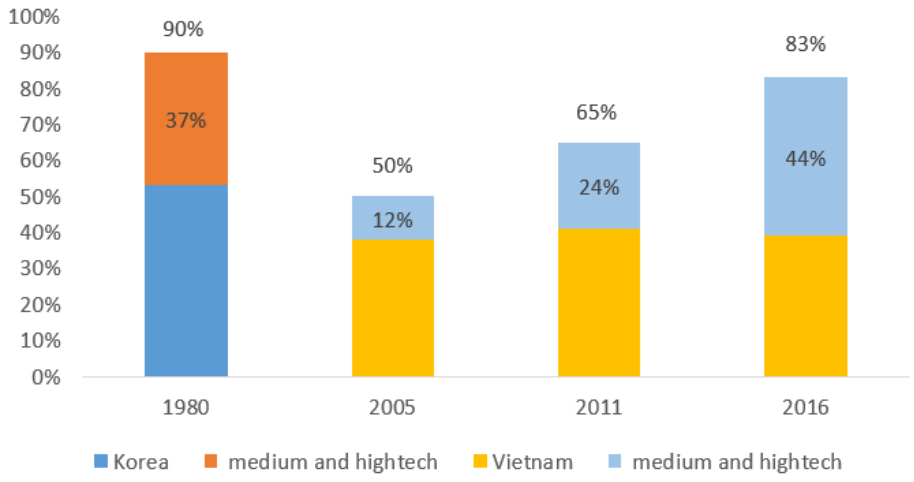

Figure 4.5: Share of manufacturers in merchandise export of Vietnam and Korea
Source: calculated from SITC rev 2 data, UN Comtrade database

In the literature review about innovation theory, global market force and foreign knowledge were consider as two determinants for innovation process in industrial sector. The manufacturing development and innovation process of industrial sector in Vietnam during 2005-2015 and Korea in 1970s were inseparable from these two determinants. As shown in the Figure 5.5, the export structure of Vietnam has become more like Korea in 1980. The share of manufacturing products in Vietnam's export has rapidly increased from 50% in 2005 to 83% 2016. The share of medium and high-tech manufacturing products started by 12% in 2005 and then increased by more than three times to reach the level of 44% in 2016. Total manufacturers exports of Vietnam in 2016 was nearly 150 billion US dollar (current prices) [14], equal to about 72% GDP of Vietnam. Data indicates a trend of Vietnam's export since 2005 that the has moved toward manufacturing export with large proportion of medium and high-tech products. In parallel with the rapid growth and structural shift of Vietnam's export, the labour productivity of manufacturing industry for period 2011-2015 grew at nearly double growth speed of period 2005-2006. The total productivity growth of manufacturing industry was just 0.45% per annual during 2006-2010, then rapidly increased to 0.82% during 2011-2015 (Table 4.3).

However, despite of similar trend of manufacturing export structure, manufacturing industry in Vietnam during 2011-2015 was less innovative than Korea during 1970s, since the manufacturing productivity growth of Vietnam was just half of Korea. Labour productivity of manufacturing industry in Korea during 1970-1980 grew with 1.48% per annual, contributed to more than 30% of labour productivity growth of Korea (Table 4.4). The underlying reason for this critical difference between Vietnam and Korea in take-off periods is the difference in knowledge factor. By using value added as the proxy for the knowledge factor, figure 4.4 indicates that Korea manufacturing sector accumulated more new knowledge to move out of basic technology towards medium and high-tech activity, while Vietnam manufacturing sector remained the large proportion of basic technology. The ineffectiveness of knowledge factor in manufacturing and industrial sector of Vietnam has made the innovation process stuck in the stage of technology adoption.

The difference in technology policy between Vietnam and Korea government caused the difference in knowledge factor of two countries. Vietnamese government did not have a specific strategy to promote technological internalization of high-tech manufacturing before 2018, while Korea government implemented a clear master plan of high-tech development in early of 1970s.

As I mentioned in chapter 2.3, to develop high tech industries, especially electronics and semiconductor, Korean government directly oriented high-tech R&D activity via state institutions and instruments, such as Korea Electronics Industry Cooperative founded in 1967, National Council of Since and Technology founded in 1973, law of "Promotion of Technology Development" enacted in 1973, six-year plan of technology development in 1974, Electronics Telecommunications Research Institute founded in 1976. Korea government used these institutions and instruments to promote technology acquisition of foreign license, create a channel for technology transfer, and upgrade domestic capacity of technological internalization in new modern industries. Meanwhile, only until 2018, the master plan of high-tech development based on foreign technological internalization was newly mentioned in the restructuring industry plan of Vietnam Ministry of Industry and Trade.

Before 2018, the state vision for Vietnam's technology innovation tended to be free R&D market and domestic technology push. Meanwhile Korea government in 1970s oriented R&D activity towards foreign technology acquisition to generate innovations. The tendency of free R&D market and domestic technology push was shown clearly in the "Strategy for

[14] SITC rev 2 dataset, UN Comtrade (2018)

development of science and technology in the period 2011-2020" of Vietnamese government, which set the goals of:

- improving the capacity of universities for basic research
- encouraging the applied research in enterprises
- investing in technology infrastructure
- promoting intellectual property rights
- pilot cooperation to establish several advanced foreign-invested science and technology institutes in Vietnam

Within the innovation theory, developing countries like Korea before 1990 and Vietnam now should enhance "absorptive capacity" to take advantage of available technology from foreign countries to generate innovations instead of investing in basic research and developing new domestic technology. The state orientation about technology acquisition and internalization was the most crucial difference in the technology development policy between Vietnam (before 2018) and Korea (during 1970s-1980s), which lead to a huge difference in the performance of high-tech sector between Vietnam and Korea.

During the period from 1970s to 1980s, Korea government played an important role in nurturing the foundation of high-tech technology via policy instruments, researching institutes funded by state, public-private joint venture projects. In response to Korea government efforts, starting with small scale and unsuccessfully operation in early 1970s, some high-tech industries in Korea started to experience a boom since late 1970s with a spate of investments from Chaebols. In 1979, Kumi complex of Korea successful built up a facility of wafer-fabrication having full capability to produce 16K Drams (most modern technology at that time). In early of 1980s, Chaebols focus on mass production of semiconductors manufacturing. In mid-1980s, successful Chaebols like Goldstar, Samsung, LG, Hyundai, had full capacity to design and produce their own Drams innovation, then directly compete with US and Japan companies at global market. In mid 1990s, Korea became the global player in electronics and semiconductors sector. (Mathews and Cho, 2007).

In contrast to Korea, Vietnam high-tech industry had a different picture that domestic companies in Vietnam (even joint-venture companies between FDI and domestic investors) fault to upgrade technology to produce high-tech products. Although electronics export accounted for 14% of total export and 58% of high-tech export in 2011, domestic value added in electronics export, was just about 30%. The domestic value-added share in gross electronics export of Vietnam was lower than all researched countries (Figure 4.6). The low share of domestic value-added shows the ineffective of knowledge factors in manufacturing export sector in Vietnam. In 2016, most of high-tech production of Vietnam came from Samsung Electronic Vietnam (100% FDI), which was over US$ 40 billion, equal to about 66% of high-tech exports[15]. However, the main activity of Samsung Vietnam is assembling imported high-tech electronics components, thus the Export-Import ratio for the electronics sector of Vietnam in 2016 was just 1.297[16].

The results indicate that the technology strategy of Vietnam was less innovative than Korea. Under the state guidance about technology acquisition and technology development, Korea firms successfully develop their own innovations and sale their innovative products at international markets (Mathews and Cho, 2007). In context of Vietnam and Korea, the state

[15] High-tech export codes: 716 + 718 + 751 + 752 + 759 + 761 + 764 + 771 + 774 + 776 + 778 + 524 + 541 + 712 + 792 + 871 + 874 + 881. Source: SITC rev2 dataset, Un Comtrade (2018)

[16] Electronic sector codes: 759 + 764 + 772 + 776 + 751 + 752 + 761 + 762 + 763 + 775. Source: SITC rev3 dataset, UN Comtrade (2018)

intervention is important to enhance the knowledge factor. The success of Korea policy proved that state oriented R&D activity to absorb foreign technology is more innovative than free R&D market.

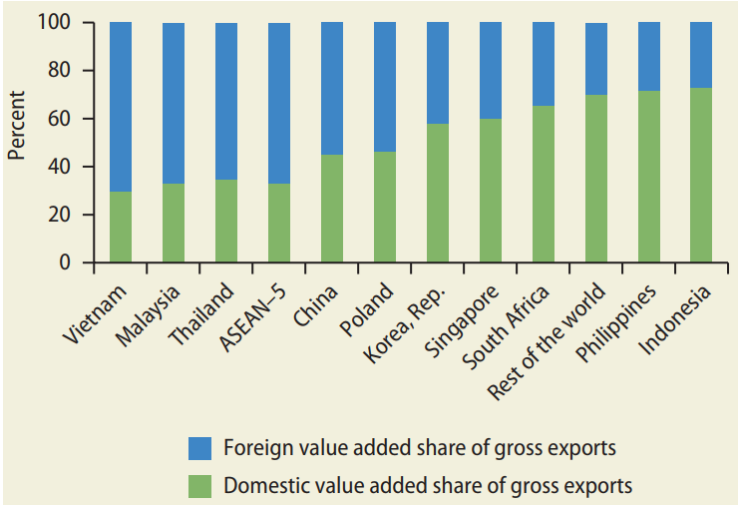

Figure 4.6: Content of electronics export in 2011
Source: World bank, 2016

4.4.2 Fiscal policy and institutional structure

The rapid increase of manufacturing export in Vietnam since 2011 has been inseparable from fiscal policy and institutional framework which had edited to promote manufacturing activity and manufacturing export since 2010. In 2010, to encourage manufacturing production, the government exempted import tax for strategic products including: i) equipment and machinery, ii) specialized transportation vehicles used in technology line, iii) parts and components for i and ii, iv) raw materials and supplies for equipment and machinery (which cannot be produced by domestic companies), v) imported goods for producing export goods. The government also exempted import and export tax for manufacturing goods being assembled in Vietnam, reduced 50% personal income tax for foreign experts and employees in economic zones to attract manufacturing FDI[17]. Besides that, the government remained high share of state investment on utility (water, gas, electric, waste treatment, air conditioning), storage and transportation to support manufacturers having competitive input costs and attract FDI. The sum of investment on utility, storage and transportation accounted for on average 36% of state investment, 14% of total investment (state and non-state investment) during 2011-2016.

Therefore, manufacturing sector of Vietnam had an significant improvements since 2011. Manufacturing labour productivity growth during 2011-2015 was nearly double in the period 2006-2010. Although Vietnam did not appear in the top 26 most competitive countries in manufacturing sector in 2010, Vietnam was ranked at No. 18 in 2016 and predicted to rank up to No. 12 in 2020 (Roth et al 2010; Giffi et al 2016). With low labour wages, large amount of state investment in utility and transportation, preferential tax policy, manufacturing sector in Vietnam become more attracted to foreign investors. The proportion of manufacturing FDI in total accumulated FDI rose from around 50% during 2005-2010 to nearly 60% in 2016 (GSO, 2011; GSO, 2016). The increase of FDI, gross export, and labour productivity in manufacturing sector proved the effectiveness of promotion policy of manufacturing export since 2010.

However, only export promotion based on FDI manufacturer is not enough for Vietnam economy to move far in the innovation process for generating technology shift toward high-

[17] The government of Vietnam (2010), *Decree No. 87/2010/NĐ-CP*

tech manufacturing and knowledge intensive economy. The speed of innovation in Vietnam still lower than Korea during 1970s, at the similar production level. East Asian industrialization process shows that the stage of technological internalization and technology shift should be driven by local enterprises. These local enterprise need the government support in both of technology and finance to scale up, enhance global competitive capacity, and generate own innovations. Thus, to activate the stage of technological internalization and then promote technology shift, Vietnamese government need to find out solutions to enhance technology absorptive capacity for domestic firms, allocate financial resource toward effective manufacturing firms.

Chapter 5. Conclusion

Joining into the debate about the role of state in the innovation process between new growth theory and innovation theory, the undertaken analysis in this research concludes that the state orientation for the industrialization process is crucial, which influences the speed of innovation process and technological change.

At the similar level of the aggregate productivity, economic structure, and export structure, the innovation process of Vietnam was less effective than Korea due to the different in state orientation of industrial sector and national R&D activity. Vietnamese industrialization strategy was stick with arguments of new growth theory including comparative advantages, free market and tax incentive for R&D activity, intellectual property rights, basic science investments. Meanwhile, Korea industrialization was stick with arguments of innovation theory that the governments used state institutions and state instruments to shape economy and R&D activity towards high-tech manufacturing export, improving absorptive capacity relating foreign technology. The successes of chaebols and large contribution of manufacturing sector on high labour productivity growth were the evidence for the effectiveness of Korea's industrialization policy and innovation theory.

Therefore, to boost up the speed of innovation and technological change, Vietnamese government should implement new industrialization strategy to move to the stage of technological internalization in the innovation process. Based on Korea and Singapore industrialization experience during 1970s-1980s, the Vietnamese government can consider some solutions to activate technological internalization process:

- Restructuring industry moving out of comparative advantages (unskilled labor-intensive manufacturing and natural resources industry), shifting towards high-tech manufacturing export.
- Enhancing technological absorption and innovation capacity of domestic firms via state R&D institutes, public-private joint venture R&D projects, high-tech manufacturing association, hi-tech complex supported by state, state funds for foreign technology acquisition.
- Supporting effective domestic enterprises in high-tech sectors scale up. Banking system and fiscal policy must be designed to ensure the sufficiency of capital and investment incentive in high-tech sectors. At the same time, the state must remain high level of monitoring technical progress and effectiveness of companies supported by state. The government can establish a special department about technology innovation to maintain the pressure of technological innovation on domestic firms.

This study also has some limitations which need to be noted. Firstly, the empirical analysis, which is labour productivity decomposition by sector, examines the impact of industrial structure on the innovation process, but it does not evaluate the direct impact of industrial strategy on the innovation process. In context of Vietnam, Singapore, and Korea, I assess the impact of state role on the innovation process via using industrial structure because industrial structure is dominated by state orientation and state targets about industrialization. The empirical results show the effectiveness of state interventions but does not fully capture the impact of state policy on innovation process. Secondly, I use the descriptive statistic and historical approach to evaluate the state impacts on innovation determinants. This means that the correlations and causal links between state policy and innovation determinants is not tested.

Annex

Table 3.1: Target and reality of economic indicators			
Indicator	average GDP growth for 2011-2015 *	labour productivity in 2015	TFP contribution to growth in 2011-2015
Target	6.5-7% per annual	4000USD/worker	35%
Reality	5.99% per annual	3667USD/worker	30% **
calculated by author, source: APO 2017 database * overlapping growth rate **calculated by Nguyen et al (2017)			

Table 3.2: Employee compensation by county (current US$)						
Country	2011	2012	2013	2014	2015	Average
Compensation per worker per year						
Vietnam	2,021	2,306	2,511	2,702	2,683	2,445
Thailand	6,249	7,201	7,192	7,029	6,617	6,858
China	5,428	6,197	7,303	7,941	8,105	6,995
Korea	25,147	28,334	29,325	28,884	27,668	27,872
Compensation per hour worked						
Vietnam	0.81	0.95	1.05	1.19	1.18	1.04
Thailand	2.76	3.21	3.26	3.19	3.07	3.10
China	2.54	2.90	3.43	3.74	3.83	3.29
Korea	11.29	12.48	13.40	12.97	12.27	12.48
Calculated by Author, Source: APO database 2017						

Table 3.3: Average Labour productivity growth in Vietnam			
Period / Productivity	2001-2005	2006-2010	2011-2015
National level			
GDP per worker	5.70%	3.39%	4.82%
GDP per hour worked	6.37%	2.72%	6.72%
Manufacturing sector			
GDP per worker	3.42%	1.98%	4.80%
The average growth rate is the overlapping growth rate for periods Source: calculated by domestic currency (constant 2015 price), APO database 2017			

Table 4.1: GDP growth and labour productivity growth of Korea during 1970-1976, Vietnam during 2009-2015									
		1970	1971	1972	1973	1974	1975	1976	Average*
Korea	GDP Growth	-	10.45%	7.15%	14.83%	9.46%	7.86%	13.12%	10.44%
	Labour Productivity	**8343**	8939	9201	10052	10574	11155	11948	
	LP.growth	-	7.13%	2.93%	9.26%	5.19%	5.50%	7.11%	**6.17%**
Vietnam		2009	2010	2011	2012	2013	2014	2015	
	GDP Growth	-	6.52%	6.33%	5.36%	5.49%	6.06%	6.73%	6.08%
	Labour Productivity	**8112**	8461	8705	9041	9396	9864	10510	
	LP.growth	-	4.30%	2.89%	3.85%	3.93%	4.99%	6.54%	**4.41%**

Labour productivity: GDP per person employed
LP.growth: labour productivity growth.
* over lapping growth rate
Source: APO database 2017, using US$ constant 2011 PPPs price

Table 4.2: Labour productivity growth by industry in Vietnam					
	Within Sector Effect	Reallocation Level Effect	Reallocation Growth Effect	Total	$\frac{Sector}{Aggregate}$ (%)
2006-2015					
Agriculture	0.84%	-0.26%	-0.05%	0.54%	14%
Industry	0.75%	0.81%	-0.08%	1.48%	37%
Service	1.24%	1.06%	-0.36%	1.94%	49%
Aggregate	2.82%	1.62%	-0.49%	3.95%	100%
2006-2010					
Agriculture	0.83%	-0.24%	0.00%	0.59%	17%
Industry	-0.13%	1.46%	-0.07%	1.27%	38%
Service	1.01%	0.52%	0.01%	1.55%	45%
Aggregate	1.71%	1.75%	-0.06%	3.40%	100%
2011-2015					
Agriculture	0.85%	-0.27%	-0.09%	0.48%	11%
Industry	1.62%	0.16%	-0.10%	1.69%	37%
Service	1.46%	1.60%	-0.73%	2.34%	52%
Aggregate	3.94%	1.49%	-0.92%	4.51%	100%

Source: APO database 2007, using national currency
Labour productivity growth for the period is the arithmetic average of years

Table 4.3: Labour productivity growth by sectors in Vietnam					
	WSPGE	SSRE	DSRE	Total effect	$\frac{Sector}{Aggregate}$ (%)
2006-2015					
Agriculture	0.84%	-0.26%	-0.05%	0.54%	14%
Manufacturing industry	0.64%	-0.04%	-0.02%	0.58%	15%
Non-manufacturing Industry	0.11%	0.85%	-0.06%	0.90%	23%
Service	1.24%	1.06%	-0.36%	1.94%	49%
Aggregate	2.82%	1.62%	-0.49%	3.95%	100%
2006-2010					
Agriculture	0.83%	-0.24%	0.00%	0.59%	17%
Manufacturing industry	0.45%	-0.05%	-0.01%	0.39%	12%
Non-manufacturing Industry	-0.58%	1.51%	-0.05%	0.87%	26%
Service	1.01%	0.52%	0.01%	1.55%	45%
Aggregate	1.71%	1.75%	-0.06%	3.40%	100%
2011-2015					
Agriculture	0.85%	-0.27%	-0.09%	0.48%	10%
Manufacturing industry	0.82%	-0.04%	-0.03%	0.76%	17%
Non-manufacturing Industry	0.80%	0.20%	-0.07%	0.93%	21%
Service	1.46%	1.60%	-0.73%	2.34%	52%
Aggregate	3.94%	1.49%	-0.92%	4.51%	100%
Source: APO database 2007, using national currency Labour productivity growth for the period is the arithmetic average of years					

Table 4.4: Labour productivity growth by sectors in Korea					
	WSPGE	SSRE	DSRE	Total effect	$\frac{Sector}{Aggregate}$ (%)
1971-1980					
Agriculture	0.78%	-0.78%	-0.07%	-0.07%	-1.49%
Manufacturing industry	1.48%	0.20%	-0.03%	1.65%	33.56%
Non-manufacturing Industry	0.03%	0.73%	-0.05%	0.71%	14.42%
Service	1.47%	1.21%	-0.06%	2.62%	53.51%
Aggregate	3.75%	1.36%	-0.21%	4.90%	100.00%
1971-1976					
Agriculture	0.96%	-0.07%	-0.02%	0.86%	18.65%
Manufacturing industry	1.25%	0.34%	0.01%	1.60%	34.69%
Non-manufacturing Industry	0.05%	0.18%	-0.09%	0.13%	2.86%
Service	2.37%	-0.27%	-0.08%	2.02%	43.80%
Aggregate	4.62%	0.18%	-0.19%	4.61%	100.00%
1976-1980					
Agriculture	0.61%	-1.49%	-0.12%	-1.01%	-19.37%
Manufacturing industry	1.69%	0.07%	-0.07%	1.69%	32.55%
Non-manufacturing Industry	0.01%	1.29%	-0.01%	1.28%	24.69%
Service	0.56%	2.70%	-0.03%	3.23%	62.13%
Aggregate	2.88%	2.55%	-0.23%	5.20%	100.00%
Source: APO database 2007, using national currency Labour productivity growth for the period is the arithmetic average of years					

Table 4.5: Labour productivity growth by sectors in Singapore					
	WSPGE	SSRE	DSRE	Total effect	$\frac{Sector}{Aggregate}$ (%)
1971-1980					
Agriculture	0.15%	-0.18%	-0.03%	-0.06%	-2.35%
Manufacturing industry	0.43%	1.14%	-0.09%	1.47%	58.73%
Non-manufacturing Industry	0.30%	-0.11%	-0.07%	0.12%	4.78%
Service	1.84%	-0.80%	-0.06%	0.97%	38.84%
Aggregate	2.71%	0.04%	-0.25%	2.51%	100.00%
1971-1976					
Agriculture	0.17%	-0.15%	-0.03%	-0.01%	-0.29%
Manufacturing industry	0.19%	1.52%	-0.20%	1.50%	42.28%
Non-manufacturing Industry	0.91%	-0.40%	-0.11%	0.40%	11.23%
Service	2.40%	-0.64%	-0.09%	1.66%	46.78%
Aggregate	3.67%	0.33%	-0.44%	3.56%	100.00%
1976-1980					
Agriculture	0.13%	-0.22%	-0.02%	-0.11%	-7.39%
Manufacturing industry	0.67%	0.75%	0.02%	1.44%	98.89%
Non-manufacturing Industry	-0.32%	0.19%	-0.03%	-0.16%	-10.95%
Service	1.28%	-0.97%	-0.03%	0.28%	19.45%
Aggregate	1.76%	-0.25%	-0.05%	1.46%	100.00%

Source: APO database 2007, using national currency
Labour productivity growth for the period is the arithmetic average of years

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