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A comparative analysis of Singapore and Malaysia: Is there a general pattern for catching-up economies?

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Abstract: This paper aims at identifying the general determinants of the catching-up process. A tentative theory of catch-up, which takes several conventional determinants into account, is deliberately set up on the basis of previous research in this area. The comparative analysis of Singapore and Malaysia provides empirical evidences for testing those determinants. This study mainly focuses on the role of structural change in the catching-up process, while some other determinants including TFP, FDI, export, and the relationships among them are investigated as well. The study result suggests that structural change does not necessarily lead to success in the catching-up, although it significantly contributes to it. Instead, the successful catching-up is determined by internal labor productivity. It also bears out that in contradiction to conventional views, TFP plays decisive role in the catching-up economies. The role of export, as well FDI, is emphasized; however, there plausibly exists thresholds regarding the effect of FDI.

Key words: Structural change, catch-up, TFP, export, FDI

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Introduction

The essential economic divergence across countries emerged after 1800, whereas up to then the Malthusian Trap had “kept incomes within a range narrow by modern standards”¹. Afterwards although it is still controversial, the practical experience of world economy’s development in the recent years to some extent has borne out that there could be incremental effect, namely the Matthew Effect², in countries’ economic growth. To be precise, there is convergence trend within richest economies (OECD countries in particular), while divergence trend exists in comparison between rich and poor economies. In this sense, therefore, the phenomenal achievement in economic development in East Asian economies over the last decades has attracted great attention not only for the economic achievement itself, but also for giving important clues for catching-up economies. Undoubtedly, the realization of less developed economies’ catching-up with advanced economies would be economically and politically conducive to both poor and rich economies. This paper thus aims at identifying the driving force for the catching-up process so as to provide reliable criteria or empirical lessons for economic and political policy prescriptions for potential catching-up economies.

To identify the driving force for catching-up process, the essential problem is to decompose the economic growth over the investigated period. There are many conventional economic growth theories and models from different perspectives. Considering the specific purpose of this study, however, theories and models are inappropriate for being employed if they concern more general factors rather than the idiosyncrasies of catching-up economies. It’s the previous researches on catching-up economies that have shed some lights on the analysis methods that could be applied for this study. Fortunately, the catching-up process finished by East Asian economies is not completely a new thing. Both Germany and the United States had caught up with and overtaken Britain in the 20th century. S. N. Broadberry gives an explicit explanation for Germany and the United States’ prominent

¹ Gregory Clark, *A Farewell to Alms: A Brief Economic History of the World*, 2006, Page 1

² In short, the Matthew Effect could be described as “the rich get richer and the poor get poorer”.

economic performances by applying sectoral analysis³. Following Broadberry's approach, this paper looks into the role of structural change in the catching-up process. On the other hand, the role of factor accumulation, as well as the roll of Total Factor Productivity (TFP), will also be investigated.

The aim of this paper is to identify the universal determinants of catching-up process. Whether these determinants are conducive to sustainable economic growth is not investigated. Neither is its purpose to calculate the accurate coefficients of these determinants contributing to overall economic growth.

The review of Broadberry's conclusion on Germany and the United States' experience qualitatively introduces several determinants of catch-up process, which will be examined by the quantitative analysis of East Asian economies. Meanwhile, countries that finally failed to realize the catching-up process will be discussed for comparison, as natural experiments.

Economic growth theories

Various factors that account for economic growth can be identified based on different theories and models, for instance, capital and labor investment based on the basic Solow Growth Model, and the level of saving and the productivity of investment based on the Harrod-Domar Model. However, most of these theories and models focus on the general pattern of economic growth, which makes it hard to explain the extraordinary economic performances of catching-up economies comparing to their contemporaries given the generally same condition. Special approach that emphasizes the idiosyncrasy of catching-up economies is thus needed for distinguishing their unique driving force.

Theoretically, the economic growth which is measured by increase in GDP per capita in this paper can be achieved either through more input of production factors (labor and /or capital), or through better use of input, which can be measured by TFP. Factor accumulation was deemed as the determinant of East Asian economies' take-off. As Paul Krugman states:

³ Stephen N. Broadberry, How Did the United States and Germany Overtake Britain? A Sectoral Analysis of Comparative productivity Levels, 1870-1990, *The Journal of Economic History*, Vol. 58, No. 2 (Jun., 1998), pp. 375-407

“Asian growth, like that of the Soviet Union in its high-growth era, seems to be driven by extraordinary growth in inputs like labor and capital rather than by gains in efficiency.”⁴ On the other hand, the TFP is widely accepted as the determinant of sustainable long term economic growth. Nevertheless, the research purpose here is to figure out the determinants of catching-up process. Therefore, it focuses only on identifying factor that had positively contributed to East Asian economies’ growth, whatever long-term effects it might have.

From another perspective, the economic growth in terms of GDP per capita growth could be either increase over all sectors in productivity or structural optimization that expands the share of higher productivity sectors. The modernization had led to improvements in both technology and management in nearly all sectors, which could have resulted in economic growth even without any change in structural change. But this doesn’t mean structural change doesn’t matter. According to Broadberry, “both Germany and the United States caught up with Britain in terms of aggregate labor productivity largely by shifting resources out of agriculture and improving their relative productivity position in services rather than by improving their position in manufacturing”⁵. Although it’s debatable whether it’s the expansion of manufacturing or service sector that had led to Germany and the United States’ catching-up, Broadberry’s work reveals the important role of structural change, which has long been underestimated. The paper partly follows Broadberry’s approach to identify the contributions of structural change and internal productivity growth respectively, so as to verify whether the structural change is a universal determinant of catching-up.

Besides these determinants discussed above, it's noteworthy that recent studies on East Asian economies have extensively emphasized on the importance of FDI and export precisely. In fact, the structural change that happened in recent catching-up economies could have largely relied on the growth in export, since export is usually composed of high productivity

⁴ Paul Krugman, The Myth of Asia’s Miracle, Foreign Affairs; Nov/Dec 1994; Vol.73, Iss. 6

⁵ Stephen N. Broadberry, How Did the United States and Germany Overtake Britain? A Sectoral Analysis of Comparative productivity Levels, 1870-1990, The Journal of Economic History, Vol. 58, No. 2 (Jun., 1998), pp. 375-407

sectors. Besides, FDI also plays important role in the structural change towards high productivity sectors. A decisive factor of the expansion of high productivity sectors is the transfer of advanced technology, organizations, knowledge, etc, which are introduced by FDI. The effects of FDI and export on economic growth are discussed respectively, as well as their relationships with structural change.

Data and methods

The successful catching-up should be clearly defined at first: it means the initiation and maintenance of certain economic growth rate (in terms of annual growth rate of GDP per capita, namely the aggregate labor productivity), rather than the achievement of certain level of GDP per capita. The structural change also has to be clarified. It might be too broad to categorize all the sectors into agriculture, industry and service, especially when there is within agriculture (or within industry, service) change. A plausible way to prevent this kind of problem is to clarify structural change as the shift from lower value added sectors to higher value added sectors. Detailed approach will be discussed later in empirical country-specific studies.

As mentioned above, FDI and international trade also play important roles in catching-up process, in particular in East Asian economies' case. E. Borensztein et al. suggests, "FDI is an important vehicle for the transfer of technology, contributing relatively more to growth than domestic investment. However, the higher productivity of FDI holds only when the host country has a minimum threshold stock of human capital. Thus, FDI contributes to economic growth only when a sufficient absorptive capability of the advanced technologies is available in the host economy."⁶ Therefore, in addition to their direct influences on economic growth, the contributions of FDI and export to the structural change will be examined as well.

Shift-share analysis

Structural transformation analysis is used for distinguishing the contributions of structural change and general internal productivity growth.

⁶ E. Borensztein, J. De Gregorio and J-W. Lee, How does foreign direct investment affect economic growth? *Journal of International Economics* Volume 45, Issue 1, 1 June 1998, Pages 115-135

It generally follows Broadberry's approach. The aggregate labor productivity in the base year ($A_{s,0}$) is defined as aggregate output in the base year ($Q_{s,0}$) divided by aggregate employment in the base year ($L_{s,0}$), which should equals to the sum of share-weighted labor productivities by sector

$$A_{s,0} = Q_{s,0}/L_{s,0} = \sum A_{i,0} S_{i,0} \quad (1)$$

Where $A_{i,0}$ denotes labor productivity in sector i , and $S_{i,0}$ is the share of employment in sector i , in the base year. Naturally, aggregate labor productivity and aggregate employment in the second year are expressed as $A_{s,1}$ and $Q_{s,1}$ respectively, and so forth.

To identify the effect of structural change on economic growth, a counterfactual aggregate labor productivity is calculated, by which the contribution of structural change can be obtained. The first year of the investigated period is chosen as the base year. The counterfactual aggregate labor productivity ($AF_{s,1}$) of the next year is calculated based on the assumption of fixed structure. Given that the actual aggregate labor productivity of the next year is $A_{s,1}$, the aggregate output in the next year is $Q_{s,1}$ and the aggregate employment in the base year $L_{s,1}$, and the labor productivity and share of employment in sector I in the next year are $A_{i,1}$ and $S_{i,1}$ respectively, the counterfactual aggregate labor productivity can thus be calculated by using the following formula:

$$AF_{s,1} = \sum A_{i,1} S_{i,0} \quad (2)$$

Since the counterfactual aggregate labor productivity $AF_{s,1}$ is calculated by using fixed structure, namely the effect of structural change is artificially excluded, the deference between the actual aggregate labor productivity $A_{s,1}$ and the counterfactual aggregate labor productivity $AF_{s,1}$ is exactly the effect of structural change on economic growth in terms of aggregate labor productivity

$$ES_1 = A_{s,1} - AF_{s,1} = Q_{s,1}/L_{s,1} - \sum A_{i,1} S_{i,0} \quad (3)$$

Where ES_1 denotes the effect of structural change on aggregate labor productivity in the next year.

However, it's not that straightforward to calculate effect of structural change in the third year. According to (3), the effect of the third year is obtained as following:

$$ES_2 = A_{s,2} - AF_{s,2} = Q_{s,2}/L_{s,2} - \sum A_{i,2} S_{i,0} \quad (4)$$

As the base year is remained the same when calculating the following years, it's necessary to exclude the effect of structure change of the previous years

$$\Delta ES_2 = ES_2 - ES_1 \quad (5)$$

It's the same case for other following years, after adjustment, we have

$$\begin{aligned} \Delta ES_n &= ES_n - ES_{n-1} & \text{If } n \geq 2 \\ \Delta ES_n &= ES_1 & \text{If } n=1 \end{aligned} \quad (6)$$

Up till now, the time series of annual effect of structural change on economic growth (ΔES_n) has been constructed. The series itself provides adequate information for quantifying the effect of structural change. However, in order to identify the correlation between structural change and economic growth, another time series of annual growth rate of GDP per capita (ΔY_n) is introduced. Since the annual growth rate of GDP per capita empirically indicates the aggregate labor productivity, the comparison between ΔES_n and ΔY_n reveals the correlation of them.

Some adjustments need to be made on the basis of the basic shift-share calculation. As Broadberry mentioned in his article, "a major problem with the basic shift-share approach is that it assumes that productivity growth rates in each sector would be unaffected by the absence of structural change"⁷. According to the theory of diminishing returns, *ceteris paribus*, the increase of a certain investment (labor for instance) would decrease the rate of return, namely the ratio of output to labor input. Hence, other things being equal, the increasing labor input would lead to the decrease in sectoral labor productivity. In other words, the decreasing sector would have been favored by the decrease in labor input. The transition that shifts out labor force from agriculture to manufacturing, other things being equal, thus increases the labor productivity in agriculture sector, and decrease labor productivity in manufacturing sector due to the diminishing returns. However, the structural transformation analysis applied in this study uses the structure in the base year and the labor productivity in the investigated year, which certainly causes bias when calculating counterfactual aggregate labor productivity since the labor productivity changes at the same time as

⁷ Stephen N. Broadberry, How Did the United States and Germany Overtake Britain? A Sectoral Analysis of Comparative productivity Levels, 1870-1990, *The Journal of Economic History*, Vol. 58, No. 2 (Jun., 1998), pp. 375-407

structural changes. In order to exclude the effects of other factors, so as to make sure the difference between actual and counterfactual productivity is exactly the effect of structural change, the change in sectoral labor productivity caused by structural change is adjusted.

The adjustment of sectoral labor productivity is approached as follows

$$\begin{aligned} A_{i,n} &= A_{i,n} - (L_s - L_i) & \text{If } S_i < 0 \\ A_{i,n} &= A_{i,n} & \text{If } S_i \geq 0 \end{aligned} \quad (7)$$

where the labor productivity in year n in a declining sector is modified by being reduced by the difference in the growth rates of labor force in the particular sector and in aggregate, when calculating the counterfactual aggregate labor productivity in year n. The labor productivity in the expanding sector, however, remains unchanged.

TFP analysis

The TFP analysis, on the other hand, investigates the contributions of factor accumulation and TFP. The analysis is based on the Solow Growth Model, which decomposes overall economic growth into capital investment, labor investment, technology improvement and other factors. Various determinants could be added into this model; however, to simplify the calculation the basic model is employed.

$$Y = AK^\alpha L^\beta \quad (8)$$

Where Y represents the total production, K is the capital input and L is labor input, and A denotes the multifactor productivity, namely the TFP. α and β are the elasticity for capital and labor respectively, which weight specific factor's contribution to overall economic growth. Whether the sum of α and β is smaller than, equals to, or larger than 1 is determined by whether it's assuming increasing, constant, or diminishing returns to scale. Constant returns to scale means that the increases in capital and labor investments will contribute in the same pace as they previously dose. Normally α and β are set to 0.3 and 0.7 and it's adopt in this study.

By taking the logarithm on both sides of the equation, we obtain

$$\ln(Y) = \ln(A) + \alpha \ln(K) + \beta \ln(L) \quad (9)$$

Let Y_{t-1} denotes the total production in the first year, and Y_t denotes the total production in year n, and so on for other variables. We have

$$\begin{aligned} \ln(Y_t) - \ln(Y_{t-1}) \\ &= \ln(A_t) - \ln(A_{t-1}) + \alpha(\ln(K_t) - \ln(K_{t-1})) + \beta(\ln(L_t) \\ &\quad - \ln(L_{t-1})) \end{aligned}$$

This can also be written as

$$\ln(Y_t/Y_{t-1}) = \ln(A_t/A_{t-1}) + \alpha\ln(K_t/K_{t-1}) + \beta\ln(L_t/L_{t-1}) \quad (10)$$

Thus, we obtain the TFP's effect on economic growth

$$\ln(A_t/A_{t-1}) = \ln(Y_t/Y_{t-1}) - \alpha\ln(K_t/K_{t-1}) - \beta\ln(L_t/L_{t-1}) \quad (11)$$

Economically, this formula indicates that TFP's effect (annually) equals to the difference between the annual change of GDP and the sum of the annual changes of capital and labor input weighted by their elasticity respectively.

Rather than investigating yearly effect, TFP's effect on economic growth is studied by time periods so as to avoid potential lag effect and illustrate a broader picture of TFP's role.

Export and FDI

As regarding the role of export, a time series of export is constructed and compared to the index of structural change. The time series of export is constructed as the index of expansion of export sector, which is calculated based on the ratio of value added in export sector to the total production of the economy. The index of structure change is constructed by calculating the absolute change in sectoral labor share

$$I_t = \sum | S_{i,t} - S_{i,t-1} | \quad (12)$$

Where I_t denotes the index of structural change in year t , while $S_{i,t}$ is the labor share in sector i in year t .

The comparison between export and the index of structural change reveals export's contribution to economy's structural transformation, which further contribute to economic growth.

The role of FDI is investigated more deliberately. According to E. Borensztein et al.'s suggestion, rather than looking into the absolute value of FDI, the ratio of FDI to host country's labor stock is used in this study. This ratio is named FDI intensity (F_t means FDI intensity in year t) for convenience.

The time series of FDI intensity is constructed and compared to economic growth rate (annual growth rate of GDP per capita). The comparison

indicates whether the contribution of FDI is significant during the catching-up process.

Natural experiment: Malaysia and Singapore

The natural experiment is introduced to empirically examine the determinants identified above. To be precise, the achievements of Singapore and Malaysia are examined respectively to compare the determinants' roles in both countries. The different performances in the catching-up period in these two countries thus reveal the importance and reliability of these determinants.

Malaysia and Singapore are two countries which had long been in similar conditions. As Ganesan states, "over the thirty years since Singapore's independence from the Federation of Malaysia, the bilateral relationship between Singapore and Malaysia has been variously described as special, symbiotic, and interdependent."⁸ Malaysia has long been partly colonized by the United Kingdom. During the Cold War, the Federation was granted independence on 31 August 1957. In 1963, Malaya together with the British crown colonies of Sabah (British North Borneo), Sarawak and Singapore, formed Malaysia. However, the conflict with Indonesia in the early years of independence marred the formation of Malaysia. Due to several reasons, both political and racial, shortly after the formation of Malaysia federation, Singapore exited in 1965. Although it was no more than two years that Singapore had been a part of Malaysia, it still reveals the close relationship between the two countries.

Singapore is an island city-state off the southern tip of the Malay Peninsula, which as its name suggests is part of Malaysia. Malaysia, on the other contrary, is composed of two regions, Peninsular Malaysia and Malaysian Borneo. The gap between sizes of these two countries is huge, which to a certain extent had led to the differences in economic policies as well as economic achievements. On the other hand, the geographic neighborhood of these two countries also accounts for the similarities from many perspectives, such as culture, ethnics and geography, between them. Before the catching-up process, Malaysia and Singapore had the similar historical

⁸ Ganesan, N., Malaysia-Singapore relations: Some recent developments. *Asian Affairs: An American Review*, 00927678, 1998, Vol. 25, Issue 1

and cultural conditions. It's more or less the same as the Korea case, which also split in two countries, more identical though.

Of course, there were a few differences between these two countries as well. In terms of natural resource, Malaysia has a better endowment as it is one of the top exporters of natural rubber and palm oil, which combined with the export of some other natural resources, for instance, sawn logs and sawn timber, cocoa, etc., forms the driving sector of economic growth in Malaysia; while Singapore rarely has any natural resource, even it is suffering from lack of fresh water. However, the important location as an international port had made Singapore rich even before its independence in 1965. The GDP per capita (in current price) of Singapore was \$511 in 1965, while the GDP per capita of Malaysia in the same year was only \$335.⁹

To sum up, before the period of catching-up, that is to say before the natural experiment, from most perspectives Malaysia and Singapore generally could be considered as in similar conditions. They share the same ethnic, linguistic and cultural environments. The climate, as well as disease environment and other even more detailed characteristics, is also the same in both countries. These similarities make the two countries comparable for this study. However, there are also notable differences between them, such as size of the country, natural endowment and the initial economic situation. Singapore had a much better GDP per capita than Malaysia (more than 50% higher), while Malaysia enjoys a vast natural endowment and Singapore almost has no natural resource reserve, these differences would have important influences on the different performances in structural change in the two countries. For instance, the Malaysia could have been much easier to be influenced by the so called "Dutch disease" for its abundant natural resources: the prosperity of natural resource export crowd out other potential high labor productivity sectors, and thus leads to a worse structural rearrangement than that of Singapore. The larger size (and population) and worse initial economic condition of Malaysia also make it harder to achieve and maintain high income per capita comparing to the city-state Singapore. Nevertheless, since the two countries shared more or less the same situation in the beginning of the natural experiment, it's thus reasonable to attribute

⁹ Data from World Bank

the different achievements in the economic development of both countries to their different employments of determinants of catching-up process. Ideally, *ceteris paribus*, the country which had better implemented the catching-up process would obtain a better economic achievement, which is then measured by GDP per capita in this study. The country with a higher GDP per capita after the catching-up period, namely in the year 1990 in this study, thus reveals the determinants of catching-up. In spite of other similar factors which intuitively should have no impact on the difference in economic development, the differences in the factors between the two countries demonstrate the determinants and their roles: while certain factors (say, factor A and factor B) showed their important roles through the catching-up process in the better developed country, namely Singapore here, and certain factors (factor B and factor C) showed their importance in another country, Malaysia, by comparative analysis, the determinants then manifest themselves (factor B).

In this paper, the initial economic conditions in both countries and the achievements of the catching-up process are examined respectively. Other factors such as culture, geography, and linguistic differences, etc., are not taken into consideration since they are similar in both countries as discussed above. The description of 10 original sectors provided by the dataset used in this study are given at first, which illustrates the initial conditions in both countries and thus manifests the impact of the determinants investigated, the impact of structural change in particular. Broadly speaking, the economic achievements are attributed to the initial conditions and the enforcements. While the final achievements and initial conditions are easy to measure, the enforcements which denote the roles of determinants can then be indirectly measured by the gap between final achievements and initial conditions. The variables thus need to be accurately controlled for estimating the enforcements, so as to make sure that the results are not biased by other potential factors. The previous discussion, fortunately, shows there is no significant factor other than initial economic conditions and determinants being investigated that would influence the economic achievements.

The natural experiment not only quantitatively examines the roles of determinants of catching-up process, but also empirically strengthens the

causality of discussed determinants and economic growth propounded by quantitative research.

Data

The dataset used in this study is mainly based on administrative records and documents. For the shift-share analysis, a 10-Sector database derived from “A Cross-country Database for Sectoral Employment and Productivity in Asia and Latin America, 1950-2005”¹⁰ is used. In the dataset the 10 sectors are defined as: agriculture, mining, manufacturing, construction, public utilities, retail and wholesale trade, transport and communication, finance and business services, other market services and government services. Data in constant prices and in current prices are both available. However, in order to identify the structural transformation only the data in current prices is used, since the sectoral inflation within economy could be an important cause of sectoral expanding and would be offset by using data in constant prices. It’s easy to prove that by using data in current prices it would not affect the calculation of contributions of each determinant. The index of structural change is constructed based on this dataset, following the procedure mentioned above. It’s worth mentioning that the categorization of sectors would probably reduce the absolute value of structural change, since there could be within-sector change which would be calculated without the categorization. Nevertheless, the underestimate of structural change is inevitable, depending on the trade-off between accuracy and workload. The FDI intensity, as well as the time series of export, is constructed by using administrative data.

The dataset used for the TFP analysis is derived from The Conference Board Total Economy Database, which as described by itself “is a comprehensive database with annual data covering GDP, population, employment, hours, labor quality, capital services, labor productivity, and total factor productivity for about 123 countries in the world.”¹¹ Capital stock and labor investment from this dataset are used for the calculation of

¹⁰ Marcel P. Timmer and Gaaitzen J. de Vries (2007), A Cross-Country Database For Sectoral Employment And Productivity In Asia And Latin America, 1950-2005, Groningen Growth and Development Centre Research Memorandum GD-98, Groningen: University of Groningen, August 2007

¹¹ The Conference Board Total Economy Database, January 2010, <http://www.conference-board.org/economics/database.cfm>

TFP. GDP is also available. Based on these data, TFP is easily calculated following the procedure previously presented.

Considering all the data used are based on administrative records and documents, multiple sources are used and connected, for instance, the GDP is derived from both datasets mentioned above and connected to each other.

It's worth mentioning that longitude data is used for this study. It means that the evolution of each economies from all the perspectives investigated is traceable. This longitude approach clearly illustrates the whole process of catching-up and favors further study on this subject.

A sketch of the catching-up mechanism

Many economies had realized their catching-up in the last century. Based on the studies on their performances, the tentative assumption for the general mechanism of catching-up process can thus be established.

In this paper, the analyses mainly focus on the role of structural change through the catching-up process. Conventional studies have shed some light on the important role of structural change. As Mario Cimoli et al. point out, "The comparative evidence shows structural divergence between Latin America and the rest of the world having a negative impact on its international competitiveness and equilibrium rate of growth."¹² The author attributes the failure of Latin America in finishing the catching-up process to its less favorable performance in the intensity and direction of structural change. In other words, "the developing countries that succeed in reducing the income gap are those that transformed their economic structures in favour of sectors with higher Schumpeterian and Keynesian efficiency."¹³ Mario Cimoli et al.'s research clearly demonstrates that economic restructuring has a decisive impact on the initiation and maintenance of catching-up process.

The importance of structural change can be explained from many perspectives. The basic mechanism that how structural change favors economic development is the rearrangement between sectors optimizes the overall labor productivity, as mentioned in previous chapter. In this sense,

¹² Mario Cimoli, Gabriel Porcile and Sebastian Rovira, Structural change and the BOP-constraint: why did Latin America fail to converge? Cambridge Journal of Economics 2010, 34, 389–411

¹³ Mario Cimoli, Gabriel Porcile and Sebastian Rovira

as long as there is difference in labor productivities among different sectors, structural change can improve the aggregated labor productivity by shifting resource to higher productivity sectors. On the other hand, for most East Asian countries, the structural changes occurred during their catching-up had fitted the expansion of export. The export sector has been the driving force for economic growth in these countries ever since their catching-up. Economic growth in many catching-up economies was accompanied by the expansion of export sector, which was accomplished by intensive structural change. The structural change shifting resource to manufacturing sector also contributed masses of job opportunities comparing to traditional agricultural sector, which was conducive to reduce the income gap eradicate poverty. As Suehiro claims, “the biggest challenge for late comer or developing countries is to increase their national wealth and distribute it more equitably, and that the most efficient means of accomplishing these ends is industrialization.”¹⁴ Suehiro suggests that industrialization leads to more equitable income distribution, while the industrialization is accomplished by structural change. Broadberry’s study on the cases of Germany and the United States also emphasizes the important role of structural change. He attributes the accomplishments of catching-up of these two countries to the shift from agriculture to manufacturing: both Germany and the United States had improved their economic efficiencies by redistributing resource to sectors with high labor productivity, while Britain had already finished the structural rearrangement during the industrial revolution period. Considering the internal labor productivity within sector, which was determined by specific technology, capital stock and various other factors, was synchronously improving in most countries, to a certain extent it should be deemed as an endogenous variable. The optimization of labor force and other resources between sectors in Germany and the United States thus played a decisive role in the catching-up process.

TFP analysis is also emphasized in this paper. Conventionally, TFP has been deemed as the important factor for sustainable economic growth. Broadberry also stresses its importance in the catching-up process, “for the

¹⁴ Catch-Up Industrialization: The Trajectory and Prospects of East Asian Economies by Akira Suehiro, trans. Tom Gill, Singapore, NUS Press in association with the Kyoto University Press, 2008, xvi + 395pp.

period as a whole, TFP growth makes a larger contribution to labor productivity growth than capital per employee growth in all three countries. Since the contribution of capital per employee growth is similar in all three countries, the bulk of the differential U.S.-U.K. and Germany-U.K. aggregate labor productivity growth is explained by differential TFP growth.”¹⁵ On the basis of previous studies, it’s reasonable to conclude that TFP plays significant role in economic development, as well as the catching-up process. However, as mentioned above, Paul Krugman’s research points out that East Asian Economies’ catching-up, Singapore in particular, was driven by the increasing input of capital and labor force, that is to say the incredible economic growth rate of East Asian economies has been matched by the input growth. Put it another way, the input growth accounted for most of the economic growth, while TFP had been unimportant. The controversial views on TFP’s role in the catching-up process raise the study on TFP in this paper.

To sum up, the mechanism of catching-up process can be described as following: the economic growth is initiated by the expansion of export sector, while the expansion is both pushed by FDI from outside and structural change from inside. As discussed in many papers, the comparative advantage in labor force or raw materials in the beginning of catching-up process attracts FDI. The attracted FDI nourishes the export sector which is always labor-intensity manufacturing. The structural change within the economy, on the other hand, shifts labor to manufacturing sector, which contributes to the comparative advantage by increasing labor force in manufacturing sector and underpins the expansion of export sector by continuously providing labor force. The expansion of export sector, in particular the labor intensive manufacturing sector, not only stimulus overall economic growth, but also creates massive job opportunities, which reduces the income gap and eradicates poverty in the countries. The improvement in employment and income distribution further favors economic growth, as frequently claimed by many scholars. That the manufacturing sector is being nourished means the masses in the country are getting rich, namely

¹⁵ Stephen N. Broadberry, How Did the United States and Germany Overtake Britain? A Sectoral Analysis of Comparative productivity Levels, 1870-1990, *The Journal of Economic History*, Vol. 58, No. 2 (Jun., 1998), pp. 399

the country's macroeconomic environment is improving in terms of domestic demand, capital stock and etc. Of course the export-oriented growth pattern might cause problems due to high degree of export dependence, and the expansion of manufacturing sector will face its limitation due to diminishing returns, however, this is not taken into account this paper focuses on the accomplishment of catching-up. Besides the direct influence of export sector, ideally, TFP contributes to the catching-up process as well. Due to the ambiguous definition of TFP, it's hard to give an explicit explanation of how TFP works in the catching-up process. TFP's role is mainly quantitatively examined in this paper.

The catch-up in Malaysia and Singapore

Both Malaysia and Singapore had commenced their rapid economic growth from the early 1960s, since their independences. The GDP per capita of Singapore in the year 1960 was \$395 (in current price), which was less than fourteen percent of that of the US in the same year, and grew to twenty percent in 1970, forty percent in 1980, and more than fifty percent from 1990. Malaysia, on the other hand, had a less outstanding performance. The GDP per capita of Malaysia in the year 1960 was \$300, not far away from that of Singapore, which was around one-tenth of that of the US in the same year, and turned into eight percent in 1970, fifteen percent in 1980, and around ten percent in 1990. According to the results, it's obvious that Singapore had succeeded in catching-up while Malaysia generally had just kept pace with the US. The GDP per capita in Malaysia and Singapore in the year 1960 were not much different, however, in the year 1990 they were no more at the same level, being \$2432 (Malaysia) and \$12091 (Singapore) respectively.¹⁶ The different performances not only suggests that Singapore has been more successful in the catching-up process, but also indicates that the difference between Singapore and Malaysia, which had caused the different economic achievements, reveals the determinants being researched in this study.

Table 1: The value added per capita and labor share of each sector

Sector	ISIC Rev. 3	Singapore		Malaysia	
		1970	1990	1975	1990

¹⁶ Data from World Bank

Agriculture, Forestry, and Fishing	01-05	6 (3.46%)	26 (0.52%)	4 (47.64%)	10 (25.99%)
Mining and Quarrying	10-14	4 (0.34%)	34 (0.06)	20 (2.19%)	381 (0.55%)
Manufacturing	15-37	8 (21.98%)	39 (28.59)	10 (11.14%)	22 (19.94%)
Public Utilities	40-41	20 (1.17%)	113 (0.72%)	18 (0.53%)	56 (0.70%)
Construction	45	9 (6.62)	27 (8.02%)	6 (4.03%)	11 (6.34%)
Wholesale and Retail Trade, Hotels and Restaurants	50-55	9 (23.49)	33 (21.90%)	6 (11.89%)	13 (18.22%)
Transport, Storage, and Communication	60-64	8 (12.14%)	58 (9.83)	11 (2.91%)	23 (4.52%)
Finance, Insurance, and Real Estate (b)	65-74	33 (3.55%)	87 (11.40%)	9 (2.69%)	42 (3.86%)
Community, Social and Personal Services	75-99	5 (27.25%)	26 (18.96)	3 (4.49%)	8 (7.16%)
Government Services	75-99			5 (12.49%)	13 (12.71&)
Sectoral Sum	01-99	9 (100%)	42 (100%)	6 (100%)	18 (100%)

Source: 10-Sector Database, the Groningen Growth and Development Centre.

Government Services (75-79) in Singapore is included in community, social and personal services; Finance, Insurance and Real estate (65-74) excludes dwellings

Table 1 shows the economic decompositions of Malaysia and Singapore in the year 1970 and 1990. The value added per capita in each sector and the labor share of each sector are listed above. It shows that in the year 1970 in Singapore, most of the labor force was tied down to low value added sectors. To be precise, more than 70 percent of the total labor was bound to three sectors: Community, Social and Personal Services; Wholesale and Retail Trade, Hotels and Restaurants; and Manufacturing, the value added of which was relatively much lower comparing to Finance, Insurance, and Real Estate, of which the labor share was only 3.55 percent. After twenty-year change of industrial structure, however, there were rarely significant changes in labor share among all sectors, except the remarkable increase in

Finance, Insurance, and Real Estate, the labor share of which had risen from 3.55 percent to 11.40 percent. Besides the changes in labor share, improvement in labor productivity within sectors was more notable. The value added per employee in manufacturing sector had increased around five times, although it was not the most increased sector, as the labor productivity in Mining and Quarrying had increased nearly nine times, the large and ever-increasing labor share of manufacturing sector strengthened its impact on overall economic growth.

On the other hand, in the year 1975 in Malaysia, nearly half of total labor force had been tied down to Agriculture, Forestry, and Fishing, while the labor share of manufacturing sector was only 11.14 percent, which was around half of that of Singapore at the same time. Unfortunately, the sectors with major labor share had relatively lower labor productivities, in particular Agriculture, Forestry, and Fishing with the value added per employee of 4; whilst the sectors with relatively higher value added per employee such as manufacturing held small portions of labor force. After fifteen-year change, the industrial structure of Malaysia had been significantly optimized. The sector with low labor productivity, namely the Agriculture, Forestry, and Fishing, had undergone loss of labor share, fallen into 25.99 percent in 1990, which was about half of that in 1975. On the contrary, the sectors that either had high labor productivity as always or had soared over the period had grabbed labor share from other sectors. There were significant increases in labor share of manufacturing and Wholesale and Retail Trade, Hotels and Restaurants, the labor shares of both sectors had increased around twice, so did their labor productivities. In this sense, the structural change among these sectors had further favored the overall economic development. However, Finance, Insurance, and Real Estate, of which the labor productivity had increased nearly five times, had no marked increase in labor share. It's also worth mentioning that there was dramatic increase in labor productivity in Mining and Quarrying, nevertheless, the labor share of it even had dropped over time.

By comparing these two countries, it's interesting to find that ideally structure change would have much greater impact on economic growth in Malaysia than Singapore, since as early as in 1970, the labor structure in

Singapore had concentrated on manufacturing and other sectors which then had the highest labor productivities in 1990. In other words, there was not much left for structural rearrangement. On the contrary, the industrial structure in the early stage of Malaysia was much less sophisticated than that of Singapore, therefore there was feasible optimization of structural change left.

Besides, as regards both the initial sectoral labor productivity and its improvement over the period, Singapore outperformed Malaysia in most sectors. Given that the increase in labor input in Malaysia had kept pace with Singapore, having increased 1.7 times and 1.5 times respectively, the difference in sectoral labor productivities can plausibly be attributed to capital intensity or other factors. The New Economic Policy that had been implemented over this period should have impact on economic growth as well.

Shift-share analysis: the comparison between Singapore and Malaysia

The increase over all in productivity together with structural change accounts for the economic growth. The shift-share approach examines the effect of structural change by excluding the influence of internal labor productivity improvements. It thus demonstrates to what extent the reallocation of industries in a country contributes to economic growth.

Table 2: Effect of structural change on aggregated labor productivity

Singapore	Annual Effect of Structural change	Annual Growth of Aggregated Labor productivity	Malaysia	Annual Effect of Structural change	Annual Growth of Aggregated Labor productivity
1971	0.07	0.70			
1972	0.04	0.68			
1973	-0.19	2.34			
1974	0.11	2.51			
1975	-0.05	0.98			
1976	0.08	0.71			
1977	-0.04	0.82	1977	-0.04	0.81
1978	0.02	0.93	1978	0.00	0.97
1979	0.00	1.61	1979	0.00	0.43
1980	0.01	3.31	1980	-0.04	0.50
1981	0.05	1.99	1981	0.01	0.38
1982	-0.13	1.45	1982	-0.03	0.49
1983	-0.07	2.58	1983	0.00	0.55
1984	0.09	2.45	1984	0.02	0.68

1985	-0.24	0.33	1985	0.04	0.89
1986	0.26	-0.01	1986	-0.01	0.89
1987	0.27	1.72	1987	-0.01	0.81
1988	0.11	3.48	1988	-0.01	1.34
1989	-0.28	3.26	1989	-0.04	1.56
1990	-0.09	2.11	1990	-0.05	1.25

Source: see Table 1.

Table 2 shows the annual effect of structural change in Singapore and Malaysia. It's apparent that structural change had significantly contributed to Singapore's economic development over the period investigated. For instance, in the year 1971 in Singapore, the annual growth rate of aggregated labor productivity was 0.70, which means the GDP per capita in 1971 was 0.70 more than that in 1970. The annual effect of structural change indicates that keeping the industrial structure unchanged between the year 1971 and 1970, the incremental in GDP per capita would be 0.63 instead of 0.70. Put it another way, 10 percent of the annual growth in GDP per capita could be attributed to the structural rearrangement during that year. However, the effect of structural change was not stable; there were years when the effect turned into insignificant or even minus. The series of annual effect suggests that the effect varies according to circumstances.

The annual effect of structural change in Malaysia was even more insignificant comparing to that in Singapore, which indicates that the structural change played a less important role in Malaysia. In the year 1977, the effects of structural change and GDP per capita were almost the same in both countries, which could be attributed to the geographic and economic similarities of them. However, in the following years, it's easy to find when the GDP per capita of Singapore outnumbered that of Malaysia, the effect of structural change did in the same way. It's thus reasonable to assume that the effect of structural change, to some extent, had accounted for the outperformance in economic development in Singapore.

However, from table 1 we have concluded that comparing to Malaysia, Singapore had hardly noticeable change in labor share of each sector, how could the effect of structural change be even greater in Singapore than that in Malaysia? This can only plausibly attributed to the difference in initial sectoral labor productivities and their improvements. Due to the relatively much higher value added per employee in expanding sector, although the

proportion of labor inflow in certain sector was lower than that of Malaysia, the effect of structural change in Singapore was still greater. The mechanism can be described as follows: as shown in Table 3, given that over the investigated period, the value added per employee in a certain sector (sector 1) of country A grows from 1 to 6, and it grows from 1 to 2 in country B. The labor share of this sector in country A only grows from 10% to 15%, while it grows from 10% to 30% in country B, that is to say the structural change in terms of absolute labor shift in country B (20%) is 4 times as great as that in country A (5%).

Table 3: An Example of the effect of structural change

Example		Country A		Country B	
		Sector 1	Sector 2	Sector 1	Sector 2
Labor productivity	Year 0	1	1	1	1
	Year t	6	1	2	1
Labor share	Year 0	10%	90%	10%	90%
	Year t	15%	85%	30%	70%
Actual productivity	Year t	1.75		1.3	
Counterfactual	Year t	1.5		1.1	
Effect of structural change		0.25		0.2	

The contribution of structural change on economic growth, using the calculating method which is described in previous chapter, is greater in country A. Just like this, the less inter-sector labor shift in Singapore had a greater contribution to overall economic growth.

The comparative analysis result suggests that structural change plays important role in the catching-up process. The different contributions of structural change in Singapore and Malaysia had led to different performances over the period. Singapore had achieved prominent economic development as mentioned before with the relatively significant contribution from structural change; on the contrary, Malaysia had an ordinary economic performance with no significant contribution from it.

It also shows that as regards the effect of structural change, rather than direct structure arrangement, the within sector labor productivity has a more important impact. Although the research result in Table 1 suggests that Malaysia had undergone greater industrial rearrangement over the investigated period while Singapore had almost finished this process before this period, the effect of structural change in Singapore still turned out to be greater.

Since in the case of Singapore and Malaysia it bears out that the effect of structural change is determined by within sector labor productivity rather than structural change, it's hard to concluded that structural change has direct impact on economic growth, in particular the catching-up process. Instead, the contribution of structural change should be the job opportunities it creates and the relatively improved income distribution. Although the structural change had no significant contribution to the overall economic growth (in terms of GDP per capita growth rate or value added per capita) in Malaysia, it should be noticed that the number of people who had been tied down to the poorest sector, that is to say the Agriculture, Forestry, and Fishing sector with the second lowest value added per employee (the Community, Social and Personal Services sector had the lowest labor productivity but it was much smaller and negligible), had drastically declined over the period due to structural change. Around half of the labor force in Malaysia had been tied down to the poorest sector in 1970, and the ratio was halved through twenty-year structural change. Instead, the relatively richer sector manufacturing had doubled its labor share over the period.

To sum up, the empirical study of Malaysia and Singapore shows that the effect of structural change on economic growth is determined by within sector labor productivity, while the structural change itself has no significant influence on it. It means that during the catching-up process, the rearrangement of industrial structure does not necessarily contribute to overall labor productivity, instead, the within sector labor productivity determines the aggregated labor productivity. Practically, the analysis result suggests that, different from conventional thinking, to shift labor from less productive sectors to higher ones does not significantly raise aggregated labor productivity. In the catching-up process, the increase in labor productivity which can be measured by growth of GDP per capita is almost completely driven by within sector productivity growth. However, it's worth mentioning that structural change indirectly contributes to economic growth, or the catching-up process, from many perspectives. The most obvious contribution of structural change is the improvement of income distribution through the expansion of manufacturing and other higher value

added sectors. There must also be positive effect on the labor productivity of declining sector according to law of diminishing returns. For example, over the period 1970 to 1990, the Agriculture, Forestry, and Fishing sector had experienced remarkable growth of labor productivity in Malaysia and Singapore, as shown in Table 1. But it is not reliable that labor productivity in both countries, in particular in Malaysia, in this sector would have grown 5.6 percent per year (from 4 to 10 over 20 years) if the labor share of this sector kept the same as it did in 1970. In this sense, the declining sectors, which were always composed of lower value added sectors, had been favored by structural change in terms of increasing their labor productivities by decreasing labor shares of them (which equals to increase capital intensity). In this way, structural change further diminishes the income gap between sectors.

Both Malaysia and Singapore had to a certain extent concentrated on the manufacturing sector, which ideally could have been related to export. Further analysis of structural change and export is given in the succeeding chapter.

TFP analysis

It had been controversial about the role TFP in East Asian economies' catching-up. This section reexamines the contribution of TFP to Singapore and Malaysia's economic growth over the investigated period.

Table 4: GDP growth rates and TFP's contributions in Singapore and Malaysia

	Singapore		Malaysia	
	TFP	GDP	TFP	GDP
1950-1960		4.96%		2.63%
1960-1970	3.99%	8.41%	1.66%	5.52%
1970-1980	2.46%	8.06%	3.24%	7.94%
1980-1990	2.60%	6.23%	1.55%	5.14%

Source: The Conference Board Total Economy Database, January 2010, Nehru and Dhareshwar (1993), "A new database on physical capital stocks: sources, methodology and results"

Table 4 shows the GDP growth rates over the investigated periods and TFP's cotemporaneous contributions in Singapore and Malaysia. As described in previous chapter, the contribution of TFP is calculated on the basis of labor input and capital stock. Employment is used as the measure of labor input, since it is more accessible than other possible indices. Arguably,

total hours worked and capital consumption would provide more accurate information for calculating TFP. Adjustment can be done in further studies on this subject.

Actually, intensive studies had been done on the role of TFP in Singapore's economic growth. As Jesus Felipe summarizes, "since the publication of Young's (1992) comparative work on total factor productivity (TFP) growth for Singapore and Hong Kong, the debate about the sources of growth in East Asia has become an important topic for scholars of growth and development (for an overall evaluation of this literature see Felipe, 1999)."¹⁷

These studies had achieved a conclusion that East Asia's spectacular growth was due to factor accumulation rather than to productivity gains. The very low growth rate of TFP thus becomes the standard view on East Asia's economic development.

The conventional conclusion claiming "Singapore's economy had grown with zero TFP growth" seems to be contradictory to the analysis result in Table 4, which presents the TFP had played an important role in Singapore's catching-up period. However, Jesus Felipe's reconsideration to the "Singapore's zero-productivity puzzle" provides convincing explanations. His thesis proves there are serious methodological problems with conventional TFP calculation approaches. Firstly, as Franklin Fisher has already pointed out, the concepts of aggregate output, aggregate capital, aggregate labor and aggregate production function do not hold in real economies. Fisher suggests not only Cobb-Douglas production function, but also other factors such as a constant mark-up on unit labor costs, the role of trade unions, etc., implies constant factor share, which is the fundamental assumption of growth accounting. He thus concluded, "the view that the constancy of labor's share is due to the presence of an aggregate Cobb-Douglas production function is mistaken. Causation runs the other way and the apparent success of this aggregate production function is due to the relative constancy of labor's share." Secondly, Jesus Felipe shows that "Cobb-Douglas and translog aggregate production functions can be derived as particular parameterizations of the value added accounting identity under

¹⁷ Jesus Felipe, On the myth and mystery of Singapore's "zero TFP", *Asian Economic Journal*, 2000, Vol. 14, No.2

appropriate assumptions about the paths followed by the factor shares and the weighted average of the growth rates of the wage and the profit rates.”¹⁸ A conclusion of Jesus Felipe’s work is that to estimate a putative aggregate production function is just to search for the best approximation to this identity. Jesus Felipe’s empirical studies bear out that the Solow residual is nothing different from the weighted average of the growth rates of the wage and profit rate. To sum up, Jesus Felipe’s work proves that the conventional analyses on Singapore cannot conclusively deny TFP’s role in Singapore’s economic growth due to the methodological problems with the notion of aggregate production function and the isomorphism between aggregate production function and income accounting identity (“which prevents the proper testing of the production function, and the unambiguous connection of TFP growth with technical progress”¹⁹).

Since the conventional analyses which claimed Singapore had zero TFP growth could have been due to inaccurate calculation or incorrect methodology, it’s thus necessary to review TFP’s role in Singapore’s economic growth, in particular in the catching-up process in this paper. The analysis result, as can be seen in Table 4, clearly indicates the catching-up process started in the 1960s, when the GDP growth rate dramatically increased to more than 8 percent from less than 5 percent in the previous decade. At the same time, calculation results present that the contribution of TFP accounted for nearly 4 percent growth rate, which means nearly half of the GDP growth in 1960s could be attributed to TFP. On the other hand, Malaysia achieved its highest GDP growth rate (7.94%) in the 1970s, when TFP had also accounted nearly half of the GDP growth (3.24%). The calculation results suggest that, though not extremely matching, the GDP growth rates were determined by the contribution of TFP. Put it another way, only in the period when TFP is relatively high can the GDP achieves high growth rates.

To test the relationship between TFP and economic growth, a sample of countries was selected and presented in the table below.

Table 5: TFP and GDP per capita growth over the period 1982 to 1990

Country	GDP per capita growth	TFP
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¹⁸ Jesus Felipe, p206

¹⁹ Jesus Felipe

Philippines	2.93%	- 16.81%
Indonesia	4.13%	- 14.55%
Algeria	9.09%	- 15.49%
South Africa	15.12%	- 52.22%
Malaysia	28.93%	2.09%
Brazil	39.71%	0.00%
China	56.08%	11.57%
United States	65.44%	2.29%
Norway	84.50%	4.90%
Netherlands	92.28%	8.50%
United Kingdom	102.88%	7.50%
Thailand	103.38%	23.86%
Singapore	109.29%	18.93%
Hong Kong	120.41%	14.42%
South Korea	217.48%	48.08%

Source: The Conference Board Total Economy Database, January 2010,

<http://www.conference-board.org/economics/database.cfm>

In Table 5, the column of GDP per capita growth presents the rate of growth comparing the GDP per capita in 1990 to that in 1982, while the column of TFP just simply shows the sum of annual shares of TFP's contribution over the period 1982 to 1990. For instance, comparing to the year 1982, GDP per capita in 1990 in Malaysia had risen by 28.93%. The TFP's contribution to economic growth (in percent) varied among the period, while the sum of them was 2.09%. The sum of TFP, although makes no economic sense, approximate the extent of TFP's contribution. It's apparent that among these countries there is roughly linear relationship between economic growth (in terms of GDP per capita growth) and TFP. As mentioned above, those countries in which TFP had played important roles had better performances in economic growth.

On the basis of these empirical studies, it's thus reasonable to conclude that TFP plays important role in economic growth, in particular in the catching-up process. As a part of economic growth, TFP positively contributes to it. There are also special cases, however. Both United Kingdom and Hong Kong can be deemed as such cases, since the contributions of TFP in these countries were relatively lower comparing to their contemporaries with similar economic achievements. Nevertheless, generally the role of TFP is important according to the data shown in Table 5. In contradiction with

previous researches on Singapore and other East Asian countries, this comparative study shows Singapore's prominent economic growth to a certain extent was due to the surpassing TFP growth, rather than "zero TFP growth". Those countries with nearly "zero TFP growth", such as Brazil and Malaysia, actually had much worse performed. The puzzle of "fast growing country having no TFP growth" actually is proven to be nonexistent, which negates the conclusion that the catching-up economies in East Asia were driving by factor accumulation rather than productivity gains: in fact, the catching-up processes were driven by TFP growth.

To sum up, by reexamining the roles of TFP in economic growth in Singapore and Malaysia, the conventional arguments are rejected and the importance of TFP in the catching-up process is confirmed. The empirical study on a series of countries further demonstrates the relationship between TFP and economic growth. Based on these analyses, we can thus conclude that TFP is an important determinant of the catching-up process. The story was similar in Germany and the United States' case, as Broadberry concludes, "Since the contribution of capital per employee growth is similar in all three countries, the bulk of the differential U.S.-U.K. and Germany-U.K. aggregate labor productivity growth is explained by differential TFP growth."²⁰ Only the country with successful TFP growth has the chance to succeed in catch-up, such as Singapore; on the contrary, the country which fails to achieve TFP growth such as Malaysia, always has worse performance in economic growth, let alone to finish the catching-up process which means to maintain high economic growth rate over years.

Export and economic growth

As mentioned before, structural change exerts its impact on economic growth in different ways, one of which is by expanding the export sector in a country. The role of export has been intensively emphasized in recent studies. Although there are still debates on whether it's export-led growth or growth-led export, as Mohsen Bahmani Oskooee points out: by applying Johansen's cointegration technique to establish the long-run relationship between exports and output (in presence of other factors), the annual data

²⁰ Stephen N. Broadberry, p399

over 1960-99 period from 61 countries specific and there is no uniform pattern.²¹ Anyway, it's indubitable that export has played decisive role in many countries' economic development. It's thus interesting to discover the relationships between export, structural change, and economic growth.

By re-examining the Spanish export-led growth hypothesis, Balaguer Jacint and Cantavella-Jordá Manuel find out: "In the first place, evidence was obtained about the existence of a long-run relationship among output, aggregate export expansion, and export structural change. The results indicate that exports are a determinant factor for Spain's real output. Moreover, economic growth also reinforces export expansion. There exists, then, a reverse causality between those two variables."²² They also address its mechanism, "Another interesting outcome is that the change in the productive specialization stemming from the absorption of external markets turns out to be, along with export expansion, a key factor for the Spanish economic development."²³ This conclusion is similar to the tentative assumption in this paper, which emphasizes the contribution of structural change to export and vice versa.

Table 6: Indices of structural change and Share of export in Singapore and Malaysia

	Malaysia		Singapore	
	IS ²⁴	Share of Export	IS	Share of Export
1971			4.59%	27.31%
1972			6.38%	28.36%
1973			5.27%	37.81%
1974			14.14%	48.31%
1975			7.37%	41.44%
1976	8.43%	20.14%	3.55%	46.50%
1977	1.54%	19.97%	1.75%	53.34%
1978	1.65%	20.95%	4.16%	58.85%
1979	2.31%	28.72%	2.62%	71.18%
1980	11.49%	30.78%	1.89%	79.01%
1981	4.77%	25.59%	4.06%	72.90%
1982	4.79%	23.95%	2.58%	64.53%
1983	3.76%	25.69%	3.78%	60.25%
1984	1.87%	27.58%	4.21%	60.38%
1985	2.21%	23.47%	4.90%	58.23%
1986	2.57%	19.13%	2.21%	58.39%

²¹ Mohsen Bahmani-Oskooee, Export Led Growth vs. Growth Led Exports: LDCs Experience The Journal of Developing Areas, Volume 42, Number 2, Spring 2009, pp. 179-209

²² Balaguer Jacint; Cantavella-Jordá Manuel, Structural change in exports and economic growth: cointegration and causality analysis for Spain (1961-2000), Applied Economics, 2004, 36,473-477

²³ Balaguer Jacint; Cantavella-Jordá Manuel

²⁴ IS denotes the index of structural change, which is constructed as described above.

1987	2.19%	22.75%	4.61%	67.69%
1988	2.54%	23.52%	5.35%	79.94%
1989	5.63%	24.21%	1.92%	79.72%
1990	7.67%	25.10%	1.50%	81.10%

Source: IS see Table 1; export data derives from the World Bank

Table 6 presents the relationship between structural change and export. The IS (index of structural change) shows to what extent the labor force was redistributed among industries comparing to previous year; while the share of export, as its name implies, is the ratio of export volume to GDP, which indicates the expansion and contribution of export sector. Generally the share of export in both countries had increased through 1970s, while the most intensive structural changes took place in 1974 in Singapore (14.14%) and in 1980 in Malaysia (11.49%) respectively. However, over the whole period, the share of export was continuously increasing in Singapore, while it was limited to around 25 percent in Malaysia. It's reasonable to conclude that it was the dramatic structural change that had underpinned the expansion of export sector in Singapore, while the nourished export sector further promoted the structural change as well. On the other hand, the same level of structural change in Malaysia had resulted in less increment in the share of export. The relationship between structural change and export is parallel to the relationship between structural change and economic growth (in terms of GDP per capita) in these two countries.

Table 7: Indices of structural change and Share of export in Singapore and Malaysia

	Malaysia (1976-1990)	Singapore(1971-1990)
IS	46.56%	31.71%
Change in Share of export	4.97%	53.79%

Source: see Table 1.

Table 7 presents the aggregated changes in industrial structure and share of export in both countries over investigated period. The results, however, is quite different from what it is assumed to be. Malaysia had been through even greater structural change than Singapore, but the latter had an increase of more than 50 percent in the share of export, while the former had relatively less improvement in the situation of export sector. The performance of export sector in both economies were contradictory to the assumption that structural change favors export and thus eventually stimulus economic growth. However, it fits the economic performance in the two countries: Singapore had achieved prominent economic growth over the two

decades, which was largely due to its remarkable export growth; whilst Malaysia had much worse performed over this period, with no particular growth in export sector. This comparative analysis result confirms the theory that export has been a determinant of economic growth, in particular the catching-up process. In spite of potential high export dependence problems, the contribution of export growth is decisive to the success in catching-up process: only the country which has prosperous export sector has the chance to finish the catching-up; the country which has failed in developing export always has worse economic performance.

If the expansion of export is pushed by structural change, how could Malaysia fail in developing the export sector with even more intensive structural change than that of Singapore? Conventionally, in order to simplify the calculation of structural change, different industries are categorized into groups and only the inter-group changes are taken into account when calculating structural change, despite the with-in group sectoral changes. Therefore, the categorization of industries veils a certain degree of structural changes, which thus biases the calculation of the index of structural change. The categorization used in this paper is processed as follows: the industries that had significantly declined over investigated period are categorized into the Declining Sector; the industries that had significantly expanded over investigated period are categorized into Expanding sector; other industries without significant expansion or decline are categorized into Constant sector. The index of structural change is afterwards calculated on the basis of these three sectors: declining sector, expanding sector, and constant sector. Apparently, the different industrial environments in Malaysia and Singapore had led to different industrial evolvments, which means the Expanding sector in Malaysia might contains different industries from that in Singapore, so do the other sectors. The categorization of industries in two countries is presented in Table 8:

Table 8: Categorization of industries in Singapore and Malaysia

	Declining sector	Constant sector	Increasing sector
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Malaysia	Agriculture, Forestry, and Fishing; Mining and Quarrying	Public Utilities; Finance, Insurance, and Real Estate; Government Services	Manufacturing; Construction; Wholesale and Retail Trade, Hotels and Restaurants; Transport, Storage, and Communication; Community, Social and Personal Services
Singapore	Agriculture, Forestry, and Fishing; Transport, Storage, and Communication; Community, Social and Personal Services	Mining and Quarrying; Public Utilities; Construction; Wholesale and Retail Trade, Hotels and Restaurants	Manufacturing; Finance, Insurance, and Real Estate

Source: see Table 1.

Table 8 illustrates the categorization of industries in Singapore and Malaysia. It's clear that there exist huge differences in structural arrangements in two countries. Malaysia had redistributed resource to manufacturing and various service sectors, while Singapore had focused on manufacturing and finance sectors. It's thus not surprising that the share of export had eventually been greater in Singapore even though the IS was less than that of Malaysia, since the export sector was mostly composed of manufacturing industries. It bears out that the structural change towards industries which favors export sector would have greater effect on economic development.

Besides, according to Table 1, any positive effect of structural change in Malaysia was also offset by the disadvantage of within-sector labor productivity. The initial labor productivities in most sectors, in particular manufacturing, were lower in Malaysia comparing to that in Singapore, and continued to be even worse over next two decades. The worse sectoral labor productivity might have been the cause, or a result, of loss of comparative advantage. As mentioned in many literatures, the expansion of export was also driven by the comparative advantage of labor cost, which could be the outcome of structural change that supplied masses of labor force by shifting from other sectors. The comparative advantage had favored the prosperity of export sector in Singapore; however, it was to a certain extent offset by the relatively much lower labor productivity. In the year 1990, the labor

productivity in Singapore was twice as high as that in Malaysia, which means no until the labor cost in Malaysia was half as high as that in Singapore would Malaysia has comparative advantage in the same sector. The difference in the shares of manufacturing sector between the two countries, as Singapore had a larger manufacturing sector than Malaysia, intensified Malaysia's disadvantage. Loss of advantage in export sectors was unaffordable for a catching-up economy, since export is a decisive determinant for the catching-up process as summarized above. The loss of advantage had also worsened the investment environment, which could have negative effect on attracting FDI and thus hinder economic growth. Further discuss on FDI's impact on economic growth is given in succeeding chapters.

In summary, the empirical study on Malaysia and Singapore's export reveals that export is a determinant for the catching-up process. It also suggests that the expansion of export sector is determined by the orientation of structural change, rather than the degree of structural change. Intensive structural change does not necessarily lead to prosperity in export sector. It fits the previous conclusion on structural change's role in the catching-up process. Since export plays important role in economic growth, the correct orientation of structural change which favors the expansion of export sector also contributes to economic growth, while the extent of structural change which does not determines the prosperity of export sector also is not necessarily related to economic growth. Another conclusion is that besides structural change, within sector labor productivity in export sector plays important role in its prosperity. Structural change undoubtedly pushes the expansion of export sector by providing labor force and decreasing labor cost, however, the key factor for export sector is the comparative advantage, which can be improved but is not determined by structural change. Put it another way, although structural change undoubtedly favors export sector in many ways, the different performances of export in the two countries could not be attributed to the different extent of structural change. Although the orientation of structural change influences its effect on promoting export sector, it does not necessarily lead to prosperity in export. Rather than

structural change, within sector labor productivity is the determinant for the performance of export.

The role of FDI

In general, it's accepted that FDI has positive effect on economic growth. In the remainder of this paper, the role of FDI in the catching-up process is discussed. Theoretically, by introducing advanced technology and providing capital, FDI plays important role in the catching-up process, as A. Wijeweera et al. summarize, "FDI should exert positive effects on economic growth, particularly in developing countries which suffer from low productivity and capital stock deficiencies."²⁵ In other words, FDI markedly contributes to economic growth by raising labor productivity, since both the spillover of advanced technology and increase of capital intensity favor labor productivity. By using a stochastic model and panel data cross 45 countries over the period 1997 to 2004, A. Wijeweera et al. draw this conclusion after their empirical study: "Firstly, FDI inflows exert a positive impact on economic growth in the presence of a highly skilled labor. But FDI by itself does not induce efficiency gains. Secondly, by merely increasing FDI inflows a country cannot improve its efficiency. Put differently, a given nation cannot absorb the advanced technology accompanying FDI unless there is well-trained skilled labor force. Thirdly, corruption has a negative impact on economic growth. Finally, trade openness increases economic growth by means of efficiency gains."²⁶ In brief, by increasing the absolute volume of FDI does not necessarily contribute to economic growth, instead, it requires the absorptive capability within the economy, namely adequate labor force. Besides, FDI favors the economic growth in terms of raising labor productivity rather than simply increasing the output. Similarly, E. Borensztein et al.'s study, which focus on the effect of FDI on economic growth in 69 developing countries over the last two decades, suggests, "FDI is an important vehicle for the transfer of technology, contributing relatively more to growth than domestic investment. However, the higher productivity of FDI holds only when the

²⁵ A Wijeweera, R Villano, B Dollery, Economic Growth and FDI Inflows: A Stochastic Frontier Analysis, The Journal of Developing Areas, 2010

²⁶ A Wijeweera, R Villano, B Dollery

host country has a minimum threshold stock of human capital. Thus, FDI contributes to economic growth only when a sufficient absorptive capability of the advanced technologies is available in the host economy.²⁷

The assumption that FDI is more productive than domestic investment can be explained by the fact that domestic firms have certain home advantages in domestic market. Only when the lower cost and higher labor productivity enjoyed by foreign firms can compensate for their domestic competitors' advantages can they possibly enter the market. The lower cost and higher labor productivity derive from advanced management skills and technologies. This mechanism is in particular significant in the catching-up economies.

Table 9: FDI intensities and GDP per capita growth rate in Singapore and Malaysia

	Malaysia		Singapore	
	FDI intensity(annual change)	Economic growth rate ²⁸	FDI intensity	Econ growth rate
1973			441.24(116.95%)	40.57%
1974			412.65(-6.48%)	21.92%
1975	87.19(-----)	-4.36%	350.12(-15.15%)	7.99%
1976	87.13(-0.07%)	-16.13%	265.04(-24.30%)	3.25%
1977	90.86(4.29%)	16.22%	322.45(21.66%)	9.37%
1978	110.08(21.15%)	16.51%	313.84(-2.67%)	17.79%
1979	122.01(10.84%)	26.70%	821.01(161.60%)	18.87%
1980	193.15(58.31%)	12.70%	1156.10(40.81%)	22.64%
1981	249.89(29.37%)	-0.37%	1438.95(24.47%)	12.97%
1982	266.28(6.56%)	4.50%	1311.81(-8.84%)	5.25%
1983	232.18(-12.81%)	9.56%	906.25(-30.92%)	12.43%
1984	143.30(-38.28%)	9.68%	1025.74(13.18%)	6.08%
1985	123.53(-13.80%)	-10.59%	847.84(-17.34%)	-5.88%
1986	85.66(-30.65%)	-13.61%	1408.45(66.12%)	1.60%
1987	71.86(-16.11%)	10.67%	2238.52(58.93%)	12.51%
1988	118.19(64.47%)	6.43%	2744.87(22.62%)	20.49%
1989	262.66(122.23%)	7.01%	2070.73(-24.56%)	15.04%
1990	348.86(32.82%)	10.20%	3627.03(75.16%)	17.67%

Source: data derives from the World Bank

Table 9 shows the FDI intensities and GDP per capita growth rates in Singapore and Malaysia. The FDI intensity is constructed on the basis of FDI net inflow and domestic employment, which measures FDI per employee; while the economic growth rate is measured by the growth rate of GDP per capita. The absolute value of FDI intensity clearly suggests that Singapore had enjoyed a better situation of FDI than Malaysia, which

²⁷ E. Borensztein, J. De Gregorio and J-W. Lee, How does foreign direct investment affect economic growth? Journal of International Economics Volume 45, Issue 1, 1 June 1998, Pages 115-135

²⁸ As mentioned above, economic growth rate is measured by GDP per capita growth rate

intuitively might have accounted for the overall outperformance in GDP per capita growth rate in Singapore.

The dataset shows that the FDI intensity in Singapore first soared in the year 1973 and then in 1979, which had both led to dramatic increase in GDP per capita growth rate (40.57% in 1973, 18.87 in 1979 and 22.64% in the next year). On the other hand, the FDI intensity had played a less important role in Malaysia, as the GDP per capita growth rate was only 12.70% in the year 1980 when the FDI intensity increased by 58.31%. The economic growth rates were low in the year 1988 and 1989 as well, when the FDI intensity increased by 64.47% and 122.23% respectively. The different performances of FDI intensity in the two countries suggest the probable threshold effect of FDI's contribution.

Table 10: ratio of Singapore to Malaysia: FDI intensities and GDP per capita

	GDP per capita	FDI intensity
1975	3.11	4.02
1976	2.76	3.04
1977	2.60	3.55
1978	2.63	2.85
1979	2.46	6.73
1980	2.68	5.99
1981	3.04	5.76
1982	3.06	4.93
1983	3.14	3.90
1984	3.04	7.16
1985	3.20	6.86
1986	3.76	16.44
1987	3.83	31.15
1988	4.33	23.22
1989	4.66	7.88
1990	4.97	10.40

Source: see Table 9.

The threshold effect of FDI might be caused by different reasons. In the first place, there were huge gaps between the levels of FDI intensity in the two countries over the investigated period. Table 10 presents the ratio of Singapore's FDI intensity to that in Malaysia and the ratio of Singapore's GDP per capita to that in Malaysia. It shows that the FDI intensity in Singapore had outnumbered that in Malaysia not only in terms of absolute volume, but also when taking country-specific capital stock into consideration. For example, in the year 1990, the FDI intensity in Singapore was more than ten times as high as that in Malaysia. Even when considering

their capital environments which are approximated by GDP per capita, say, the capital per capita in Singapore was around five times as high as that in Malaysia, the “relative FDI intensity” was still more than 2.5 times as high as that in Malaysia. The gap in FDI intensities between these two countries to some extent had accounted for the different performances of FDI. An assumption would be the FDI intensity in Malaysia was too low to significantly exert its effect on overall economic growth. In other words, it didn't reach the minimum volume threshold. In the second place, the threshold effect may also be attributed to the different environments of human capital. As E. Borensztein et al. conclude, “... the effect of FDI on economic growth is dependent on the level of human capital available in the host economy. There is a strong positive interaction between FDI and the level of educational attainment (our proxy for human capital). Notably, the same interaction is not significant in the case of domestic investment, possibly a reflection of differences of technological nature between FDI and domestic investment.”²⁹ Since the FDI always represents relatively higher technologies, as previously discussed, it's natural the utilization of FDI requires higher level of human capital. Therefore, in addition to the lower volume of FDI, the plausible poorer human capital accounted for the relatively obscure performance of FDI in Malaysia. However, as mentioned before, the two countries share nearly identical ethnic and cultural roots; the poorer human capital in Malaysia could have been mainly attributed to the differences in educational investments and certain economic policies. It's not the aim of this paper to discuss educational investment and economic policies, but it's worth mentioning that the Malaysian New Economic Policy (NEP), which was implemented over the period 1971 to 1990, being identical with the investigated period in this paper, had definitely hindered the economic growth in Malaysia in many ways, in particular in terms of human capital development, since the NEP arbitrarily redistributes resources (education opportunities, economic privileges, etc.) among different ethnic groups instead of free competition.

To sum up, FDI plays important role in economic growth, probably as a determinant for the catching-up process. It contributes to economic growth

²⁹ E. Borensztein, J. De Gregorio and J-W. Lee

in terms of technology diffusion (i.e. introducing advanced management skills and modern technologies) and capital supply (i.e. narrowing the saving gap which means the gap between domestic savings and capital needed). However, there is threshold effect on the utilization of FDI, which could stems from the existence of minimum effective FDI intensity and human capital level.

Concluding remarks

This paper has attempted to figure out the general pattern for the catching-up process by comparative analyses between Malaysia and Singapore. Rather than establishing a new theory for the catching-up, this paper has adopted Broadberry's framework in which he had analyzed the catch-up of Germany and the United States. The roles of and the relationships among several determinants: structural change, TFP, export and FDI respectively have been examined respectively.

The comparative study on Malaysia and Singapore suggests that the structural change has significant impact on the catching-up process. However, the specific rearrangement of industries determines the efficiency of structural change, which means the economic development depends more on the form (or orientation) of structural change rather than the extent of structural change. The mechanism is that structural change does not necessarily directly contribute to overall economic growth, but it increases aggregated labor productivity by adjusting the labor share of each industry. By shifting labor from lower productivity sectors to higher ones, structural change raises the overall labor productivity not only by enlarging the high productivity sectors, but also by raising the labor productivity in declining sectors due to the law of diminishing returns. It's also important that according to the empirical study on Malaysia and Singapore, the within-sector labor productivity plays the more decisive role in the effectiveness of structural change. In other words, structural change itself could not significantly raise overall labor productivity without successful improvement in within-sector productivity.

Another conclusion, which is in contradiction to conventional views, is that TFP plays important role in the catching-up process. Previous studies

suggest TFP had no contribution on the East Asian economies' catch-up, however, the TFP analysis in this paper indicates that the highest economic growth rates that occurred in the catching-up period could be mainly (half) attributed to the contribution of TFP.

The comparison between Malaysia and Singapore also confirms the importance of export in the catching-up process. It also reveals that the prosperity of export sector is mainly determined by the within sector labor productivity, rather than structural change. Although the orientation and extent of structural change have their impacts on the expansion of export sector, the comparative advantage which underpins export is largely influenced by labor productivity in the case of Malaysia and Singapore.

In this study, we also found that the contribution of FDI in the catching-up process might have threshold effect. The research results suggests that the phenomenal performance of GDP per capita growth rate in Singapore could be linked to the soar of FDI intensity, but the soar of FDI intensity had no effect on the economic growth rate in Malaysia. The different performance of FDI in these two countries might be attributed to the gap in FDI intensities and human capital environments.

The results of this study provide some theoretical basis for policy prescriptions. Firstly, although structural change with correct orientation contributes to economic growth, it's still much less important than internal labor productivities. Overall economic growth, prosperity of export sector, and attraction for FDI are determined by internal labor productivities, while structural change might exert positive effect on them. This means rather than focusing on the rearrangement of industries, it's more important and fundamental to make effort to raise labor productivity within sectors. Secondly, as regards FDI which plays determinant role in the catching-up process, besides trying to increase its volume, it's also important to improve the absorptive capability in the host country, such as the education attainments of labor force and etc. Failure to achieve a certain level of either FDI intensity or human capital could lead to low performance of FDI due to the plausible threshold effect.

In the last place, the results of this study suggest some directions for further research. Since the within sector labor productivity is proven to be more

important than structural change in the catching-up process, further analysis of its mechanism and determinants will be necessary for studying the catching-up process. It's also important to figure out the mechanism that how internal labor productivities affect export and FDI. In addition, the reliability of this study is largely limited since only two countries' data is employed, it's thus of great value to test it in a broader context.

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