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The Nature of Industrial Structural Change and Economic Growth: A Decomposition Analysis

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Abstract

The concentration of the economy on the specific sector and lack of industrial structural change is the cause for the divergence of developing countries. Using data from the Asian KLEMS database for China and South Korea, we employed decomposition techniques to analyze the nature of structural transformation and industries' contribution to growth. It is confirmed that both within-sector and between-sectors structural change contribute to the growth, but the modern economy does not follow the traditional linear structural transformation. Structural transformation through industrial upgrading, technological innovation, institutional and infrastructural development can stimulate dynamic and rapid economic growth. Therefore, the existence of structural transformation is another factor that affects economic performance, and hence income gaps. Since the rate of structural transformation is declining as the economy becomes advance, developing countries have the advantage of transforming their economy faster. They have the technological advantage of a latecomer. To undertake structural change and uphold sustainable development, diversification of the economy is required.

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1. Introduction

Before the industrial revolution, which makes a dramatic turning point in the economic progress of nations (Clark G. , 2007), the speed of economic growth and difference in per capita GDP across countries was small, stagnant, and flat; estimated to take about one and a half-century to double in Western European (Lin, 2016). The industrial revolution, which begins in the 18th century in the UK, applies science in industry and introduces machine as a means of production, shifting the structure of the economy, it brought about rapid Economic growth. Later the advancement of the industrial revolution following technological innovation, which improves productivity, reduces transaction costs and helps to create new industries with higher value, resulted in higher per capita income (Kuznets, 1966). Then, during the 19th century, most countries in Western Europe and North America becomes the most pioneers of the industrial revolution, and indeed, in the 20th century, they become the world riches part as their per capita GDP reached the higher level Figure 1. It has resulted in a higher gap in income and living standards. Following the divergence of per capita income and living standard, which is the result of the industrial revolution, the world has classified as developed and backward; and the world economic growth has driven by few Western economies. Since it is the dream of every backward country to become an advanced industrialized and developed nation (Lin, 2011), the government of developing nations adopts various institutional arrangements to cutch-up the developed countries. However, in the late 19th century, only a group of colonial offshoots (United States, Australia, New Zealand, and Canada) and in post-WWII Japan achieved this catch-up. In the 20th century, the backward nations suffered a lot from the disadvantage of backwardness as the divergence in income level between them and developed countries has accelerated. Later, at the end of the 20th century, the Asian Tigers (South Korea, Singapore, Hong Kong, and Taiwan) underwent rapid industrialization (average economic growth 7% between 1960 and 2000) and achieved the catch-up see Figure 1.

In general, both theoretical and empirical evidence suggested that industrialization plays a core role in the economic growth of a nation. For example, Kaldor's law (Kaldor 1968) states that manufacturing serves as an engine of growth and, this works for many counties (Opoku, et al., 2019; Alexious, C., & Tsaliki, P., 2010; Dahlman, C. J., 2009; Haraguchi, N., et al., 2017; UNIDO, 2013). Also, in China, a dynamic industrial structural change through industrial upgrading, technological innovation, and improvement in infrastructure help to accumulate capital, which brings a transformation in the structures of their endowment, resulting in the stimulation of a dynamic and rapid economic growth (Zhao & Tang, 2015; Lin, 2016; Lin, 2011). However, these few industrialized nations achieved this process, not at the same time with the same model. Few economies had become industrialized as leaders (those that developed the technologies), and some other becomes industrialized as a follower (those that adopts the technology first) (Lin, 2011). Thus, industrialized nations have their own story of industrialization, and they followed different models of development. Because of these differences in the models of development, the trend and structure of their economy are also different. The initially industrialized western European countries (UK, Italy, France, and Germany) follow a relatively similar growth model/path, that is the application of mechanically powered machinery and factory system in production, which is an innovation guided by scientific progress. Then, following the footsteps of the Western European countries, the Anglophone colonial offshoots achieved higher economic growth with a higher rate of industrialization (especially the USA). And in the mid of the 20th century, Japan joined them as many firms migrated from the USA to Japan (because of economies of scale (krugman, 1991)). After the mid of the 20th century, firms started migration from Japan to the East Asian countries (Asian Tigers). Also, following Export Promotion Strategies as the policy initiative, rather than import substitution (as advocated by Structuralisms), which brings a structural change to their

economy through industrial upgrading, they have achieved higher economic growth and higher employment rate.

Currently, following a State Lead Development Policy and dual-track opening up its economy based on the Comparative Advantage Following (CAF) strategies of the New Structural Economics, China is achieving a higher rate of industrialization and consistently registered an unprecedented higher rate of Economic growth. Following this strategy, the Chines invest in the labor-intensive manufacturing sector and transform through the process of industrial upgrading, technological innovation, and higher infrastructural investment. Then, they have changed the structure of their economy from labor-intensive to capital intensive sectors and now towards high tech firms, and become the second-largest economy in the world. On the other hand, during the 1970s, many Latin America and sub-Saharan African countries following the structuralisms' view of massive government intervention in the economy, they failed to achieve the expected goals. Again, later during the 1980s, they adopted the import substitution strategies of the neoliberal policy and implemented the structural adjustment program of the World Bank. But finally, they remained underdeveloped without observing any structural transformation and ended with the conclusion saying the lost decades.

2. Industrialization and Growth: Trend and Structure

As displayed in Figure 1 the development pattern of different regions of the world shows high variation since the outcome of the industrial revolution and technological advancement. For example, the real GDP per capita difference between Western European and Latin America before the industrial revolution was so insignificant. But since the industrial revolution, the growth pattern between the two regions was diverging at a high rate. As per the Maddison 2018 historical database, in 1870 the real GDP per capita of Latin America was about 39 percent, and 38 percent of Western Europe, and Western offshoots respectively, where it was declined to 36 percent and 27 percent respectively in 2016. Since 1950, Africa, which has 43 percent real GDP per capita higher than that of East Asia (the poorest region of that time) in 1950, has recorded the highest divergence rates relative to the other regions. For example, the real GDP per capita of Africa was 33.6 percent higher than that of South Korea in the 1950s. But eventually, in 2016, the real GDP per capita of Africa was only about 13 percent of South Korea's real GDP per capita. Relative to 1950, in 2016, the real GDP of Africa has diverged by 9 percent and 26 percent from Western Europe and Japan, respectively[1]. Also, West Asia and East European countries have failed to achieve this catch-up, even if they were better than Latin America and Africa.

On the other hand, some countries especially, Eastern Asia countries such as Japan following the footnote of the west offshoots and later the Asian Tigers, show a higher growth rate and achieved the catch-up. When we see the Japanese economy, it was small relative to other regions before WWII. In 1870 the real GDP per capita of Japan was 20 percent lower than that of Latin America's, and it was only about 31 percent of the Western offshoot's economy. The Japanese economy has diverged from Latin American and Western offshoots economy by 8 percent (from 80 percent to 72 percent) and 10 percent (from 31 percent to 21 percent) respectively in 1950. But eventually, Japan's economy started growing at a higher rate following the industrial establishment and upgrading through absorption from the USA (Fagerberg & Verspagen, 2002). Then, Japan becomes one of the largest economies in the world (Japan's real GDP per capita was 271 percent higher than that of Latin America in 2016) and has achieved the catch-up reducing the income gap with the Western Offshoots.

[1] Based on Maddison 2018 historical database and also see figure 1

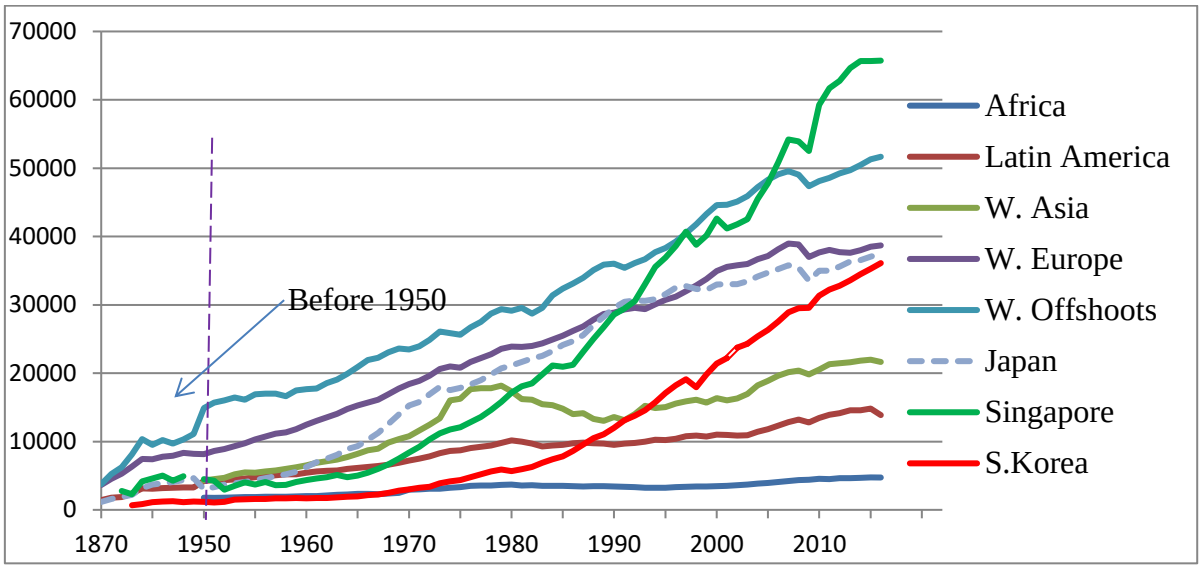

Figure 1: Development Patterns of Different Regions and Countries

Following Japan, the four Asian Tigers (Hong Kong, Singapore, South Korea, and Taiwan), started growing at a faster rate during the 1960s adopting export promotion strategies (Lin, 2011) and become successful in a convergence in early 1990s. For example, on average, Asia Tigers' per capita income relative to the USA, which was only about 15 percent in 1950, is raised to 60 percent in 1994 and 91 percent in 2016. During the 1970s and 1980s, the growth pattern of Asian Tigers not only shows a divergence from the Latin America and Africa economy, but it also showed a faster convergence towards the higher income countries' real GDP per capita.

Here is the divergence, for example, while the real GDP per capita of South Korea was equal to Africa's real GDP per capita in 1970, the real GDP per capita of Singapore was also equivalent to that of Latin American's in 1968. However, the story was quite different after this period, following the industrialization of the Asian Tigers. In 2016, the real GDP per capita of Africa was only 13.13 percent of that of South Korea's. Similarly, during this time, the real GDP per capita of Latin America was about 21 percent of that of Singapore. In general, this income gap among industrialized and non-industrialized countries was diverging at a higher rate since the industrial revolution making the catch-up more difficult. Before the industrial revolution, economic growth was stagnant, and the relative income distribution was almost flat (Lin, 2011). Following the industrial revolution, while the economy of the leaders and the followers of the pioneer of the industrial revolution started growing faster, the other's countries income remained infant and stagnant resulting in a dynamic distribution of nations by their relative income relative to the USA (the highs performing economy). As seen in **Figure 2**, about 91 percent of the world counties have a real GDP per capita of half and less than half of the level in the USA in 1950. In 1980 this number was reduced to 79 percent following the economic improvement of the middle-income counties.

Since the 1950s, the position of countries relative to the USA was dynamic. It was changing from time to time (while some were continuously converging, the other were showing on average divergence). For example, relative to 1950, about 42 percent of the countries were diverged (on average by 4 percent) from their real GDP per capita relative to the USA in 1980. During this time, while about 40 percent of the countries have converged by a small amount, that is (0 to 0.2) on average recording 0.06 convergence, only 3 countries recorded a

convergence rate higher than 0.5. The remaining 16 percent shows a moderate convergence (0.2 to 0.5). But the story was different for the period of the post-1980s.

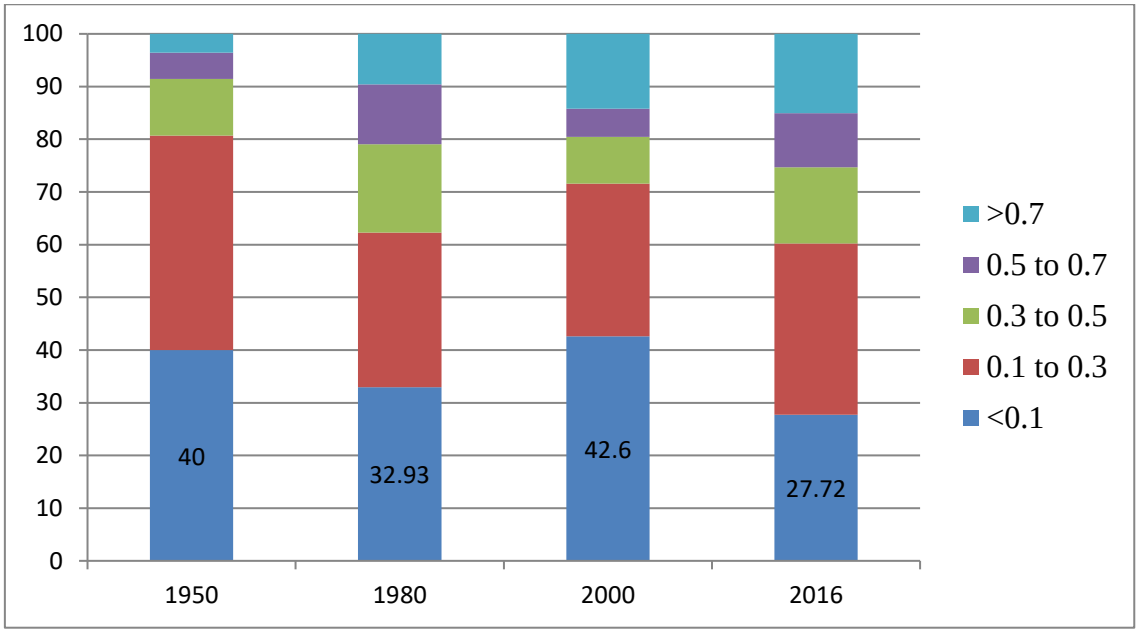

Figure 2: Distribution of Countries by Relative Income

The period of 1980 to 2000 has been marked as a period where the highest divergence has been recorded, and the world economic performance was the worst (the whole countries change in average real GDP per capita relative to the USA from 1980 to 2000 has recorded negative 0.075)[2]. In 2000 about 69 percent of the world countries (114 countries) recorded divergence (change in real GDP per capita relative to the USA was negative) from their relative position of 1980. These countries' economic performance relative to the USA in 2000 was lower than what it was in 1980 (on average declined by 15.7 percent).

It was also this time when many of the middle-income countries have suffered from a middle-income trap. Only six countries such as Hong Kong, South Korea, Taiwan, Malta, Norway, and Ireland have registered a moderate improvement in their performance relative to the USA. While Singapore and Luxembourg were the countries with higher performance (on average improved by 55.8 percent over what they were in 1980 in real GDP), 44 countries show only a slight improvement (an average change in real GDP per capita relative to the USA was 0.054) in 2000 relative to what they were in 1980. In contrast to the preceding decades, even though Singapore was the only country recording higher relative performance in real GDP per capita relative to the USA in 2016 as compared to that of its 2000 relative performance, there was a significant improvement from the bottom during the period of post-2000. For example, while only about 17 percent of the world countries recorded divergence in 2016 from their relative position of 2000, about 71 percent shows a slight improvement in the performance of real GDP per capita relative to the USA over this period. The number of countries showing an intermediate improvement (0.2 to 0.5) has increased from six to nineteen with an average change in real GDP per capita relative to the USA during this period. About 54 countries registered divergence in 2016 from what they were in 1950 relative to the USA. The real GDP per capita of these countries relative to the USA has lowered on average by 5.7 percent. That means in 2016, about 39 percent of the world countries are living below what they were living in 1950 relative to the USA. But this does not mean the divergence was limited to only

[2] We have excluded United Arab Emirates and Slovakia because of incomplete data

developing countries, even though the intensity was small developed countries were experiencing this divergence. For example, New Zealand and Australia were diverged from the USA by 12 percent and 4 percent respectively in 2016 relative to 1950.

In general, the real GDP per capita of the world countries relative to the USA shows a convergence on average by 12 percent in 2016 relative to 1950[3]. This improvement was mainly recorded by 13 countries (which are all higher-income countries except Equatorial Guinea) which, showed a higher convergence (on average 66 percent) see Table 1. At the same time, from the bottom, about 34 percent of the world countries recorded a slight convergence, about 8 percent on average. About 25 countries presented an intermediate improvement with an average convergence of 30 percent. Generally, during this period, countries that undertake industrialization are converging to high-income countries, while developing countries (mainly African countries) keep on diverging. Although some resource-rich counties have achieved the catch-up, their growth lacks consistency. For example, Saudi Arabia, the second-largest oil reserves and one of the largest oil-exporting countries (95 percent of its export), recorded 66 percent divergence in 2000 relative to 1980 following the 1990s world oil price stagnation and dropped off the higher income countries before it reappeared again. Equatorial Guinea, one of the emerging economies and the third-largest producer of oil in sub-Saharan Africa after Nigeria and Angola, has experienced a decline in economic growth since 2010 and this situation goes to the worst following the collapse of oil price in 2014. Then in 2016, as per the World Bank classification, Equatorial Guinea was dropped off high-income countries. Also, Russia and Venezuela, which are known as resource-rich countries, were dropped from higher-income categories in 2016, falling to maintain the per capita income growth.

The world countries' real GDP per capita relative to the USA did not show a significant improvement in 2016 relative to 1980 (only about 0.5 percent improvement is recorded over this period). At the same time, while about 45 percent of the world economies were diverged (on average by 14.8 percent), only four countries (Singapore, Norway, Ireland, and Equatorial Guinea[4]) have recorded relatively a higher convergence (averaging 0.65). The maximum divergence of this time is recorded by resource-rich countries of which Qatar (420 percent), Libya (126 percent), and Kuwait (124 percent) ranked the top three. Also, Algeria (14 percent), Gabon (21 percent), Iraq (32.5 percent), Nigeria (11.6 percent), Russia (17 percent), Saudi Arabia (20.8 percent), Ukraine (13 percent), and Venezuela (13.5 percent) were suffering from this divergence too. Of the world countries, about 46 percent of them recorded an average of 0.076 convergences, and only eleven nations showed an intermediate improvement (averaging 0.317).

In general, the period of the 1980s and the 1990s has remarked as the period were many countries of the world, especially those in low-income and middle-income categories, as well as a resource-rich country shows the worst performance and higher divergence, and only a few countries achieved the catch-up. It was the result of the structural adjustment policy and the stagnation of oil prices. As we have recognized in the previous section, developed countries that have achieved higher industrialization do not follow the same ways and strategies to reach where they are today. They are industrialized and achieved higher economic growth during different times. The policies and tactics to approach economic development vary widely (Cardinale, 2018). For example, the initially industrialized Western nations, which start through industrial revolution applies mechanically powered machinery and factory system in production, which is an innovation guided by scientific progress. Then the Western offshores

[3] For comparison purpose we have included only 139 counties which exists both during 1950 and 2016
[4] Equatorial Guinea begins exploitation of oil and gas deposits in 1990s

and Japan becomes industrialized but not through revolution. The trend of growth and industrialization has changed since the 1950s. Since then, rather than revolution, incentives played a key role in the industrialization of a nation as the economy goes more sophisticated. For example, manufacturing firms start to migrate to Eastern Asia following different policies and institutional incentives of the region (Export Promotion Strategies). Following different economic reforms, the third wave of the Fordist[5] Models of growth has started in China and India in the 1980s, and 1990s respectively. Both countries benefited from post-Fordism (since the USA pass through the first and Western European, Japan, and Asian Tigers passed through the second waves) and from several advantages of relative economic backwardness. However, the intensity of growth and structural change was higher in China (Valli & Saccone, 2009).

Table 1: Countries with Higher Performance in Relative Real GDP Per Capita

Number	country	1950	2016	Change
1	Switzerland	0.594	1.167	0.573
2	Austria	0.299	0.849	0.550
3	Germany	0.363	0.884	0.520
4	Equatorial Guinea	0.055	0.594	0.539
5	China, Hong Kong SAR	0.263	0.887	0.624
6	Ireland	0.306	1.050	0.743
7	Japan	0.165	0.688	0.522
8	Republic of Korea	0.074	0.682	0.608
9	Norway	0.521	1.441	0.920
10	Oman	0.086	0.696	0.610
11	Saudi Arabia	0.280	0.895	0.615
12	Singapore	0.160	1.267	1.107
13	Taiwan, Province of China	0.091	0.798	0.707

China recorded impressive catching-up, rising from 5.7 percent of the USA per capita in 1980 to 23.3 percent in 2016 based on Maddison Project Database. This rapid economic growth and structural changes were stimulated mainly by economic reforms, the growth of the internal market (in the 1980s), and penetration in its industrial products into the world market in the mid-1990 following the joining of China into the World Trade Organizations (WTO). The difference in the industrial structural change, and then economic growth and labor productivity in many countries was the resulted from differences in the reaction and adjustment of countries to various reforms (Zhaoa & Tang, 2018). For example, China executed economic reforms through a gradual fashion or dual-track opening up (Zhao & Tang, 2015; Lin, 2011; Zhaoa & Tang, 2018; Valli & Saccone, 2009). Other countries like India and Russia implement different reforming strategies. The reforms undertaken in India (since 1992) and Russia (since 1991) were relatively recent and smaller. In addition to the reaction and adjustment of countries to policy reforms, different policies and incentives affect the nature and structure of industrial changes (Szirmai & Verspagen, 2015). Besides this difference, all these countries passed through essential structural change and economic growth following the reform, specifically China and India experienced very rapid economic growth (Valli & Saccone, 2009; Zhaoa & Tang, 2018). The chines economic growth is more than doubled of what it was before 1978, (on average it was 4.6 percent from 1952 to 1978). It was 9.81 percent on average from 1982 to 1990 and this figure rise to 10.45 from 1991 to 2000.

[5] Fordist model of growth is associated to a phase of strong growth of some interlinked industrial and service sectors where scale economy and network economies are of crucial importance and it is different from more general concept of "Fordism" of Gramsci or of the French regulation school (Valli & Saccone, 2009).

Industrial structural change, which is a driving force of long-run economic growth (Zhao & Tang, 2015), will occur when the economy shifts from the traditional industry to new industries. Both demand and supply play a crucial role in achieving industrial structural change. On the supply side, technological change and innovation affect the structures of industries in different ways. First, technological change and innovation lead to the emerging of new industries (new products). Second, it helps to upgrade the existing industries, and then, reducing costs of production (economies of scale) (Lin, 2011; Szirmai A. , 2012). On the demand side, a rise in income and international trade drives both domestic and international demand for the existing and new industries. In addition to the supply and demand, infrastructural and institutional development plays a vital role in bringing industrial structural change both within and among industries through reducing transaction costs (in case of digital service, the marginal cost is close to zero) and information asymmetry. On the other hand, the tertiary sector demands more of infrastructure and best institutional set up than the primary. Therefore, having a better institutional setup and well-developed infrastructure pulls the economy to undertake the industrial structural changes. A dynamic industrial structural change that comes through industrial upgrading, technological innovation, and improvement in infrastructure leads to a difference in economic growth and labor productivity. It resulted in the stimulation of dynamic and rapid economic growth (Zhao & Tang, 2015; Lin, 2016; Lin, 2011; Szirmai & Verspagen, 2015; Rodrik, 2009; Szirmai A. , 2012). Therefore, studying the nature of industrial structural change and the source of economic growth is crucial for policymaking and drawing a lesson for developing nations.

Methodologically most of the analyses of structural changes have two shortcomings. The first one is related to the aggregation of industries or sectors. Many empirical studies often consider the transformation between the three aggregated productive sectors; agriculture, manufacturing, and service sector see (Szirmai & Verspagen, 2015; Szirmai A. , 2012). Such aggregation ignores the changes within a given sector or/and industry (say industrial or service), which have great importance. In modern economic growth, it is not one sector as a whole say manufacturing that is important, but subsectors of manufacturing. It is the information and communication technology and the high technology products which are more important for productivity growth in the 1990s (Szirmai & Verspagen, 2015; Valli & Saccone, 2009; Zhaoa & Tang, 2018). Since the aggregation method ignores the changes within specific industry\sectors, (one) it might overestimate or underestimate the structural transformation of that subsector. For example, initially, if the traditional (low-tech) manufacturing sector's contribution to economic growth and labor productivity was high, and finally, if this role has shifted to the high-tech manufacturing sectors, then the overall aggregation of each subsector might show that the structure of manufacturing has remained unchanged while the actual is not. (Two) it does not show the relative importance of subsectors. As of the previous example (low-tech and high-tech), the aggregation method indicates that the high-tech is as good as low-tech initially, and low-tech is as good as high-tech finally. (Three) it will make it hard to perform counterfactuals or policy simulations based on its finding. Therefore, it is recommended to analyses the structural changes based on the disaggregation or subsector level. The second problem with the existing empirical analyses of structural change is that most researchers use the traditional formulation of aggregate GDP growth being a weighted sum of industry value-added growth a method that considers only quantity effect (the effect due to industry or subsector real output growth) and ignores price effect (which reflects the rising importance of an industry in its ability to create economic value). This method has shortcomings; one, it underestimates the contribution of industries with rising output prices and overestimates the contribution of subsectors with falling output prices since it ignores the

price effect (Zhao & Tang, 2015). Two, it shows only the output (value-added) growth and labor productivity growth of each industry/subsector but, it does not show the exact contribution of each subsector to the economic growth and total labor productivity growth, respectively. Higher output growth or higher productivity growth of a specific industry/subsector does not necessarily mean that the contribution of that industry/subsector to economic growth or total labor productivity growth is higher. It depends not only on the productivity or growth of each industry, but it also depends on the relative share of each subsector. For example, in the modern economy (post-1973) the labor productivity growth of the agricultural sector is higher than that of the service sector, because of the extensive application of biotechnological innovations (Szirmai A. , 2012). But, the contribution of labor productivity of the agricultural to the aggregate labor productivity growth is too lower than that of the service sector contributions because the relative share of the later for the output as well as total employment is higher than the other's sectors. Therefore, since the value-added (output growth) or labor productivity growth of a specific industry/subsector alone does not show the contribution of that particular industry/subsector to the overall (total) economic growth or labor productivity growth, any policy conclusion based on such finding will be misleading. So, to estimate industries' contributions to economic growth and labor productivity growth, we have used decomposition methods[6] developed by (Tang & Wang, 2004) and improved by (Diewert, 2014). It has many advantages over traditional methods. Firstly, it decomposes the aggregate real GDP growth into its industry/subsector components. Secondly, it has the advantage of incorporating the effects of both quantity and price, and it implicitly integrates both demand and supply factors in evaluation (Tang & Wang, 2015). Third, it captures the market force since it allows us to take advantage of the relative weighting of goods and services that arise from the valuation of output made by producer and consumer. Fourth, it helps us to identify the source of economic growth as quantity and price effect and that of total labor productivity as pure productivity effect and shift effect.

3. The measure of Concentration and Methods of Decomposition

3.1. Measure of Concentration

The industry/sector concentration is measured using the Hirschman-Herfindahl Index (HHI); the HHI takes into account all points on the concentration curve. HHI is the sum of the squares of the relative sizes (or industry shares) of all industries in the economy, where the relative sizes are expressed as proportions of the total size of the economy. Mathematically, the HHI index is given by:

$HHI = \sum_{i=1}^{n} S_i^2 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 1$

Where $S_i = q_i/Q$, q_i is the output of the i^{th} industry/sector and Q is the total output of all the industries in the economy, and n is the total number of industries

The index is close to zero when there are large numbers of equal-sized industries in the economy, or approaches to one when specific sectors contribute a larger proportion to the economic growth or productivity. The HHI has two principal advantages: squaring the individual industry shares gives more weight to the shares of the larger industry, and it uses information about the share of all relevant industries. The Hirschman-Herfindahl index gives added weight to the biggest industries.

3.2. Decomposition Methods

To estimate industry contribution to economic growth and labor productivity growth, we have used a decomposition method developed by Tang and Wang (2004) and improved by (Diewert, 2014). The method decomposes the aggregate real GDP into its industry component. This

[6] See the methodology section in chapter three

method has the advantage of incorporating the effect of both quantity and price effect, and it implicitly incorporates both demand and supply factors in evaluation (Tang & Wang, 2015). It also captures the market force since it allows us to take advantage of the relative weighting of goods and services that arise from the natural valuation of output made by producer and consumer. It helps us to identify the source of economic growth as quantity and price effect.

3.2.1. Industry Contribution to Economic Growth

The quantity effect measures the contributions of growth in quantity produced in the industry, and the price effect measures a rise in the relative output price. Then each industry/subsector will contribute to aggregate economic growth either through an increase in real output or a rise in its price or both. That means the industry can contribute to economic growth even if the output remains unchanged. But contribution of each subsector is weighted by its share of nominal GDP at the beginning of the period.

Assuming there are n numbers of industries in a specific economy, the contribution of each industry to GDP is estimated as

$$y_t = \frac{Y_t}{p_t} = \frac{\sum_{i=1}^{n} Y_{it}}{p_t} = \frac{\sum_{i=1}^{n} p_i y_{it}}{p_t} = \sum_{i=1}^{n} \tilde{p}_{it} y_{it} \dots\dots\dots 9$$

Where Y_t is nominal GDP, y_t is real GDP, p_t is GDP deflator, Y_{it} is a nominal value-added by specific industry i, y_{it} is real value added by specific industry i, and $\tilde{p}_{it}$ is the relative price of value-added output to the industry i in year t. The above equation suggests that the importance of industry in real GDP increase with its real value-added or with the relative price of output.

Now the contribution of each industry to real GDP growth is estimated as

$$\dot{y}_t = \frac{y_t - y_{t-1}}{y_{t-1}} = \frac{1}{y_{t-1}} \sum_{i=1}^{n} \left[\tilde{p}_{it} y_{it} - \tilde{p}_{i,t-1} y_{i,t-1}\right] \dots\dots\dots\dots\dots\dots\dots 10a$$

$$= \frac{1}{y_{t-1}} \sum_{i=1}^{n} \left[\tilde{p}_{i,t-1}(y_{it} - y_{i,t-1}) + (\tilde{p}_{it} - \tilde{p}_{i,t-1})(y_{it} - y_{i,t-1}) + (\tilde{p}_{it} - \tilde{p}_{i,t-1}) y_{i,t-1}\right]$$

$$= \sum_{i=1}^{n} \frac{\tilde{p}_{i,t-1} y_{i,t-1}}{y_{t-1}} \left[\frac{(y_{it} - y_{i,t-1})}{y_{i,t-1}} + \frac{(\tilde{p}_{it} - \tilde{p}_{i,t-1})}{\tilde{p}_{i,t-1}} + \frac{(y_{it} - y_{i,t-1})}{y_{i,t-1}} \frac{(\tilde{p}_{it} - \tilde{p}_{i,t-1})}{\tilde{p}_{i,t-1}}\right]$$

$$= \sum_{i=1}^{n} \frac{p_{i,t-1}}{p_{t-1}} \frac{y_{i,t-1}}{y_{t-1}} \left[\dot{y}_{it} + (1 + \dot{y}_{it}) \dot{\tilde{p}}_{it}\right]$$

$$= \sum_{i=1}^{n} \frac{Y_{i,t-1}}{Y_{t-1}} \left[\dot{y}_{it} + (1 + \dot{y}_{it}) \dot{\tilde{p}}_{it}\right]$$

Letting $\frac{Y_{i,t-1}}{Y_{t-1}} = w_{i,t-1}$ which is the nominal value-added share in total GDP, we will get:

$$= \sum_{i=1}^{n} w_{i,t-1} \dot{y}_{it} + \sum_{i=1}^{n} w_{i,t-1} (1 + \dot{y}_{it}) \dot{\tilde{p}}_{it} \dots\dots\dots 10b$$

Where the first part of equation 10b is the quantity effect, and the second part of it is the price effect. $\dot{y}_t$ is the real GDP growth rate, $\dot{y}_{it}$is the real value-added growth of the industry i over the period from t-1 to t, and $\tilde{p}_{it}$ is the percentage change in the real value-added price of industry i over the period from t-1 to t. Equation 10b shows that each industry contributes to real GDP growth through an increase in real output or a rise in the price of real output.

4. The Nature of Industrial Structural Change and Economic Growth

The nature of industrial structural change varies within a given economy (between and within industries) or between countries resulting in variation in economic growth. Those counties that undertake a dynamic structural transformation have successfully achieved

industrialization and catch-up processes with a higher rate of convergence (Rodrik, 2009; Valli & Saccone, 2009). The Chines and South Korean economies were few among those that undertake a dynamic structural change. In 1978 Chines economic growth was about 4.5 percentage with per capital income $1,648, which is lower than that of African's per capita income and per capita income relative to US 0.055. The same figure rose to 10.6, $9,475, and 0.19 respectively in 2010. Similarly, the South Koreans economy has passed through this transformation as per capita income rose from $2,560 in 1970, which is lower than that of Africa, to $32,485 in 2012. Relative to the US in terms of per capita income, South Korea's economy shows a significant improvement with a higher convergence rate since 1970 (raised from 0.107 in 1970 to 0.644 in 2012) based on data from Maddison 2018.

4.1. The Nature of Industrial Structural Change and Economic Growth in China

Following the reform, the composition of the Chines economy has passed through a dynamic transformation since 1979. When we see this composition, in 1981, the Chines economy was mainly dominated by the primary sector both in terms of value-added and labor share as it was about 37.46 percent and 64.23 percent, respectively. But for the simplicity of analysis and better comparison over time, we have decomposed the whole study period into three; 1981-1990, 1991-2000, and post-2000. Now onward, our examination will follow this periodical classification of the study time. Between 1981 and 1990, the primary sector contributed the largest share of value-added with an average of 33.72 percent share. During the same period, the share of the manufacturing was 31.77 percent, and that of the service sector shares about 27.26 percent. The remaining, which amounts to about 2.52 percent and 4.72, was contributed by the utility and construction sectors, respectively. It is in line with the finding of Szirmai & Verspagen (2010), which states that the structure of commodity production is related to the level of per capita income and at the early stage of development the share of the manufactory was lower, and that of agriculture is higher.

In the next period, 1991-2000, the service sector takes the leading role as its value-added share increased to 35 percent (increased by 28 percent), and that of primary industry's share has decreased by 30 percent relative to the preceding period. Although the construction and manufacturing sector shows improvement, the rate of improvement of the construction sector was very large as it increased by about 22 percent, while manufacturing increased only by 5.36 percent.

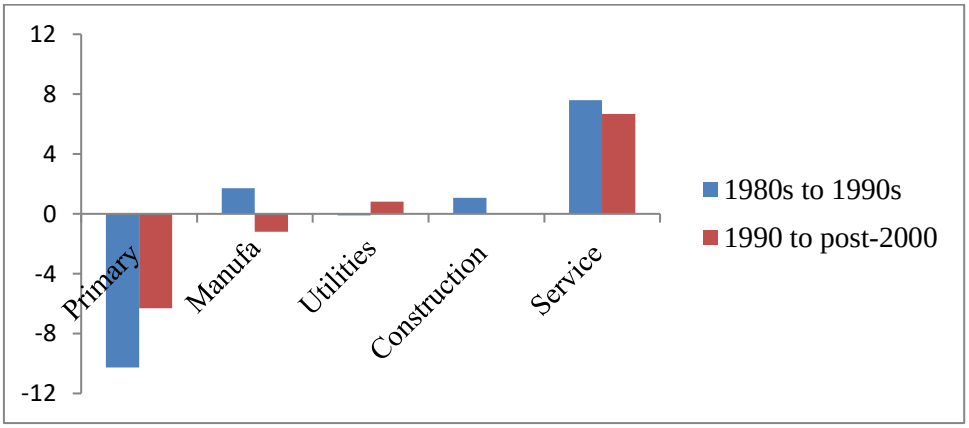

Figure 3: Change in Industries Value Added share Over Time

During the post-2000 period, the service sector dominates the Chines economy in terms of the value-added share as its share has increased to 41.54 percent. The share of the primary industries was continuously declining as it lowered to 17.16 percent but at a decreasing rate. It reveals that there is a significant and dynamic shift in the structure of the economy from the

primary to the tertiary sector (see Figure 3). But the transformation does not follows the traditional linear sequence of a shift from agriculture to manufacturing and then to the service sector. Another important thing that we should have to consider is that the change in economic composition occurs not only between sectors but also it occurs within a given sector over time due to the reallocation effect, resources are reallocated from a less efficient subsector to a more efficient one. Such changes of subsectoral composition within a given industry have a strong policy implication. For example, Szirmai & Verspagen (2015) argue that it is subsectors of manufacturing, such as information and communication technologies, which are more important as a source of productivity growth than the whole manufacturing in the 1990s. Here below let we will explore such effects in detail based on the value-added share before analyzing its contribution.

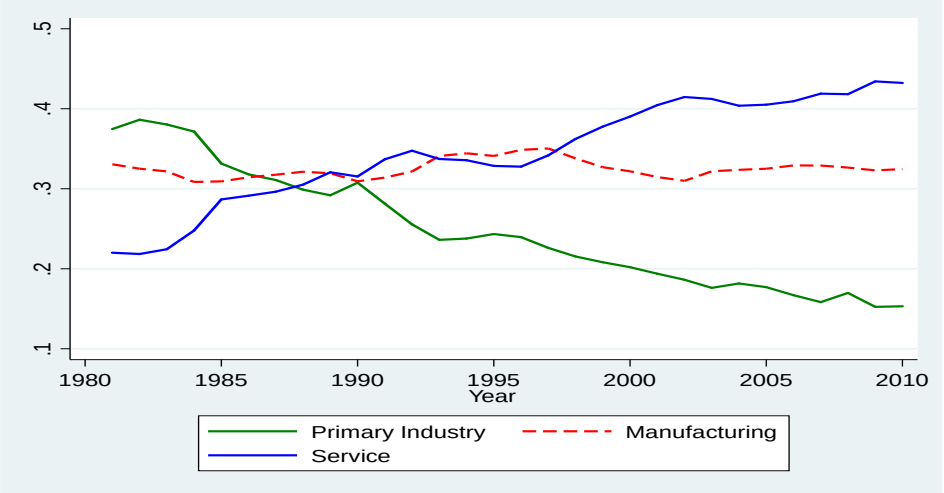

Figure 4: Value Added Share of the Chines Economy over Time

Accordingly, within the primary sector, while the value-added share of agriculture, forestry, animal husbandry, and fishery industry has dynamically declined from 29.59 percent in 1981 to 1990 to about 12 percent in the post-2000 period, the other subsectors (except oil and gas excavation) does not show a very large change over this period. It is difficult to conclude that there is a significant structural change within the primary sector that is the shift is from the primary to other sectors but not to other subsectors/industries of the primary sector. As the degree of substitutability of industries of the primary sector is very low within a sectoral shift is not expected in this sector. In the modern economy, oil and gas excavation and metal mining industries are more capital intensive, unlike the traditional agriculture and mining. Since at the early stage of development capital is scarce, it is more difficult for the economy to shift from agriculture to this capital intensive subsector of the primary industry. Unlike the primary industry, the dual-track reform has resulted in a significant structural change within the manufacturing sector. Firstly, in the 1980s, traditional manufacturing and giant firms owned and run by the state are the major contributor to the value-added share of manufacturing. Industrial machinery and equipment and chemical and allied products were the major contributors to the share of the sector. But this share was continuously declining since then due to the diversification of the economy following the policy reform. Following the second wave of reform, the shares of traditional manufacturing products such as food and kindred products, apparel and other textile products, leather and leather products, stone, clay and glass products, metal products, and other manufacturing industries have increased during 1991 to 2000. But these shares have declined in the post-2000 period. The change in the value-added share is the result of the demand effect. The increment has attributed to the increase in local demand, which has resulted from an increase in income. But as income increase more, the

consumer consumes more of service than manufacturing goods, so that its share will start to decline (Szirmai A. , 2012; Valli & Saccone, 2009). Besides, the value-added share of tobacco products and textile mill products were declining continuously since 1990. On the other hand, the value-added share of high technology products such as electric equipment, electronic and communication equipment, and motor vehicles and other transportation equipment shows a dynamic improvement over this period. Following the third wave of reform, Chines joining of the world market and larger FDI as well as information and communication technology market, make the improvement higher during the post-2000 period. Generally, there is a shift in manufacturing from traditional low technological products to high technology products in China, signifying the existence of structural change within the manufacturing sector. Although the service sector has shown a significant improvement in value-added share, there is no sufficient evidence indicating the existence of structural change within this sector. However, the increment in each subsector varies during different periods. For example, following the second wave of policy reform service sectors which are mainly owned by the private sector such as wholesale and retail trades, hotels and restaurants, transport, storage and post services, real state service, and financial intermediations has shown higher growth in terms of value-added share from 1991 to 2000 than that of post-2000. On the other hand, other service subsectors which were mainly run by the state such as leasing, technical, science and business services, government, public administration, and political and social organizations, education, healthcare, and social security services, and culture, sports, and entertainment services show higher performance in post-2000 period than before this period. This difference in subsectoral composition over time has resulted from the difference in policy reforms, during different periods, that is, each reform focuses basically on specific subsectors to maintain a stable higher economic growth. Also, these subsectors have a high probability of being suffering from structural change burden as most of them were inefficient at the early stage of development. During 1982-1990, the highest real value-added growth was recorded by non-durable consumption goods, which was the result of an increase in local demand (Valli & Saccone, 2009). From 1991 to 2000, the service subsectors dominate in terms of value-added growth. It was the result of the second wave of reform from which privatization played a vital role. During the post-2000 period, the high-tech and export-oriented manufacturing industries with some service subsectors take the upper hand in terms of value-added growth.

4.1.2. Result and Discussion

Even though the change in value-added share and real value-added growth conveys information about the existence of structural change, it does not tell anything about the contribution of each sector/industry to economic growth. Therefore, we have used the decomposition techniques which decomposes the total economic growth into sectors and subsectors; and identify the source of this growth as output effect and price effect. The Chines economy grows on average by 10.29 from 1982 to 2010. This growth has not evenly distributed throughout the sectors and industries over different periods. The Chines economy has mainly dominated by the primary and manufacturing sectors during 1982-1990 as the value-added shares of both accounts about 65.49 percent. During this time, the share of the service sector was only about 27 percent. It is not consistent with Szirmai & Verspagen's (2010), which states that developing countries have characterized by a large share of service at the early stage of development. During the same period, in terms of real value-added growth, it was the construction and service sectors that are in the frontline, and this is also inconsistent with the finding of Szirmai A. (2012). Now, when we see the contribution of each sector to the total economic growth even if its share was lower, the service sector was the dominant as it contributes about 3.72 out of the 9.81 growth rate. The primary and manufacturing, which were the larger sharer of value-added, contribute 2.86 and 2.58 respectively to the total

economic growth. On the other hand, the construction sector, which had higher real value-added growth in the 1980s, had contributed only 0.51. So, the value-added share or real value-added growth is not a good measure of the relative importance of sectors and the existence of structural changes. One important finding here is that during 1982-1990 even if the output effect dominates the price effect, the average price effect was positive for both the primary and manufacturing sectors. This positive price effect was the result of a higher share as well as higher growth of the real value-added of these sectors.

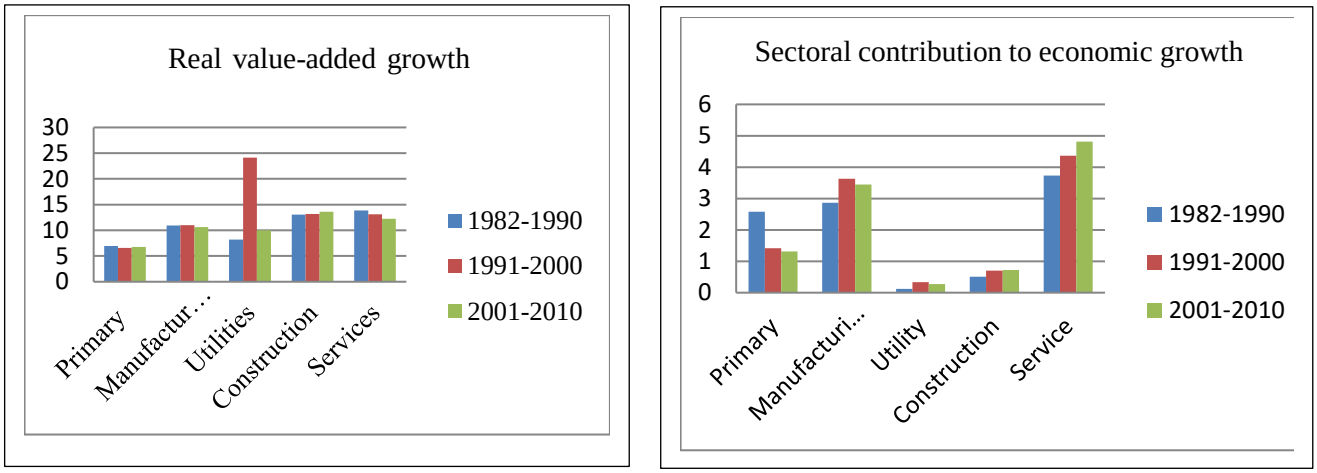

Figure 5: Sectoral Contribution to Economic growth and its Real Value-Added Growth

In the next decade, 1991-2000, the contribution of each sector to economic growth shows significant and dynamic changes see **Figure 5.** For example, while the contribution of the primary sector has declined by 45 percent, that is, it drops from 2.58 to 1.42, the role of the manufacturing sector in the economic growth has reached its pick, as it rises by 27 percent. On the other hand, even though the contribution of the service sector to economic growth (which is 4.37) was higher than others, the growth of this contribution (17 percent) is lower than that of the manufacturing (which is 27 percent). This high performance in the manufacturing sector has resulted from two main factors. The first one is consumption expenditure; that is, an increase in domestic income leads to a rise in the demand for manufacturing goods (Szirmai & Verspagen, 2010). The second factor that leads to this high performance is the reform, which is mainly associated with industry and property right during the 1980s and 1990s (Valli & Saccone, 2009). In contrary to the preceding decade, during the post-2000 period, the contribution of the manufacturing sectors starts to decline. Even though it was dropping (declined by 5 percent), this contribution is remained high (its contribution was 3.44). On the other hand, while the contribution of the tertiary sector was remained higher and increasing, that of the primary sector's contribution was continuously declining but at a decreasing rate. Therefore, as the value-added share indicates, this reduction in the contribution of the primary on one side and on the other hand, the rise in the secondary and service sectors reveals the existence of structural transformation. But the pattern of this structural change is different radically from the traditional one, where the rise of industry precedes that of the service. The Chines economy does not follow the traditional linear sequence of structural transformation since the contribution of the service sector has raised before that of manufacturing.

Old literature argues that manufacturing is more significant in developing countries. For example, (Fagerberg & Verspagen, 2002) manufacturing is the engine of growth in East Asia and Latin America, (Szirmai & Verspagen, 2010) manufacturing is more important in developing countries before 1973, (Szirmai A. , 2012) manufacturing is dominant in terms of output growth. Methodologically all these studies use growth accounting techniques, a

technique that analyses what proportion of a given growth rate of national income derives from the growth of a specific sector. These techniques are straightforward and transparent. But it tends to underestimate the contributions of a dynamic industry because it does not take various external effects. In contradiction, recent literature argues that the contribution of the service sector has increased, for example, (Szirmai & Verspagen, 2015) after 1973 it is an information communication technology which is more important, (Timmer & De Vries, 2009) the contribution of the service sector is more during accelerated growth, and (Zhao & Tang, 2015) there is an increased reliance on the service sector as a source of growth as the sector strengthened its role as the largest contributor to aggregate real GDP growth. Our findings support the argument of the new literature since the contribution of the service sector to economic growth is higher than the others. But this finding does not deny the relative importance of the manufacturing sector in the Chines economic growth, as there is a significant contribution from this sector.

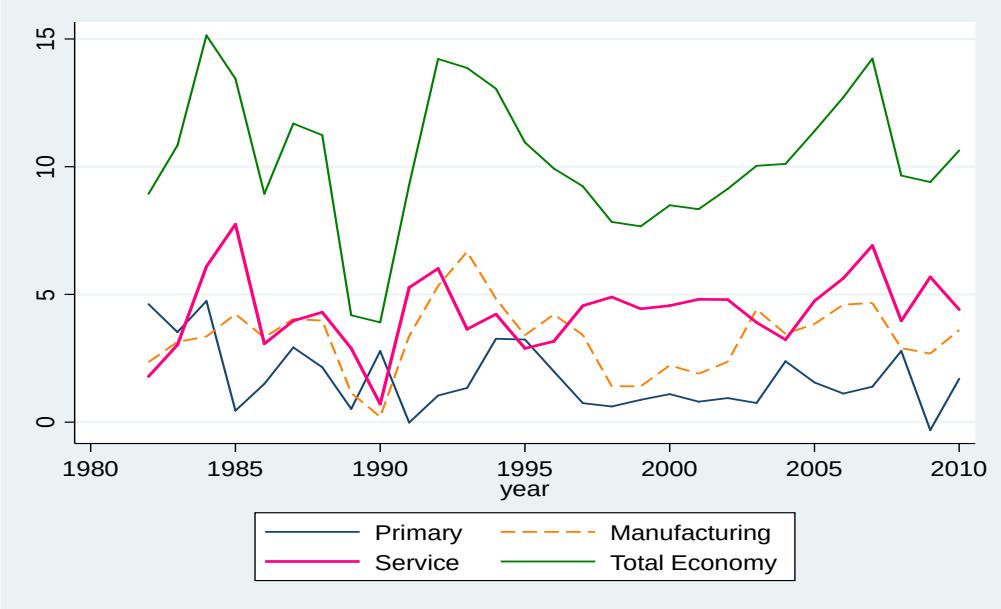

Figure 6: Sectoral Contribution to Economic Growth

This structural transformation is also observed within a sector. For example, within the primary sector, while the contribution of agriculture, animal husbandry, forestry, and the fishery was continuously declining, that of coal and metal mining industry shows continuous improvement. The contribution of oil and gas excavation was too volatile, showing a relatively higher amount during 1991-2000 than before and post this period. Even though the output of this industry was continuously increasing, the fluctuation in its price resulted in a higher variation of its contribution to economic growth see Appendix Table A-1. The total effect of non-metallic mineral mining has increased during 1991-2000. But it was declined from 0.08 to 0.04 during the post-2000 period, mainly due to a reduction in output effect. When we compare coal mining with the oil and gas excavation industry during the post-2000 period in terms of value-added share and real value-added growth, the latter is high. Also, the output effect of the latter is higher by about 37 percent. But when we see the total effect, the contribution of the coal mining industry is almost twice of the latter. Again if we see the value-added share as well as the output effect of both industries from 1982 to 2010, the oil and gas excavation industry takes the upper hand. However, at the end of the day, the total effect (contribution to economic growth) of both industries was equal (about 0.17). This difference was the result of the price effect. Therefore, any policy conclusion based only on either value-added share or real value-added share or output effect is misleading since it either overestimates or underestimates the actual contribution. Another interesting point here is that a small increase in the relative value-

added price of agriculture, forestry, animal husbandry, and fishery, was resulted in a higher positive price effect during 1982-1990 and post-2000 period. Two main factors are contributing to this positive price effect. The first one is within the primary sector the relative value-added share of this industry was relatively higher, especially during the 1980s, so that an increase in price will result in a higher price effect. The second reason behind this positive effect is related to the price elasticity of demand; that is, since the price elasticity of demand for the agricultural product is inelastic, the quantity demand will not decrease as the price of the product increase. On the other hand, this higher price will stimulate the supply of the products. Thus, a small rise in the price of the product contributes positively to the growth of the economy.

A significant structural change has happened within the manufacturing sector, which is the result of both output and price effect. There was a higher price effect for food and kindred products (per-2000), petroleum, and coal products (per-1990), and low tech products (1991-200). But the output effect outweighs the price effect except for petroleum and coal products. The highest growth of output effect in the manufacturing sector has recorded during 1991 - 2000. During this period, the contribution of all manufacturing industries to Chines economic growth has increased except that of tobacco products, which declines from 0.18 during 1981-1990 to 0.05 in 1991-2000 and chemicals and allied products (which fails from 0.4 to 0.3 during the same period). However, for traditional manufacturing industries (low tech products), this increment was not sustained during the post-2000 period. In the service sector, even though the output effect dominates the price effect like manufacturing, the price effect plays an important role. For example, it plays a significant role in wholesale and retail trade, hotel and restaurant, transport, storage, and postal service and information and computer service industries, especially during the per-2000 period and the education subsector during post-1991.

The contribution of all service industries to economic growth shows an improvement relative to that of the per-1991 period except transportation, storage, and postal service which declines from 0.6 to 0.59 (due to price effect) and financial intermediation which decrease from 0.75 to 0.35 (mainly due to output effect). But the contribution of the financial intermediation has risen again during the post-2000 period. The level of sectoral concentration is another indicator of the existence of structural transformation. Initially, the Chines economy was highly concentrated, mainly on agriculture. For example, in 1981 it was about 0.125, of which the primary sector is 0.106. The concentration of the manufacturing and service sectors was only 0.009 and 0.006, respectively. However, in 2010 the total economic concentration index was only 0.045, of which about half of it (0.022) comes from the service sector. The manufacturing sector was relatively stable throughout the period and, the concentration of the primary sector has declined to only 0.01 in 2010 from what it was in 1981. This measure of concentration confirms the structural transformation of the Chines economy from the primary sector to the tertiary sector. It implies the relative importance of a specific sector has changed, and the economy is more concentrated in the service sector than the others. Besides, this measure of concentration confirms an improvement in the economic base. In general, the Chines economy has passed through a structural transformation from primary to the tertiary sector following the reform. Also, this transformation has occurred within a given sector, especially manufacturing. The service sector is relatively more important to economic growth as it has measured in terms of sectoral and industries contribution. The price effect has played a significant role in determining this contribution of each industry to the total economic growth.

4.2. The Nature of Industrial Structural Change and Economic Growth in South Korea

Unlike China, where the value-added share of the primary and manufacturing industries was higher than the service sector in the early period, during the 1970s in Korea the Value-added share of the service sector was higher than the others. But this does not mean that the country has already passed through structural change. Many countries, especially in developing countries, even if they do not undertake any structural transformation, the value-added share of the service sector was higher than others during the 1950s and 1960s (Szirmai & Verspagen, 2010). During 1970- 1990, a period where South Korea recorded higher economic growth, there was a significant structural change between the primary and secondary sectors in terms of value-added share. The value-added share of the primary sector has declined by 68.5 percent in 1990 relative to that of 1970. But that of manufacturing, construction, and utility has increased by 53.23, 121.57, and 54 percent respectively. The share of the service sector has also increased but relatively at a smaller rate (only 10.7 percent). However, during the post-1990s, the story is changed and the value-added share of the service sector has increased at a higher rate than others, except the construction sector during 1991-2000.

Table 2: Sectoral value-Added share

	Value-added share		Change	Average
Year	1970	1990	From 1970 to 1990	(1970-1990)
Primary	31	9.77	-21.23	20.81
Manufacturing	17.79	27.26	9.47	24.69
Utility	1.36	2.1	0.74	2.03
Construction	5.1	11.3	6.2	6.59
Service	44.7	49.49	4.79	45.88

Methodologically taking a specific year and making comparisons is misleading. To avoid such a case, we take the average value-added share of each sector and/or industry by classifying the whole period into three; 1970-1990, 1991-2000, and post-2000. Based on this classification, when we see the composition of South Korean's economy, the value-added share of the primary sector was continuously decreasing (from 20.8 in 1970-1990 to 3.65 in post-2000). On the other side, the manufacturing and service sector was raising, but at a decreasing rate. These have two basic implications; the first one is, the change in composition from primary to secondary and tertiary sector signifies the existence of structural change within the economy. The second one is related to the rate of changes in the value-added share; the rates at which the primary sector was declining and other sectors were increasing imply the declining rate of structural change. In terms of value-added share, the change in the composition of the economy was observed not only between sectors, but it has happened within the same sector, especially in the manufacturing and service sectors. Within the manufacturing sector, the value-added share of the traditional manufacturing industries such as food, beverage, and tobacco, textile, leather, and footwear, wood and of wood and cork, non-metallic minerals and manufacturing recycling has declined during post-1990. On the other hand, the share of high technology products such as chemical and chemical products, basic and fabricated metals, machinery, electronic and optical equipment, and transportation equipment has increased, especially during 1991-2000 it has rising at an increasing rate see Appendix A Table A-2.

This change in industrial composition was also observed within the service sectors too. The value-added share of less capital intensive services industries such as sale, maintenance, and repair of motor vehicles and motorcycles, retail sale of fuel, wholesale and commission trade, retail trade and repair of household goods, and transportation and storage has continuously decreased during post-1990. During this period, the other service industries which are

relatively large and more capital intensive such as postal and telecommunication, financial intermediation, renting of machinery and equipment, and other business activities has increased in terms of value-added share. Some basic public service industries such as public administration and defense, and health and social work have registered a higher growth rate during the post-2000 period. This improvement has resulted from within the sectoral shift, which is supported by the advancement of information communication technology.

In South Korea's economy, even if the intensity was different, the real Value-added growth of all sectors and industries has been decreasing over the three periods. Relative to the primary and service sector, this growth was higher in manufacturing. Within the manufacturing sector, the real value-added growth of the traditional industries (low technology) was decreasing at a higher rate than the others. For example, during post-2000, it was negative for some industries such as textile, leather and footwear, wood and wood cork, and pulp, paper, printing, and publishing. On the other hand, this real value-added growth of high technology products was higher even if it was declining after the year 2000. This change in the value-added growth of the industries signifies the existence of structural transformation within the manufacturing sector. In each sector, the change is the relative value-added price is another factor leading to its variation over time. Within the primary sector, this price of the mining and quarry industry was relatively higher during post-2000 than what it was before. But, during this period, agriculture, hunting, forestry, and fishing industry has relatively declined; that is, throughout the period while the agricultural products were going low-priced, the mining and quarrying industry was becoming expensive see. From 1970 to 1990, the relative value-added price of all manufacturing products was high, especially the high tech products. During post-1990 it shows a small reduction and remained stable for the traditional manufactory industry. But the high tech industries show a significant reduction (especially during post-2000). For example, transport equipment, electrical and optical equipment, and chemical and chemical products show a significant reduction in relative price. This change in value-added growth and its relative price indicates the existence of a dynamic structural change within the manufacturing sector.

Service industries that are relatively small in size and less capital-intensive such as sale, maintenance, and repair of motor vehicles and motorcycles, wholesale, commission, and retail trades had a higher relative value-added price before 1990. All these show a reduction in price after 1990. Post and telecommunication, which was the most expensive during 1970-1990, shows a continuous reduction and becomes the cheapest industry during post-2000.
The service subsectors which had a moderate relative value-added price during 1970-1990, such as hotel and restaurant, and renting of machinery and equipment become relatively expensive during post-1990. On the other hand, publically owned service industries that were cheaper at the early stage of development shows a significant increment in its relative price in the post-2000 period. This change in relative valued-added price implies that at the initial stage of development, traditional manufacturing and service industries, which are small in size and less capital-intensive, were more important for economic growth. As the structure of the economy is changed and economic development becomes advanced, high technology manufacturing industries and capital-intensive and public owned service industries become relatively more important.

4.2.1. Result and Discussion

From 1970 to 2012, the Korean economy was growing on average by 7.45 percent, of which more than half is contributed by the service sector. Like the Chines economy, even if the output effect dominates the price effect, the price effect plays a positive and significant role in the

construction and service industries. The contribution of each sector to economic growth was declining at an increasing rate since 1990.

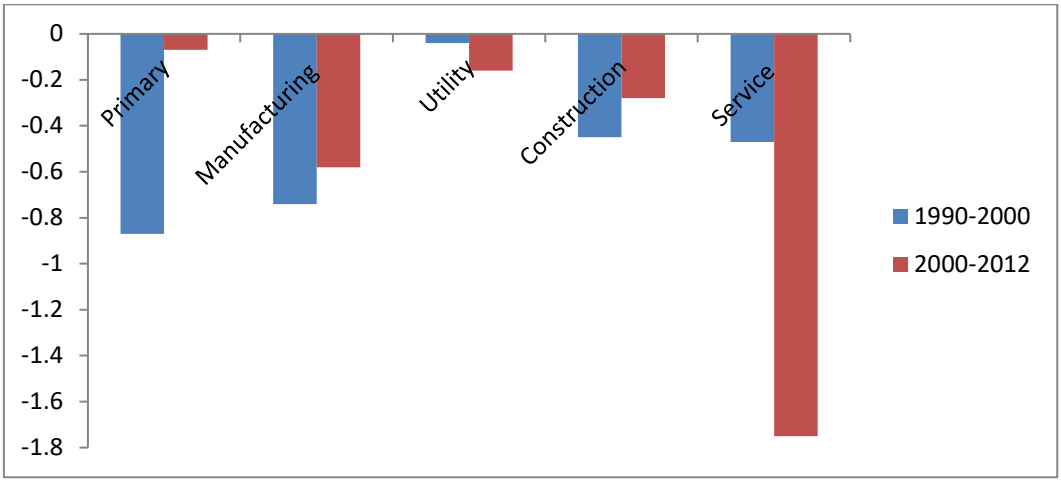

Figure 7: Change in Sectoral Contribution to Economic Growth of South Korea

The total effect of the primary sector has declined by 96 percent during 1990-2000 relative to the previous period see Appendix A Table A-2. This number has risen to 175 percent in post-2000 relative to the period of 1990- 2000. The service sector shows a smaller reduction during 1990-2000 (only 10 percent). Also, the utility and manufacturing sector recorded a medium reduction. But, during the post-2000 the manufacturing and service sectors were declining relatively at a slower rate than the previous period. From 1990 to 2000, although the contribution of all sectors was dropping, the primary industry was declining at a higher rate than others. However, the rate at which the economic growth was falling is relatively smaller. During post-2000, the amount at which the service sector has declined is the highest of all. It is this time when economic growth has dropped at a higher rate. These indicate that the Korean economy is service dependent. The change in the combination of sectors evidences the existence of structural transformation.

Also, the HHI indicates that economic concentration was declining continuously. In 1970 it was 0.115, which finally decreased to 0.051 in 2012. That is, the economy is diversifying at a higher rate. Initially, it was more concentrated in the primary sector. But the primary sector's concentration index has declined, from 0.086 in 1970 to 0.0007 in 2012. On the other hand, it has increased in the manufacturing and service sector, from 0.004 and 0.022 to 0.016 and 0.029 respectively in 2012. The relative importance of the sector has shifted towards the secondary and tertiary sectors. In addition to the above indicators, these measures of concentration signify the existence of structural change. Measurement is an important issue relevant to identify the structural change and relative importance of a sector. If we measure the structural change using the traditional method, which is just comparing the value-added share, it does not tell anything about the relative importance of sectors over different periods and may lead to a false conclusion since it ignores the price effect. For example, if we compare the primary industry with the construction sector during 1970-1990, the value-added share of the former is more than twice of the later. But the contribution of the construction sector to economic growth is relatively higher. Again, when we see the value-added gap between the primary and manufacturing sectors, it is too small. However, the contribution of the former was about three times less than its counterpart. Therefore, making such a comparison based on just the value-added share is misleading.

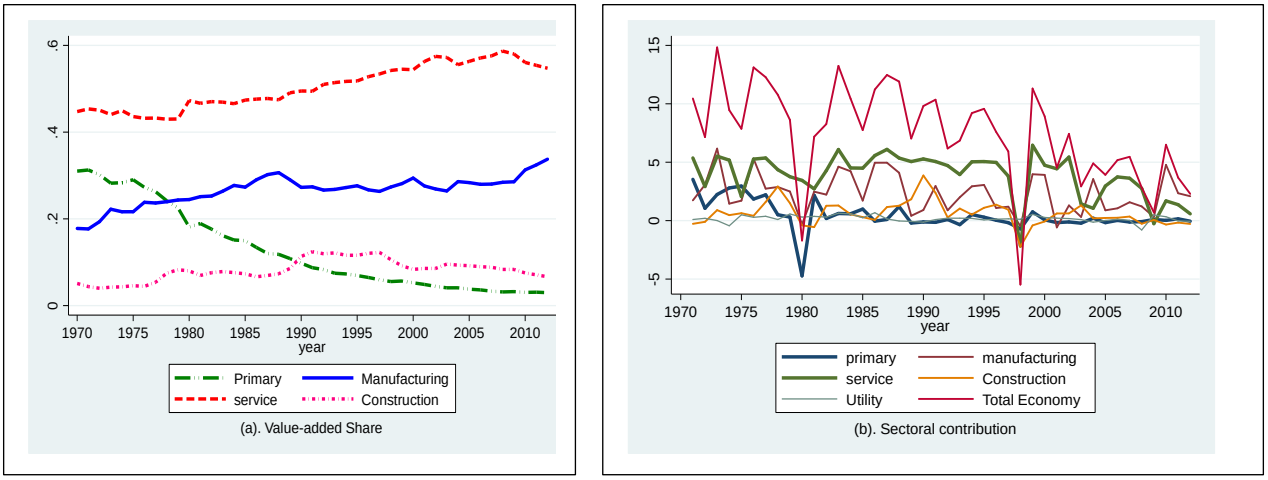

Figure 8: Sectoral Value-added Share and its Contribution to Economic Growth of South Korea

Within the primary sector, the contribution of agriculture, hunting, forestry, and fishing continuously declining and, even it were negative during the post-2000 period. This reduction was the result of both output and price effect, mainly the output effect. The other industry in this sector, the mining and quarrying, does not show a significant contribution since 1990. Like its value-added share, the contribution of the traditional manufacturing subsector was relatively low and declining at a higher rate after 1990 than what it was before. Even if the reduction in the relative value-added prices of these industries, leads to an increase in its contribution through the price effect, the larger fall in the output effect outweighs it.

On the other hand, the contribution of high technology manufacturing industries has remained relatively larger during this period with a small reduction, and even it starts to increase during the post-2000 period. In these industries, the price effect plays an important role, especially in electrical and optical equipment, and chemical and chemical products see appendix

Table A-2. This result signifies the existence of structural change within the manufacturing sector (a change from traditional to modern high tech industries). After 1990 the contribution of small-sized and less capital-intensive privately owned service industries has declined. But others such as financial intermediation, real estate activities, renting of machinery and equipment, and health and social work industries become more important. In the service sector, the price effect was positive during the post-2000 period. During this period, the Korean economy shows the lows growth of all the times. Especially following the 2007/08 financial crisis, its economic growth has declined to 2.8 and 0.7 percent respectively in 2008 and 2009. Real estate activities, hotels and restaurants, transport and storage, and post and telecommunications were industries showing the major reduction. Also, following the 1997 Asian financial crises, the Korean economy has suffered from bad economic performance in 1998.

5. Conclusion

Structural transformation through industrial upgrading, technological innovation, institutional and infrastructural development can stimulate dynamic and rapid economic growth. Therefore, the existence of structural transformation is another factor that affects economic performance, and hence income gaps (for example, the case of China). The shift of the economy from the traditional to new industries, industrial structural transformation, which occurs through technological change, innovation, institutional and infrastructural development, drives the long-run economic growth. However, the structural transformation in the modern

economy does not follow the traditional linear sequence of a shift from agriculture to manufacturing and then to the service sector. As countries that undertake a dynamic structural transformation have successfully achieved industrialization and catch-up, their experience is a good lesson for developing countries. Since South Korea and China have passed through this structural transformation in the past few decades, we take their experience to draw a lesson for developing countries on structural changes.

Both economies do not follow the traditional linear structural transformation. However, the nature of the two economies is not identical. The Chines economy, which passed through a dynamic transformation since 1979, has initially dominated by the primary sector both in terms of value-added and labor share. Unlike the Chines economy, during the 1970s in South Korea, the value-added share of the service sector was higher than the others. One basic feature of developing countries is that they are characterized by a larger share of the service sector at the early stage of development. Unlike the initially industrialized countries where the value-added growth of manufacturing was higher than that of other sectors at the early stage of development, in newly industrialized nations, the highest value-added growth has recorded by construction and service sectors. The structural transformation of the economy, which is reflected by the declining share of primary and rise in other sectors, changes in value-added growth, and relative price change, has occurred in currently industrialized countries. But it does not follow the traditional linear structural transformation. While developing policies, developing countries should have to consider not only structural change between sectors but also within a sector too. Except for the primary industries, the structural change between industries within a given sector plays a significant role in economic growth.

Since the rate of structural transformation is declining as the economy becomes advance, developing countries have the advantage of transforming their economy faster. They have the technological advantage of a latecomer. To undertake structural change and uphold sustainable development, diversification of the economy is required. Like developing countries, both in China and South Korea early, the economy is concentrated in the primary sector, contributing more than half of the concentration index. But, as the concentration index declined in primary and rise in the secondary and tertiary sectors, economic growth becomes more sustainable. Therefore, diversification of the economy to the industry and service sector can enhance structural transformation and hence economic growth in developing countries.
Since, except for the primary industries, the structural change between industries within a given sector plays a significant role in economic growth, while developing policies, developing countries should have to give more emphasis for structural change between industries within a sector too. Also, since a large share or higher value-added growth of a specific sector does not necessarily imply the relative importance of that sector, policymakers should have to consider the contribution of each sector to the economic growth (output and price effect).

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Appendix

Table A-1: Industries Contribution to Economic Growth of China in Percentage

	Output Effect				Price Effect				Total Effect			
Industries	1982-1990	1991-2000	2001-2010	1982-2010	1982-1990	1991-2000	2001-2010	1982-2010	1982-1990	1991-2000	2001-2010	1982-2010
Primary industries	**2.50**	**1.76**	**1.59**	**1.93**	**0.08**	**-0.34**	**-0.28**	**-0.19**	**2.58**	**1.42**	**1.31**	**1.74**
Agriculture, forestry & fishery	2.24	1.16	0.61	1.31	0.12	-0.32	0.13	-0.03	2.36	0.84	0.74	1.28
Coal mining	0.10	0.17	0.29	0.19	-0.02	-0.02	-0.02	-0.02	0.08	0.15	0.27	0.17
Oil & gas excavation	0.11	0.22	0.46	0.27	-0.02	0.06	-0.32	-0.09	0.09	0.28	0.14	0.17
Metal mining	0.03	0.10	0.19	0.11	-0.01	-0.03	-0.08	-0.04	0.02	0.06	0.12	0.07
Non-metallic minerals mining	0.02	0.12	0.04	0.06	0.01	-0.03	0.00	-0.01	0.03	0.08	0.04	0.05
Manufacturing	**1.85**	**5.10**	**3.93**	**3.69**	**1.02**	**1.47**	**0.49**	**0.36**	**2.86**	**3.63**	**3.44**	**3.33**
Food and kindred products	0.89	0.53	0.27	0.55	-0.69	-0.15	0.02	-0.26	0.20	0.39	0.29	0.30
Tobacco products	0.21	0.04	0.10	0.11	-0.03	0.01	-0.01	-0.01	0.18	0.05	0.09	0.10
Textile mill products	0.15	0.31	0.11	0.19	-0.03	-0.08	-0.01	-0.04	0.11	0.23	0.09	0.15
Apparel and other textile products	0.09	0.25	0.06	0.13	-0.02	-0.07	-0.01	-0.03	0.07	0.18	0.05	0.10
Leather and leather products	0.03	0.07	0.05	0.05	0.00	-0.01	-0.01	-0.01	0.03	0.06	0.05	0.05
Saw mill products, furniture, fixtures	0.06	0.15	0.10	0.10	-0.02	-0.05	-0.01	-0.03	0.04	0.10	0.09	0.08
Paper products, printing & publishing	0.12	0.30	0.08	0.17	-0.01	-0.14	-0.01	-0.05	0.12	0.16	0.07	0.12
Petroleum and coal products	-2.37	0.15	0.33	-0.57	2.44	-0.05	-0.14	0.69	0.07	0.09	0.20	0.12
Chemicals and allied products	0.50	0.41	0.31	0.40	-0.10	-0.11	0.00	-0.07	0.40	0.30	0.31	0.33
Rubber and plastics products	0.14	0.19	0.11	0.15	-0.04	-0.04	-0.01	-0.03	0.10	0.15	0.10	0.12
Stone, clay, and glass products	0.38	0.44	0.21	0.34	-0.12	-0.14	-0.01	-0.09	0.26	0.31	0.20	0.26
Primary & fabricated metal industries	0.24	0.84	0.62	0.58	-0.01	-0.58	-0.13	-0.25	0.23	0.26	0.50	0.33
Metal products (excluding rolling products)	0.17	0.16	0.14	0.15	-0.05	-0.01	-0.02	-0.03	0.12	0.14	0.12	0.13
Industrial machinery and equipment	0.33	0.37	0.37	0.36	-0.03	-0.04	-0.04	-0.04	0.30	0.32	0.33	0.32
Electric equipment	0.26	0.18	0.24	0.22	-0.12	-0.01	-0.04	-0.05	0.14	0.17	0.20	0.17
Electronic and telecommunication equipment	0.12	0.26	0.33	0.24	-0.03	0.00	-0.03	-0.02	0.09	0.26	0.30	0.22
Instruments and office equipment	0.03	0.02	0.05	0.03	-0.01	0.00	-0.01	-0.01	0.02	0.02	0.04	0.03
Motor vehicles & other transportation equipment	0.23	0.23	0.45	0.30	-0.05	-0.02	-0.05	-0.04	0.18	0.21	0.41	0.27
Miscellaneous manufacturing industries	0.26	0.19	0.01	0.15	-0.05	0.04	0.01	0.00	0.21	0.23	0.02	0.15
Utilities: Power, steam, gas and tap water supply	**0.19**	**0.54**	**0.33**	**0.36**	**-0.07**	**-0.20**	**-0.06**	**-0.11**	**0.12**	**0.34**	**0.28**	**0.25**
Construction	**0.63**	**0.74**	**0.80**	**0.73**	**-0.12**	**-0.03**	**-0.08**	**-0.08**	**0.51**	**0.70**	**0.72**	**0.65**
Services	**4.90**	**5.77**	**5.19**	**5.30**	**1.17**	**1.41**	**0.38**	**0.98**	**3.73**	**4.37**	**4.81**	**4.32**
Wholesale and retail trades	2.15	1.33	0.86	1.42	-1.24	-0.33	0.07	-0.48	0.91	1.00	0.92	0.95
Hotels and restaurants	0.48	0.62	0.24	0.45	-0.28	-0.35	-0.03	-0.22	0.20	0.27	0.21	0.23
Transport, storage & post services	0.32	1.11	0.53	0.66	0.32	-0.52	-0.10	-0.11	0.64	0.59	0.43	0.55
Information & computer services	0.03	0.41	0.32	0.26	0.03	-0.18	-0.04	-0.07	0.06	0.23	0.28	0.19
Financial Intermediations	0.78	0.35	0.54	0.55	-0.03	0.00	0.01	-0.01	0.75	0.35	0.55	0.54
Real estate services	0.43	0.48	0.63	0.52	0.00	0.00	0.03	0.01	0.43	0.47	0.66	0.52
Leasing, technical, science & business services	0.08	0.32	0.60	0.34	0.05	-0.07	-0.05	-0.02	0.14	0.25	0.55	0.32

Government, public administration, and political and social organizations	0.22	0.41	0.50	0.38	0.00	0.01	-0.03	-0.01	0.22	0.42	0.48	0.37
Education	0.23	0.22	0.50	0.32	-0.02	0.12	-0.18	-0.03	0.21	0.35	0.32	0.29
Healthcare and social security	0.09	0.25	0.20	0.18	0.01	-0.07	-0.03	-0.03	0.11	0.18	0.16	0.15
Cultural, sports, entertainment services; residential and others	0.08	0.28	0.26	0.21	0.00	0.00	-0.03	-0.01	0.09	0.28	0.23	0.20
Total	**10.07**	**13.91**	**11.85**	**12.01**	**-0.26**	**-3.45**	**-1.28**	**-1.71**	**9.81**	**10.45**	**10.57**	**10.29**

Table A-2: Industries Contribution to Economic Growth of South Korea in Percentage

Industries	Output Effect				Price Effect				Total Effect			
	1971-1990	1991-2000	2001-2012	1971-2012	1971-1990	1991-2000	2001-2012	1971-2012	1971-1990	1991-2000	2001-2012	1971-2012
Primary industries	**1.02**	**0.18**	**0.03**	**0.54**	**-0.11**	**-0.14**	**-0.06**	**-0.10**	**0.91**	**0.04**	**-0.03**	**0.43**
Agriculture, hunting, forestry and fishing	0.95	0.20	0.03	0.51	-0.13	-0.16	-0.07	-0.12	0.81	0.05	-0.04	0.39
Mining and quarrying	0.07	-0.02	0.00	0.03	0.02	0.02	0.01	0.02	0.10	0.00	0.01	0.05
Manufacturing	**4.28**	**2.83**	**1.67**	**3.19**	**-1.39**	**-0.68**	**-0.10**	**-0.85**	**2.89**	**2.15**	**1.57**	**2.34**
Food , beverages and tobacco	0.34	0.10	0.02	0.19	-0.13	0.03	0.02	-0.05	0.21	0.13	0.04	0.14
Textiles, textile , leather and footwear	0.72	-0.02	-0.05	0.33	-0.29	0.06	0.01	-0.12	0.44	0.05	-0.04	0.21
Wood and of wood and cork	0.05	0.00	0.00	0.02	-0.03	0.01	0.00	-0.01	0.02	0.01	0.00	0.01
Pulp, paper, printing and publishing	0.20	0.09	-0.01	0.11	-0.06	0.00	0.02	-0.03	0.14	0.09	0.00	0.09
Coke, refined petroleum and nuclear fuel	0.10	0.16	0.03	0.09	-0.01	0.00	0.04	0.01	0.09	0.16	0.07	0.10
Chemicals and chemical products	0.54	0.33	0.14	0.38	-0.22	-0.13	0.14	-0.10	0.31	0.21	0.28	0.28
Rubber and plastics	0.16	0.09	0.03	0.11	-0.05	-0.01	0.02	-0.02	0.11	0.08	0.06	0.09
Other non-metallic mineral	0.22	0.09	0.02	0.13	-0.05	-0.05	-0.01	-0.04	0.17	0.04	0.01	0.09
Basic metals and fabricated metal	0.47	0.31	0.12	0.33	-0.05	-0.06	0.29	0.04	0.42	0.25	0.40	0.38
Machinery, nec	0.18	0.12	0.16	0.16	-0.06	-0.03	-0.01	-0.04	0.12	0.10	0.15	0.13
Electrical and optical equipment	0.80	1.12	0.90	0.91	-0.27	-0.37	-0.65	-0.40	0.52	0.76	0.25	0.50
Transport equipment	0.39	0.42	0.30	0.37	-0.13	-0.16	0.04	-0.09	0.26	0.26	0.34	0.28
Manufacturing nec; recycling	0.12	0.00	0.01	0.06	-0.04	0.02	0.00	-0.01	0.08	0.02	0.01	0.05
Electricity, gas and water supply	**0.37**	**0.23**	**0.12**	**0.26**	**-0.14**	**-0.03**	**-0.08**	**-0.09**	**0.24**	**0.20**	**0.04**	**0.17**
Construction	**0.77**	**0.46**	**0.08**	**0.50**	**0.17**	**0.03**	**0.13**	**0.13**	**0.94**	**0.49**	**0.21**	**0.62**
Services	**4.94**	**3.80**	**1.83**	**3.78**	**-0.31**	**-0.36**	**-0.57**	**-0.10**	**4.63**	**4.16**	**2.41**	**3.89**
Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of fuel	0.06	0.05	0.01	0.05	-0.02	-0.01	0.00	-0.01	0.04	0.03	0.02	0.03
Wholesale and commission trade, except of motor vehicles and motorcycles	0.70	0.22	0.08	0.41	-0.20	-0.08	0.03	-0.11	0.50	0.13	0.12	0.30
Retail trade, except of motor vehicles and motorcycles; repair of household goods	0.83	0.31	0.08	0.49	-0.23	-0.10	0.05	-0.12	0.59	0.21	0.13	0.37
Hotels and restaurants	0.19	0.19	0.05	0.15	0.03	0.04	0.02	0.03	0.22	0.23	0.07	0.18
Transport and storage	0.69	0.35	0.16	0.46	-0.20	-0.04	-0.11	-0.14	0.49	0.31	0.05	0.32
Post and telecommunications	0.28	0.46	0.23	0.31	-0.08	-0.28	-0.18	-0.16	0.20	0.18	0.05	0.15
Financial intermediation	0.66	0.62	0.46	0.59	-0.14	-0.03	0.10	-0.04	0.53	0.58	0.56	0.55

Real estate activities	0.29	0.45	0.01	0.25	0.15	0.32	0.03	0.15	0.44	0.76	0.04	0.40
Renting of m&eq and other business activities	0.31	0.39	0.20	0.30	0.00	0.07	0.12	0.05	0.32	0.46	0.32	0.35
Public admin and defense; compulsory social security	0.25	0.24	0.14	0.22	0.21	0.19	0.18	0.19	0.46	0.43	0.32	0.41
Education	0.28	0.18	0.12	0.21	0.18	0.19	0.17	0.18	0.46	0.37	0.29	0.39
Health and social work	0.20	0.12	0.17	0.17	-0.01	0.11	0.12	0.06	0.19	0.23	0.29	0.23
Other community, social and personal services	0.20	0.21	0.11	0.17	0.01	0.00	0.03	0.01	0.21	0.20	0.13	0.19
Private households with employed persons	0.01	0.01	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.02	0.01	0.01
Total Economy	**11.38**	**7.49**	**3.73**	**8.27**	**-1.77**	**-0.45**	**0.46**	**-0.82**	**9.61**	**7.04**	**4.20**	**7.45**

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