



## PATTERN AND SOURCES OF GROWTH OF THE VIETNAM ECONOMY: A DEVIATION FROM PROPORTIONAL GROWTH ANALYSIS



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### ABSTRACT

*The purpose of this paper is to conduct a deviation from proportional growth (DPG) analysis for the Vietnamese economy over the period of 1996-2007. This aims to determine the pattern and sources of growth of the economy based on the experience of other developed and newly developing Asian economies. Their experiences could provide indicative information to the authorities of Vietnam for delineating future growth paths. Similar analyses were also carried out for other major Asian economies and the results are compared with those of Vietnam. While the 10<sup>th</sup> and 11<sup>th</sup> Congress of the communist party of Vietnam have adopted targets for Vietnam to become an industrialized economy by 2020, sorting out and implementing the most appropriate strategies have become the key to whether the targets will be met or not. Our results shows that The Vietnamese economy in this period exhibited several similarities with Taiwan during the period 1966-1984, Korea 1963-1985, and Japan 1914-1975. Even though the Vietnamese economy has grown rapidly since 1996, especially during the period from 2000 to 2007, the process of industrialization in Vietnam during this period was still slower and weaker compared with those NITs before 1985 and in Japan before 1975. We also predict that its hard for Vietnam to become an industrialized economy by 2020.*

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### Contribution/ Originality

This study provided very important information for policymakers who wish to identify historical sources of growth of every single energy sector and other industries since the start of Vietnam's economic Doi Moi reform. Furthermore, policymakers can recognize which perspective can help those sectors increase or decrease.

### 1. INTRODUCTION

Industrialization originated from United Kingdom in the 18th and 19th century, then, spread throughout Netherland, France and Germany. The other European countries and the rest of the world soon follow. In Asia industrialization started from Japan in the 19th and 20<sup>th</sup> century. Hong Kong, Singapore, Taiwan, South Korea soon followed as well as the other Asian countries. World economic expansion began after World War II, spanning from

1945 to 1952. Overall, the growth lasted well until the early 1970s, before the booms in individual countries were differentiated. The rise of the East Asian economies is highlighted in the 1980s or 1990s. In response to globalization, Vietnam is striving for the national goal of industrialization and modernization, a goal widely shared by other developing and transition countries. After seventeen years since the inception of the “doi moi” reform, and after roughly a decade of serious international integration. These high growths in both GDP and exports have also affected the micro level by decreasing poverty rates significantly. However, although average wages have increased during this time, wage inequality has also increased as well. In addition, Kuznets (1966) compared of some 50 countries and had shown a marked increase of manufacturing with rising per capita income, as did the earlier analyses of Bean (1946). Another study was that of Chenery (1960) whose approach was to combine several factors that had been known as the causes of that pattern. An example of which was the change of household consumption investigated by Hauthakker (1957). He presented a method to introduce a concept, "Deviation from Proportional Growth," as a measure of the degree of change in output composition and to break it down into several factors, a method which we refer to as DPG analysis.

Similar studies were also made and applied to the data of Japan in the studies of Chen and Kiyoshi (1987) and Watanabe and Terukazu (1977) and of Chen (1989). However, their result does not make a consistent comparison. Recently, Chen and Fujikawa apply those versions for three economies to analyze a period covering from 1914-1985 for Japan, 1963-1985 for Korea and 1966-84 for Taiwan. Comparison of the growth patterns between Japan, including the pre-war period, and the Newly Industrializing Economies in Asia were then made with a more consistent result.

In this paper, we adopted the original Deviation from Proportional Growth (DPG) method, as presented by Chenery (1960) and Chen and Kiyoshi (1992). It is utilized to measure of the degree of change in input composition and to break it down into several factors then apply it to the data of Japan, Korea and Taiwan in order to compare their pattern of growth. An attempt to apply the same method to analyze the pattern growth of Vietnam in periods 1996-2000 and 2000-2007 is then made to determine whether Vietnam economy follow the industrialization process. The results are the compared to other developed countries, then, compare with the measure of pattern growth of NIEs and Japan in period 1914-1985 for Japan, 1963-1985 for Korea and 1966-84 for Taiwan. This was done to predict the pattern growth of Vietnam in the future.

## 2. METHODOLOGY AND DATA

First we compare the Vietnam DPG with Japan, Korea and Taiwan in the first period 1914 -1975 with Japan, 1963-1985 with Korea as well as 1965-1985 with Taiwan. We then use the data of those countries for a period of time that includes 1995 -2009. We use WIOD data base to analyze the DPG of Taiwan, Japan and Korea; this gives us a very sound forecast for the DPG of Vietnam for the next decade.

### 2.1. The Basic Data

To calculate the DPG of the countries Taiwan, Korea and Japan in periods 1914-54, 1955-65, 1965-75 and 1975-85, for Japan; two periods, 1963-75 and 1975-85, for Korea; and two periods, 1966-76 and 1976-84. For Taiwan, we use the data the same source with Chen and Kiyoshi (1992) and get the same result. See appendix A for more detail on this result.

Our method has its origin in Chenery (1960) who intended to incorporate changes in both demand and supply conditions into a more general explanation of the growth of individual sectors of production, which can then be used to explain the observed patterns of industrial growth. For Vietnam, we use the input-output table in 1996-2000 and 2000-2007 GSO (2012) and then we aggregated the original tables, which were composed of about 96 sectors of

production in 1996, 112 sectors 2000 and 138 sectors for 2007 into 14 sectors tables and then converted them into ones expressed in constant prices.

## 2.2. Research Method

The original Leontief model is modified and discussed in [Chenery and Clark \(1959\)](#) can be stated as follow:

$$X_{t,i} - W_{t,i} = F_{t,i} + E_{t,i} - M_{t,i} \quad (1)$$

Where:

$X_i^t$  = total production of commodity  $i$  in period  $t$

$M_i^t$  = import of commodity  $i$  in period  $t$ ;

$E_i^t$  = export of commodity  $i$  in period  $t$ ;

$F_i^t$  = domestic final demand for commodity  $i$  in period  $t$ ;

$W_i^t$  = Total intermediate use of commodity  $I$  in period  $t$

To determine the solution corresponding to the assumption of proportionate growth between period's  $t$  and  $t+1$ , we define the ratio of total domestic demand in the two periods as follow:  $\alpha$  is the average ratio of expansion of production, obtained by the division of the total of the gross production in period  $t + 1$  by that of period  $t$

The equation is also can be write as equation (2) bellow:

$$X_i^t = \sum_j B_{ij}^t (F_i^t + E_i^t - M_i^t) \quad (2)$$

With the coefficients  $B_{ij}^t$  are the elements of the inverse to the Leontief matrix

$$[I-A]^{-1} = B_{ij}^t \quad (3)$$

We shall define the difference between the actual values in period  $t+1$  and values given by proportionate expansion of the system between period's  $t$  and  $t+1$  as:

$$\Delta X = X^{t+1} - \alpha X^t \quad (4)$$

Now we applied the first form of the Balance Growth Theory, and we feel it is the extreme view and use the DPG method to determine whether the patterns of Vietnam, NIEs and Japan increase. In case  $\Delta X$  is zero, we mean that all the sectors have expanded at the average ratio. Each element of  $\Delta X$  is DPG of each sector. It is positive when a sector has grown faster than the average, negative when a sector has grown lesser than the average ratio ( $\alpha$ ). DPG analysis decomposes  $\Delta X$  into several factors. Our formula for the decomposition is based on the following balance equation:

$$X_t = [I - (I - M_t) A_t]^{-1} [(I - M_t) (C_t + I_f + J_t) + E_t] \quad (5)$$

$$\begin{aligned} \Delta X = & B_{t+1} (I - M_{t+1}) \Delta C + B_{t+1} (I - M_{t+1}) \Delta I_f \\ & + B_{t+1} (I - M_{t+1}) \Delta J + B_{t+1} \Delta E \\ & + B_{t+1} (M_t - M_{t+1}) \alpha (A_t X_t + C_t + I_f + J_t) \\ & + B_{t+1} (I - M_{t+1}) (A_{t+1} - A_t) \alpha X_t \end{aligned} \quad (6)$$

Where:

$M_t$ : the diagonal matrix the  $(i,i)$  th element of which is the import coefficient of the  $i$ -th domestic demand, which is the total of intermediate, consumption, investment demand and an increase in stocks

$J_t$ : the vector representing increases in stocks including imported goods

$I$ : the identity matrix

$Q, I_f$ : the vectors of final consumption and investment

$J_t, E_t$ : the vectors of increases in stocks and of exports of domestic products

Our decomposition analysis includes four periods, 1996-2000, and 2000-2007 for Vietnam.

$$B^{t+1} = [I - (I - M^{t+1}) A^{t+1}]^{-1}$$

$$\Delta I_f = I_f^{t+1} - \alpha I_f^t$$

$$\Delta J = J^{t+1} - \alpha J^t$$

$$\Delta E = E^{t+1} - \alpha E^t$$

$$\Delta C = C^{t+1} - \alpha C^t$$

In the equation (6) we included deviations of four categories of final demand, consumption, investment, increases in stocks and exports, and changes in two categories of coefficients, import coefficients and input coefficients. However, the changes in inventory data are not available for 1996 and 2000. We prepared a revised model that is applicable even if data are less detailed and replaced equation (6) with the following:

$$\begin{aligned} \Delta X = & B_{t+1} (I - M_{t+1}) \Delta C + B_{t+1} (I - M_{t+1}) \Delta I_f \\ & + B_{t+1} \Delta E \\ & + B_{t+1} (M_t - M_{t+1}) \alpha (A_t X_t + C_t + I_f^t) \\ & + B_{t+1} (I - M_{t+1}) (A_{t+1} - A_t) \alpha X_t \end{aligned} \quad (7)$$

### 3. RESEARCH RESULTS

In a Vietnamese investment case, there were some similarities between the Vietnamese pattern of growth in this period and the Taiwanese pattern in 1966-1985 (see table 3 appendix A). That investment became a negative source of DPG in the period of time of 1976-1984; whereas the investment of Vietnam is also a negative source in the period of 200-2007. Japan economy in period 1914-1954 as well as Korea 1963-1975 (table 1, 2 appendix A), every sector of manufacturing increased its share and the deviation of investment was a significant source.

Table 1 Give the results for Vietnam in 1996-2000, The table show that manufacturing Deviation from Proportional Growth amount to 58,1% positive deviations compare to Korea 1963 – 1975 is 94,5%, Taiwan 1966-1976 is 92,4% and japan 1914-1954 is 83,3% positive deviations. However the crops and other agricultural decrease their share, Vietnam in this period is thus slide characterized by its industrialization “*Doi Moi*” was launched after the Sixth Party Congress in December 1986 with the broad aims of reducing macroeconomic instability as well as accelerating growth. Furthermore, Economic structure look like continued the positive shift, GDP shares of agriculture forestry-fishery reduced while industry and construction share increased.

Table-1. DPG Decomposition for Vietnam, 1996-2000

Sectors	Deviation of			Change in coef		
	DPG	C	If	E	M	A
	P1	P1	P1	P1	P1	P1
Agriculture	-49.5	-60.7	-8.0	10.6	-129.6	5.5
Mining	0.7	0.0	-0.1	3.5	-29.5	0.0
Manufacturing	-34.0	2.8	-240.6	24.9	-139.1	-7.3
Chemicals	2.7	-8.7	0.1	5.4	2.5	-48.2
Machinery	27.1	2.2	0.6	30.8	-15.1	-54.3
Other manufacturing	14.0	1.5	-8.3	18.0	-38.5	-10.7
Construction	11.5	0.2	15.9	0.1	-79.1	2.7
trade	9.0	2.9	0.6	-12.0	4.6	2.1
Finance	7.7	7.6	0.1	-4.1	0.8	-5.3
Public services	4.3	5.2	0.0	-2.4	-1.8	-5.7
Others	6.6	5.7	-27.1	2.1	-7.8	2.1
Total	0.0	-41.3	-266.9	76.9	-432.7	-119.3

Sources: VNGSO database, author calculation

In generally, in the early twenty-first century, industrial promotion in Vietnam must take a different shape from the one practiced around the 1960s when Japan, Korea and Taiwan were growing rapidly. The last row of the table

shows that change in input coefficients played the most significant part in producing positive deviations. Every sector received its benefit except crops (agriculture, forestry, and fishery) and mining. Table 1 indicates, in terms of DPG, the direction, degree, and the sources of change in the composition of output. This is the result for Vietnam in 1996-2000 and the values are expressed in millions of 1994 Vietnam Dong (VND). As far as we are concerned with the relative degree of the change and the relative magnitude of the causes, however, they do not have to be measured by a specific money unit. They can be divided by the sum of DPGs that are positive and then multiplied by 100, thereby being normalized so that the sum of positive DPGs equals 100 and that of negative DPG equals -100. This normalization would make the table clearer and the comparison between periods and economies easier. Every table presented in the next section shows such a normalized result.

Table-2. DPG Decomposition for Vietnam, 2000-2007

Sectors	Deviation of				Change in coef	
	DPG	C	If	E	M	A
	P2	P2	P2	P2	P2	P2
Agriculture	-56.1	-67.9	1.5	-8.5	10.2	-14.4
Mining	18.9	-2.1	0.0	25.4	-5.5	-6.8
Manufacturing	15.2	-29.9	1.2	20.8	-9.6	13.3
Chemicals	2.1	-2.7	-0.2	1.7	-0.3	1.9
Machinery	28.5	-13.8	2.6	16.6	11.1	4.6
Other manufacturing	-19.7	-18.7	-2.2	-6.5	-2.3	4.6
Construction	-2.2	0.0	1.9	0.0	0.0	-6.3
trade	0.4	-11.3	1.1	21.0	-55.5	9.1
Finance	22.6	1.1	0.2	5.1	-0.7	16.6
Public services	-6.1	2.4	0.2	0.6	-10.2	-2.9
Others	-3.6	0.0	0.1	1.8	-1.5	-6.2
Total	0.0	-143.0	6.4	78.0	-64.4	13.3

Sources: VNGSO database, author 'calculation

In the period of time 2000-2007 as show in table 2, although the textile and closing industry decrease the output share however the manufacturing Deviation from Proportional Growth still account for 56,55% positive deviations. In period 1996-2000 some industries like machinery mining, business and other service increase their output share and keep strongly increase in the next period 2000-2007, however the construction, other manufacturing, agriculture, processed food, chemical decrease compare with the period 1996-2000 even those industry still increase their output share. We assume this is because Vietnam economy start growth strongly start from 1996-2000 and slowdown in the next period 2000-2007 in some industry or the development of various industrial sectors in period 1996-2007, some of which might be "newborn," caused intermediate demand to shift toward a direction in favor of those industries like japan in period 1914-1954. The last column of this table shows that the change in input coefficients is significant in producing positive deviations. Every sector received its benefit except crop mining, construction and utilities. Conspicuous in this decade are thus the export-led expansion of the clothing and textile sector, mining, wood and paper, 2.2%-17,4%; 3,5%-25,4%; 3,2%-4,4% of positive deviation from period 1996-2000 to 2000-2007; respectively. In this period the exports played a remarkable role in Vietnam like the case of Korea in period 1963-1975 and japan in period 1966-1975. The factors the total effects of which were positive in this period were the deviations of investment and exports.

As the note at the end of Table 1 and table 2 suggest, their expansion was considerably large so that not a few sectors could receive its linkage effects. These tables show us that Export benefited almost all sectors in period 1996-2000 and 2000-2007 as well and the growth of investment benefited machinery, metals and chemicals. It might seem strange that the total effect of investment growth was much less than that of export growth, whereas the difference

between their rates of growth was only a little. Our reasoning for this is that the investments were smaller in amount than the export. Vietnam in this period is thus characterized by its industrialization.

We applied equation (7) for Vietnam in the period 1996-2007 and (4) for all the others. Data were obtained from the input-output tables for the beginning and the ending year of each period. We using 35 sectors for every countries table and then converted them into ones expressed in constant prices.

Like the case of Taiwan and Korea the most significant source of positive DPGs was the deviation of exports, which expanded at a considerably rapid rate and benefited machinery, "other manufacturing" and chemicals, in particular. Although the change in input coefficients and the deviation of exports were also positive factors, the former being the second source of the expansion of the expansion of chemical and "other manufacturing" and the latter being significant for construction, their significance on the whole was inferior to that of exports. The different between Vietnam with the case of Taiwan and Korea if export of crop and agriculture still play remarkable role compare with those NIEs (Taiwan, Korea) where agriculture decrease their share. In generally, Vietnam in this period characterized by the expansion of manufacturing, the expansion of construction is also support for the expansion of other sectors. Investment became a negative source of DPGs. In spite of the slowing down, exports could continue to be an outstanding cause of positive DPGs. The export-led pattern of growth was still obvious in this decade. Especially, coke, refined petroleum, rubber and plastics industries

The last column of the table shows that change in input coefficients played the most significant part in producing positive deviations in periods 1914-1954. Every sector received its benefit except agriculture, forestry, fishery and mining. However, in period 1955-1965 Change in input coefficients, having been the most significant source in the previous period and still explaining a fair part of positive deviations of chemicals and machinery, could not favor so many sectors as before and its total effect turned negative. However, the change of input coefficient play the significant part in producing positive deviations again in periods 1965-1975 and total effect turned slight negative in periods 1975-1985 and the change of total input coefficient negative in periods 1995-2000, then keep played the most significant part in producing positive deviations in periods 2000-2009. Furthermore, Japan in period 1995-2000 and 2000-2005 the export keeps plays a remarkable role, in the period 2005-2009 the export of japan slowdown, Its mean that the japan economic keep growth very fast after the industrialized successfully. Like the japan in the period 1914-1954 and 1955-1965, the change in input coefficients played the most significant part in producing positive deviations of Vietnam in periods 1996-2000. We also assume this is because the development of various industrial sectors in this period, some of which might be "newborn," caused intermediate demand to shift toward a direction in favor of those industries. In contract, in periods 2000-2007 total effect turned negative. In generally the pattern of growth in period 1996-2007 in Vietnam similarities with japan 1914-1975 in change of input coefficient where almost sectors get profit. The export played a remarkable role in the Vietnam case the same with Korea in 1963-1985 where total output return positive. Obviously in the previous war period (1914-1954) Japanese expansion of its manufacturing and construction sectors, manufacturing and construction accounted for more than 83% of positive deviations. See Appendix A table 5 for more detail on Japan DPG. Japan in the period 1914-1985 the gross investment of some factors like machinery, manufacturing and construction grows faster than others, then enlarge heavy industry in periods 1955-1966, and enlarge its service in 1966-1985, in periods 20005-2009 the economy growth of japan seems slowdowns, investment of all sector are negative deviation. Korea 1963-1984 and Taiwan in period 1966-1984 like Japan in period 1914-1966. The gross investment of Taiwan of after 1984 seems slowdown compare with Korea and Japan with the same periods. In case of Vietnam in periods 1996-2000, the gross investment still very low compare with japan in periods 1914-1954 and 1955-1965 as well as Taiwan in periods 1966-1976, 1976-1984 and Korea in periods 1963-1975, 1975-1985, except some sectors like agricultural and machinery with gross investment are higher others sectors. See Appendix A. However in the next periods 2000-2007 the gross investment of Construction very

high compare with other, in this periods Vietnam government try to improve construction and agricultural still keep importance role in Vietnam economy.

In short, In the case of Vietnam in periods 1996-2000 and 2000-2007, on the first period this country try to expansion of its manufacturing factors. The manufacturing factors are treat like Specific sectors of the economy will be growing at a rapid rate. Then they shift to enlarge the heavy industry sectors, finally the services sectors are expansion treat like Specific sectors of the economy will be growing at a rapid rate. Furthermore, Vietnam 1996-2000, 2000-2007 look like unbalanced growth with gross investment, or output, grows faster in some sectors than in others.

#### 4. CONCLUSIONS

The Vietnamese economy in the period 1996 to 2007 was, generally speaking, in the second period of the economic development take-off. As would be expected, some sectors have increased while some other important sectors of the economy continued to lag behind or occasionally decrease such as textiles, agriculture service, travel services, trade, and rice processing. The Vietnamese economy looks as though it has some challenges in these areas; the reason is as Rostow had stated that much depends upon the pre take-off period. In Vietnam, the pre take-off period would likely take as much time or longer time that the USA, England, or Japan. In Vietnam, the first step of economic growth (the pre take-off period of Doi Moi) may have missed some important aspects in deeply preparing. In this pre take-off period, the Vietnamese government and society needed to build up the necessary resources and develop them in advance of the next take-off period, but the country was still low in DPG of manufacturing in comparison with other countries who had already successfully industrialized. In hindsight, the Vietnamese government should have encouraged domestic enterprises to make investments in technology and use their own techniques for production before opting to utilize international technologies. In doing so, Vietnamese enterprises would have acquired the leverage to sustain its economy and technology even as the entire world moves rapidly forward itself with high technology. A lesson can also be drawn from Japan's dedication to developing much of its own technology in areas of manufacturing and increasing much of their domestic supplies as well as comparative international foreign exports during a long term period from 1914 until 1975. Therefore, one suggestion would be for the Vietnamese government to strategically return to targeting certain sectors with renewed pre take-off support of domestic enterprise investments in technology. Furthermore, the government could modify the economy by keeping some less important sectors that are under the normal rate to help them reach the normal rate ratio and/or even develop more quickly. Certain sectors such as fishing and forestry would be prime sectors to target. Additionally, strategic economic development cannot miss the auxiliary sectors such as electricity, gas, and other energy sectors. The supplemental growth in these sectors would be attainable with government investment – and – these sectors are the precise ones most likely to open the larger critical pathways towards reaching the overall industrialization target.

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#### REFERENCES

- Bean, H.L., 1946. Study income and wealth. New York: The National Bureau of Economic Research. pp: 119-144.
- Chen, A.K.F., 1989. A note on DPG (Deviation from Proportional Growth) analysis and the patterns of industrial development in Japan and Taiwan. International Journal of Energy Policy University of Japan, Annual Review, 6: 125-144.

Chen, K.-H. and F. Kiyoshi, 1987. An analysis of deviation from proportional growth of the Taiwanese economy. Sekai Keizai Hyoron, Aug: 53-65.

Chen, K.-H. and F. Kiyoshi, 1992. A DPG (Deviation from Proportional Growth) analysis of the Japanese, Korean and Taiwanese economies. Sekai Keizai Hyoron, Aug: 53-65.

Chenery, H.B., 1960. Patterns of industrial growth. American Economic Review, 50(4): 624-654.

Chenery, H.B. and P. Clark, 1959. Interindustry economics. New York: John Wiley.

GSO, 2012. Input-output tables for Vietnam. Hanoi: General Statistics Office.

Hauthakker, H.S., 1957. An international comparison of household expenditure patterns, commemorating the centenary of Engel's law. Econometrica, 25: 532-551.

Kuznets, S., 1966. Modern economic growth: Rate, structure and spread. New Haven: Yale UP.

Watanabe, T. and Terukazu, 1977. Methods for analyzing the sources of industrial growth and postwar Japan's experience Osaka. Economic Papers, Osaka University, 26: 154-166.

Appendix A

Table-3. DPG Decomposition for Japan, 1914-1954, 1955-65, 1965-1975 and 1975-1985

	DPG				Deviation of												Change in coef												
					C			If			E			M <sup>c</sup>			M <sup>f</sup>			M <sup>a</sup>			A						
	P1	P2	P3	P4	P1	P2	P3	P4	P1	P2	P3	P4	P1	P2	P3	P4	P1	P2	P3	P4	P1	P2	P3	P4	P1	P2	P3	P4	
Agriculture, Forest	-7,7	-19,3	-38,1	-80,0	-3,9	-10,6	-5,7	-48,9	-0,2	-1,0	1,5	1,5	0,0	-0,9	-0,4	-5,2	0,0	-0,7	-0,8	-9,8	0,0	0,0	0,0	-3,3	0,0	-2,9	-1,8	-29	-18
Mining	-3	-6,0	-2,4	-4,9	0,1	0,1	0,1	-2,9	-0,7	-1,2	0,7	1,9	0,0	0,1	0,0	-1,6	-0,1	-0,4	0,0	-1,8	0,0	0,0	0,0	-3,1	-2,4	-2,3	-1,4	-1	0
Chemicals	-14	0,0	18,7	18,6	2,4	-1,3	3,7	-11,2	-1,8	-2,5	2,3	2,2	-0,1	2,6	2,3	-1,0	0,3	-1,1	-0,1	16,8	0,0	0,0	0,0	-3,6	0,0	-0,8	-10,6	3,2	11,1
Metals	-11	10,6	18,0	38,1	0,2	-0,4	3,4	-8,8	-7,4	-7,8	8,5	9,8	-2,5	10,2	6,8	4,1	0,0	-0,3	0,0	12,0	0,2	0,0	0,1	-1,6	0,7	-2,2	0,2	7,8	1,1
Machinery	69	29,2	56,4	7,9	8,9	2,3	8,0	6,7	13,3	2,9	22,4	5,8	33,0	17,1	9,7	2,0	0,2	-0,8	0,0	2,1	0,0	0,2	0,2	0,3	-0,3	-0,1	10,0	9,1	16,6
Other Manufacturi	-6,1	-30,4	-1,8	7,7	-7,0	-19,0	4,7	-27,7	-6,5	-8,7	7,9	7,5	2,4	-3,5	-2,1	-13,2	-0,1	-2,4	-0,5	6,7	0,0	-0,1	0,0	-1,1	-2,8	-1,7	5,9	9,6	-10
Construction	-37	-44,3	7,3	11,0	0,2	0,2	-0,6	-3,6	-35,8	-39,4	13,9	11,9	0,1	0,1	-0,8	0,0	0,0	0,0	0,0	0,2	0,0	0,0	0,0	0,0	0,0	0,0	-0,9	-5,2	-5,1
Trade	18	2,2	-3,8	16,7	11,8	-2,2	-4,2	0,4	0,0	-1,7	4,7	2,8	3,8	0,9	-1,2	-1,5	0,0	-0,3	0,0	0,9	0,0	0,0	0,0	-0,6	-0,3	-0,1	3,1	6,2	-3
Finance	6,4	15,5	NA	NA	6,1	0,8	NA	NA	-1,4	-1,9	NA	NA	1,6	1,0	NA	NA	-0,1	-0,3	NA	NA	0,0	0,0	NA	-0,5	-0,5	NA	0,6	16,7	NA
Public services	6,5	10,7	NA	NA	1,9	9,3	NA	NA	-0,1	-0,2	NA	NA	0,8	0,2	NA	NA	0,0	0,0	NA	NA	0,0	0,0	NA	-0,1	0,0	NA	3,9	1,3	NA
Others	-22	31,9	-53,9	-15,1	-6,2	15,0	-7,1	-53,2	-7,8	-6,3	6,4	9,3	-0,9	3,7	-3,7	-9,1	-0,6	-1,0		6,2	0,2		0,0	0,7	-1,5	-0,2	-7,7	22,8	-49
Total	-0,2	0,1	0,4	0	14,5	-5,8	2,3	-149	-48	-68	68,3	52,7	38,2	31,5	10,6	-26	-0,4	-7,3	-1,4	33,3	0,4	0,1	0,3	-6,5	-11	-7,5	-0,7	68,3	-68

Note: P1: 1975-1985, P2: 1965-1975, P3: 1955-1965, P4: 1914-1954

Sources: Chen and Kiyoshi (1992)

Table-4. DPG Decomposition for Korea, 1963-1974, 1975-85

	DPG				Deviation of								Change in coef							
					C		If		E		M <sup>c</sup>		M <sup>f</sup>		M <sup>a</sup>		A			
	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2				
Agriculture, Forest	-59,9	-70,6	-61,7	-62,6	-0,8	0,8	-6,7	3,2	3,7	-4,8	0	0	5,1	-1,7	0,6	0,5				
Mining	-5,4	-2,6	-1	-1,1	-0,2	0,3	0,8	0,1	0	0	0	0	-1,1	-1,9	-1,9	0				
Chemicals	-0,4	23,4	-13,7	-7,1	-0,7	0,9	8,5	11,7	0,2	-0,5	0,5	0,1	3,1	6,7	4,2	11,5				
Metals	23,6	11,3	-1,2	-0,6	-0,7	2,5	6,6	6,4	0	-0,1	0,9	0,2	5	2,3	5,8	0,7				
Machinery	50,1	25,6	1,6	4,4	5,8	6,8	23,5	12	0,1	-0,1	6,7	0,8	1,3	-0,9	12,1	1,7				
Other Manufacturin	19	34,2	-9,1	-6,5	-1	1,7	-2,8	40,6	1	-0,8	0,3	0,1	3,4	-0,2	26,2	-0,2				
Construction	-10,2	5,5	-2,7	-0,9	-10,2	6,7	0,4	-0,2	0	0	0,1	0	0,1	0	2,2	0				
Trade	-12,7	-9,9	-9,7	-10,4	-0,4	1,7	2	5,7	-0,4	-0,1	0,4	0,1	-0,1	0,3	-4,9	-6,1				
Finance	7,3	-5,7	-2,7	-10,7	-0,4	1	0,9	1,3	0	-0,1	0,3	0	0,7	0,1	8,6	2,7				
Public Services	-10,5	NA	-10,5	NA	0	NA	0,1	NA	-0,4	NA	0	NA	0	NA	0,2	NA				
Others	-0,8	-11,2	-11,0	-18,6	-1,10	1,60	3,20	8,60	0,20	0,40	0,50	0,10	0,30	0,30	7,6	-4,5				
Total	0,0	0,0	-121,7	-114,1	-9,7	24,0	36,5	89,4	4,4	-6,1	9,7	1,4	17,8	5,0	60,7	6,3				

Note: P1: 1975-1985, P2: 1963-1974

Sources: Chen and Kiyoshi (1992)



Table-5. DPG Decomposition for Taiwan, 1966-1976, 1976-84

	DPG		Deviation of						Change in coef							
			C		If		E		M <sup>c</sup>		M <sup>f</sup>		M <sup>A</sup>		A	
	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2
Agriculture, Forestry, &	-30,0	-50.1	-8,3	-51.9	-0,6	-0.7	-7,6	-7.5	-1,2	0.9	0,0	0,0	-6,2	-12.4	-3,0	20.0
Mining	-12,4	-8.2	-1,0	-1.7	-1,7	0.7	0,8	-0.3	0,0	0,0	0,1	0,0	-4,3	-1.8	-5,5	-5.1
Chemicals	12,0	22.5	-7,9	-6.7	-5,0	0.9	14,8	18.2	-1,3	-0.3	0,7	0.2	12,2	1.0	1,2	10.1
Metals	29,1	9.8	-0,1	-1.2	-7,8	2.7	19,9	5.1	0,0	-0.1	2,4	0.1	15,5	2.0	2,0	2.1
Machinery	45,2	26.5	5,2	0.5	-4,6	4.9	34,6	29.0	-0,8	0.1	5,5	0.8	2,2	-1.0	2,8	2.8
Other Manufacturing	-15,7	33.6	-17,0	-13.3	-7,8	1.9	9,0	27.7	-5,9	1.0	0,3	0.5	-2,1	-0.5	12,5	15.6
Construction	-22,1	5.5	-0,9	-1.3	-22,6	7.8	0,3	-1.5	0,1	-0.1	0,0	0,0	-0,2	-0.1	1,3	0.7
Trade	8,1	-16.4	2,9	-7.7	-2,4	-1.9	3,2	1.8	-1,0	0.1	0,4	0,0	1,7	-0.2	4,4	-8.2
Finance	-9,7	2.2	-9,6	-1.6	-1,2	0,0	2,4	1.4	0,4	-0.2	0,2	0,0	-2,8	0.1	1,1	2.5
Public Services	5,6	NA	5,6	NA	0,0	NA	0,0	NA	0,0	NA	0,0	NA	0,0	NA	0,0	NA
Others	-10,2	-25.4	-8,8	-31.4	-4,0	0.3	1,7	2.7	0,8	-2.0	-0,6	0.1	2,2	-2.7	-1,0	7.7
Total	0,0	0.0	-39,9	-116.3	-57,5	16.7	78,8	66.5	-8,8	-0.6	10,1	1.8	18,2	-15.5	15,9	48.1

Note: P1: 1976-1984, P2: 1966-1976

Sources: Chen and Kiyoshi (1992)

## Appendix B

Sector classification for Taiwan, Korea, Japan, 1995-2009

1	Agriculture, Hunting, Forestry and Fishing	Agriculture, Hunting, Forestry and Fishing
2	Mining and Quarrying	Mining and Quarrying
3	Chemicals	Coke, Refined Petroleum and Nuclear Fuel Chemicals and Chemical Products Rubber and Plastics Other Non-Metallic Mineral
4	Metals and Fabricated Metal	Metals and Fabricated Metal
5	Machinery, Nec	Machinery, Nec Electrical and Optical Equipment Transport Equipment
6	Manufacturing	Food, Beverages and Tobacco Textiles and Textile Products Leather, Leather and Footwear Wood and Products of Wood and Cork Pulp, Paper, Paper, Printing and Publishing Manufacturing, Nec; Recycling
7	Construction	Construction  Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Fuel  Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles
8	Trade	Trade
9	Financial	Financial Intermediation Real Estate Activities

		Renting of M&Eq and Other Business Activities
		Public Admin and Defence; Compulsory Social Security
		Education
10	Public services	Public Admin and Defence; Compulsory Social Security
		Education
		Health and Social Work
11	Others	Hotels and Restaurants
		Inland Transport
		Water Transport
		Air Transport
		Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies
		Post and Telecommunications
		Other Community, Social and Personal Services
		Private Households with Employed Persons
		Electricity, Gas and Water Supply

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