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How Large is the impact of Exports on Economic Growth? New Evidence from the Korean Case

Lee, Siwook
KDI School of Public Policy and Management

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How Large is the impact of Exports on Economic Growth? New Evidence from the Korean Case

The positive relationship between trade and economic growth is one of the most fundamental propositions in economics field. However, the existing empirical studies tend to have emphasized statistical significance of the trade-growth nexus, but they have paid less attention to the actual size of trade's impact on economic growth. Is exports' impact sufficiently large to justify the widespread pro-trade prescriptions to attain the long-term growth?

In this respect, this paper empirically examines the impact of exports on economic growth, for the case of Korea since its economic take-off period in 1960s. We adopt two inter-related GDP decomposition methods to quantify the contributions of export to GDP growth from a historical perspective. We find that export's contribution to GDP growth has been substantial. Specifically, the average contribution of net exports to growth for the period of 1960-2014 is 30.3 percent, which means that net exports accounts for 2.3 percent point per annum of Korea's GDP growth. This figure is truly a remarkable one, taken into consideration that the average growth rates of developed and developing countries were 3.17 percent and 3.37 percent over the last five decades, respectively.

JEL Classification: F14, F43, O41
Keywords: Export Growth, Economic Growth, GDP Decomposition, Input-Output Analysis

I. Introduction

Over the last several decades, the positive association between exports and economic growth has been regarded as a stylized fact in the economic growth literature. Practically, exports can contribute to an economy through various channels: first of all, many countries, especially at the early stage of economic development, are facing the shortage of physical and human resources needed for attaining sustainable growth. Exports help to accumulate factors of production by injecting foreign reserves into the economy. Foreign receipts earned by exporting activities substantially contributed to fill the financial gap to meet surging demand for domestic investment.

Exporters can also exploit economies of scale through their access to large world markets. In addition, export promotion changes the relative prices among domestic economic activities and divert production factors into more productive market activities. Most importantly, exports can have the effect of boosting productivity by facilitating learning-by-exporting in the process of export activities, thereby raising the economic growth rate over the medium to long term.

An extensive body of existing research provides empirical evidence supporting for the positive relationship between exports - more generally international trade - and economic growth. Most of these studies are based on regression analysis, especially under the framework of the neoclassical growth theory. At the same time, however, there also exist irrefutable criticisms upon such pro-trade proposition, notably from Rodriguez and Rodrik (2001) and Rodrik, Subramanian and Trebbi (2002). These criticisms are rooted on the observation that the existing empirical studies on the trade-growth nexus are more or less subject to various modelling and data problems, including the appropriateness of trade openness measures, possible reverse causality between trade and growth, omitted variable bias, and data quality issues for developing countries. Hence, no one can conclude yet that the current literature succeeds in providing an explicit answer on the question of whether trade openness or exports really matters for achieving sustainable economic growth.

Furthermore, the existing literature has focused largely on statistical significance of the trade-growth nexus, and it has paid less attention to the actual size of trade's impact on economic growth. If international trade is a decisive factor for the long-term economic growth, its impact on economic growth should be shown to be sufficiently large in the empirical studies. As a matter of fact, studies on the gains from trade based on traditional static models generally suggest that the welfare gains from trade opening would be no larger than one percent of GDP. If this is case, as Lewer and Van den Berg (2003) convincingly suggest, how can economists justify their strong support for free trade as a priority policy in order to attain sustained growth and to reduce huge income gaps between developed and developing countries?

On the other hand, Korea's experience on rapid structural transformation since the early 1960s has been drawn great attention from international communities. It is widely recognized that export-oriented industrialization is one of the most salient features for the

Korean economic development. The importance of exports to the Korean economy still remains undiminished even today, as globalization has been unprecedentedly accelerated, although the Korean economy already entered into its mature stage of development.

While exports are almost unanimously regarded as the main driver for Korea' rapid growth, there is relatively a paucity of empirical research that provides the exact quantitative contributions of exports to GDP growth over the course of its structural transformation. How large has been the impact of exports in economic development at each stage of Korea's economic development? And how have exports contributed to economic growth in Korea?

In this respect, this paper empirically examines the impact of exports in Korea's economic development since its economic take-off in 1960s. For this purpose, we adopt two inter-related GDP decomposition methods to quantify the contribution of export to GDP growth at each stage of economic development. Specifically, taking into account that the conventional GDP decomposition method provides limited insight into the exact contribution of exports to GDP growth, we instead employ the import-adjusted method, discussed in Kranendonk and Verbruggen (2005, 2008), to measure the exact relative contributions of domestic and external components to GDP growth.[1]

This paper further intends to supplement a more detailed analysis investigating the specific channels through which exports contribute to economic growth in the medium to long term, by employing the multi-sector comparative analysis proposed by Kubo et al. (1986). Using national input-output tables for the periods of 1975-2005, we identify the relative contributions of the following specific channels to economic growth: direct export expansion, import substitution of intermediate goods used for exports, and technological change linked to exports.

The structure of this paper is as follows: In Section II, we discuss the existing related literature. The basic empirical strategies, data description and estimation results are presented in Section III. Some policy implications and concluding remarks are provided in Section V.

II. Literature Survey

As aforementioned, the positive relationship between trade and economic growth is

[1] It should be noted that this import-adjusted decomposition analysis also contains a certain degree of limitations. Since this is simply an accounting method, it does not provide precise evidence on the causal linkage between exports and economic growth. In addition, it explains only the short demand-side drivers of GDP growth fluctuations along the business cycle.

one of the most fundamental propositions in economics field, and economists have provided an extensive set of empirical studies supporting for such pro-trade propositions. Lewer and Van der Berg (2003) argue that the existing literature has focused largely on the statistical significance of the trade-growth nexus, but less attention has been drawn to the actual size of trade's impact on economic growth. Lewer and Van der Berg (2003) re-examine the vast empirical literature from the perspective of the quantitative economic effects of international trade on economic growth. Their survey analysis indicates that the existing studies provide surprisingly consistent results: A one percent point increase in export growth is associated with a 0.2 percent point increase in economic growth. Most of these studies are based on regression analysis, especially under the framework of the neoclassical growth theory. The regression-based pro-trade empirical results are still challenged, largely due to the inherent econometric problems regarding data quality, reverse causality, omitted variable bias, and the measures of trade openness.

One possible alternative to quantify the impact of trade, more specifically exports, to economic growth is the GDP decomposition approach. Exports are a key component in the expenditure-side GDP equation, and thus its contribution to GDP could be readily estimated by using the equation. The conventional approach is to decompose GDP by its expenditure categories, - private consumption, investments, government expenditure, and net exports -, and to identify their relative contributions to the overall GDP growth.

While this conventional method is useful to highlight the net contribution of external demand through international trade, it provides limited insight into the exact contribution of exports to GDP growth. As Kranendonk and Verbruggen (2008) argue, the conventional method attributes all the intermediate and final imports to net exports and consequently results in the possible overestimation of domestic demand's contribution to growth. For example, suppose that an investment boom for an economy is driven solely by massive imports of capital goods. In this case, applying the conventional method is at the risk of understating the impact of exports on economic outcome, since it is based on gross domestic demand, but not net domestic demand for domestically-produced goods.

In this context, Kranendonk and Verbruggen (2005, 2008) argue that "the import-adjusted method" is a more sensible approach to quantify the sources of economic growth. In the import-adjusted approach, final and intermediate import demands are apportioned to each GDP expenditure category on the basis of import intensities derived from input-output tables. With such adjustment, each expenditure category represents net final demand solely for domestically-produced goods and services, which enables us to identify the exact relative contributions of domestic and external components to GDP growth.

Applying this method to six European countries and the United States, Kranendonk

and Verbruggen (2008) show quite a different story, compared to that from the conventional method. For instance, for the Netherlands, the import-adjusted method suggests that the contribution of exports to GDP growth is stable and very significant for the periods of 2004-2007, while the conventional approach reveals a minimal contribution of exports to GDP growth. The Central Bank of Malta (2016) also suggests that the import-adjusted method yields more intuitive results than the traditional approach. By employing the import-adjusted approach, Martin (2015) shows that the domestic value-added of manufacturing sector in Philippines did not increase with the rise of exports over a second half of the 20th century.

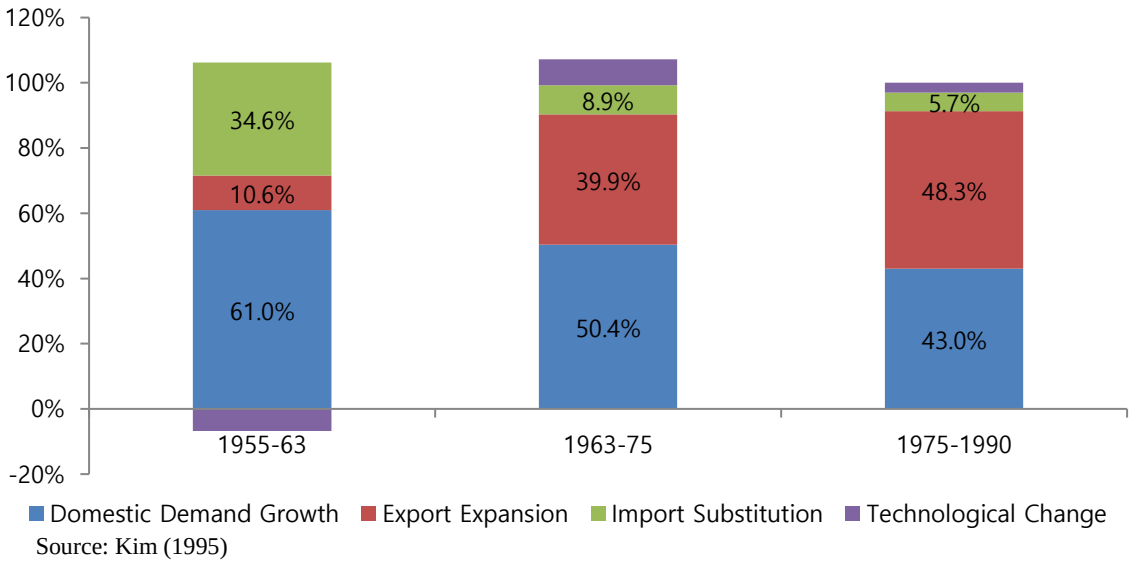
In a similar vein but from a different motivation, Chenery (1960), Chenery et al. (1962), Syrquin (1976), and Kubo et al. (1986) propose another strand of the GDP decomposition approaches to investigate the specific channels through which exports contribute to economic growth. By employing the multi-sector comparative analysis, these studies identify the relative contributions of the following specific channels to economic growth: direct export expansion, import substitution of intermediate goods used for exports, and technological change linked to exports. Chenery (1960) finds that, for countries with rapidly rising manufacturing exports like Korea and Taiwan, the expansion of exports accounts for 50 percent or more of the total increase of aggregate output. This decomposition method has since been employed by many researchers to examine the sources of economic growth for a country basis; for instance, Celasun (1984) for Turkey, Akita (1991) for Indonesia, Korres (1996) for Greece, Tregenna (2012) for the case of South Africa, Albala-Bertrand (2016) for China among many others.

On the other hand, Frank, Kim and Westphal (1975) is a seminal paper to adopt this approach to the Korean case. Frank, Kim and Westphal (1975) show that about 20.2 percent of overall growth could be attributable directly and indirectly to export expansion for the period of 1955-1968. Expansion of domestic demand was the most important factor, accounting for more than 80 percent of overall growth, and the impact of import substitution was very negligible. Another important finding that deserves much attention is that export expansion generated substantial domestic backward linkages while import substitution did not. Such indirect contribution of export promotion accounts for almost a half of export impacts on total growth.

Kim (1995) documents previous findings from this approach on Korea's manufacturing for the period of 1955-1990. As shown in Figure 1, before export-oriented strategy was adopted in the early 1960s, import substitution made a greater contribution to the overall growth relative export expansion. But the impacts of export expansion became much larger as export promotion became a prioritized policy objective since 1960s. For the period of 1975-90, the contribution of exports to total output growth even surpassed that of

domestic demand.

[Figure 1] Sources of Manufacturing Output Growth: 1955-1990



Source: Kim (1995)

III. Empirics

From now on, we apply two strands of the GDP decomposition methods that are discussed in Section II to the Korean case. We start with implementing the import-adjusted method à la Kranendonk and Verbruggen (2008) to examine how the role of exports has evolved over the course of Korean economic development for the last five decades. Then, we employ a factor decomposition method initially developed by Chenery (1960) and further extended by Kubo et al. (1986) to investigate more specific channels through which exports contributes to the overall economic growth.

1. Sources of Economic Growth I: Year-to-year Change

1.1 Empirical Strategy

Let's take a look at the following conventional GDP identity:

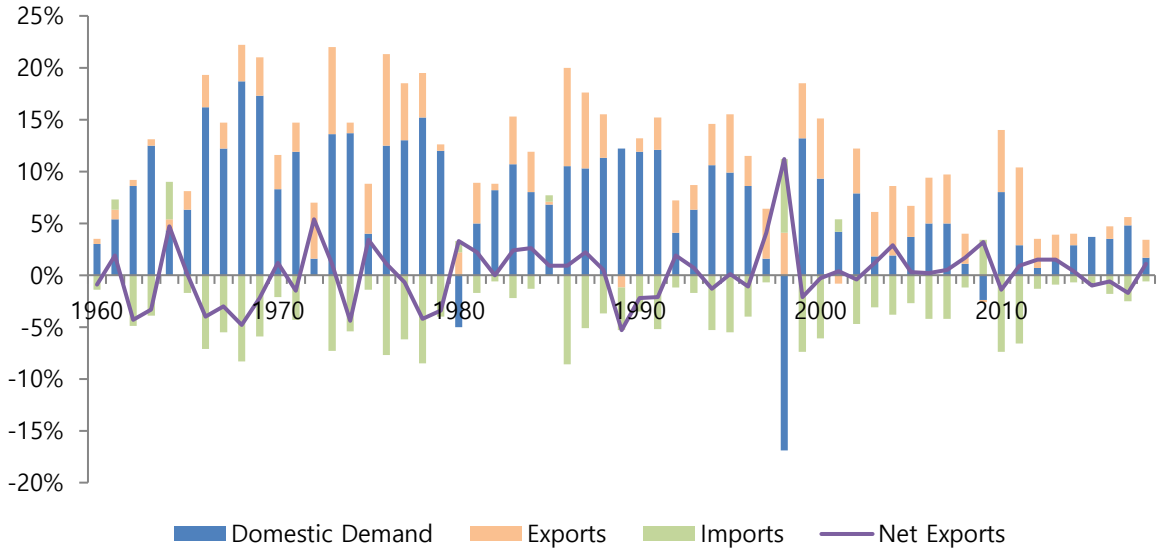
$$GDP_t \equiv C_t + I_t + G_t + EX_t - IM_t \quad \cdots\cdots\cdots\cdots\cdots (1)$$

In this conventional approach, GDP consists of private consumption, investments, government expenditure, and net exports, of which the first three factors represent domestic

demand. The contribution of a demand component is calculated as the growth in that component in real terms multiplied by the previous year's share of that component out of GDP in nominal terms.

Figure 2 depicts year-to-year growth rates of domestic demand and net exports for the period of 1960-2015.[2] Over the whole period, domestic demand growth explains most of the overall GDP growth while the contribution of net exports has been rather limited. In fact, net exports recorded negative for most years.

[Figure 2] Sources of GDP Growth by expenditure item 1960-2015



Source: Bank of Korea Database

As Kranendonk and Verbruggen (2008) argue, this conventional method of GDP decomposition attributes all the intermediate and final imports to net exports and results in the possible overestimation of domestic demand's contribution to growth. To see this, let's decompose further import into the following:

$$IM_t \equiv IM_{C_t} + IM_{I_t} + IM_{G_t} + +IM_{EX_t} \quad \cdots\cdots\cdots\cdots\cdots\cdots \quad (2)$$

where IM_{i_t} is final and intermediate import demand for each expenditure category $i =$

[2] Unlike Kim (1995), our analysis covers the period after 1960, because I/O tables for 1950s are not available at this moment. We plan to extend our analysis up to earlier periods if additional data are available.

C, I, G, EX. Now suppose that an investment boom for an economy is driven solely by massive imports of capital goods. In this case, the overall GDP remains the same because the increase of domestic investment ΔI_t is exactly canceled out by the increase of ΔIM_{I_t}. This implies that the conventional method is often at the risk of overstating the impact of domestic demand, since it is based on gross domestic demand, but not net domestic demand for domestically-produced goods. A considerable amount of imports, especially in developing countries, is consumed by households or used for fixed capital formation, and the traditional approach fails to take into account that domestic demand and exports contains different extents of import intensities.

On the other hand, if Equation (2) is plugged into Equation (1), then we have

$$GDP_t = (C_t - IM_{C_t}) + (I_t - IM_{I_t}) + (G_t - IM_{G_t}) + (EX_t - IM_{EX_t}) \quad \cdots\cdots\cdots\cdots\cdots \quad (3)$$

In Equation (3), we see that imports are apportioned to each of GDP expenditure components. Consequently, each term in this equation now represents *net domestic demand* for domestically-produced goods and services for an expenditure category $i = C, I, G, EX$.

As far as concerning economic development for a long-run perspective, the import-adjusted GDP account represented by Equation (3) can be apparently more sensible to quantify the exact relative contributions of domestic and external components to GDP growth than the conventional GDP account represented in Equation (1). Final and intermediate import demand for each expenditure category in Equation (3) is derived from input-output tables.[3] Intermediate import demand for each item can be obtained by first calculating each component's import inducement coefficients using Leontief inverse matrices and multiplying them by the amount of each item's final domestic demand. All the data come from the Bank of Korea database. Given the unavailability of IO tables based on constant prices consistent for the whole period, our estimation is based on nominal import intensity rather than real marginal import intensity.[4]

Let a_c, a_i, a_g, a_{ex} denote the import intensities of consumption, investment, government expenditure and exports respectively. Using the equation (2), it can be express as follows:

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[3] For more detailed information on the import-adjusted method, please refer to Kranendonk and Verbruggen (2005, 2008).

[4] Many technological innovations tend to be embodied in new investment goods over the past several decades, and price indices more or less reflect these quality changes. Consequently, our analytic results based on nominal values may suffer from a downward bias, especially for the import intensity of private investment.

$$IM_t \equiv a_c C_t + a_i I_t + a_g G_t + a_{ex} EX_t \quad \cdots\cdots\cdots\cdots\cdots (4)$$

where the terms to the right of Equation (4) represents imports directly and indirectly generated by consumption, investment and exports.

For measuring the contribution of GDP components to economic growth, we can express the GDP identity equation into growth rate terms using the observed data. The GDP growth rate can be decomposed using each element of aggregate expenditure and the observed growth rate. Therefore, we can express equation (1) as follows in ex-post growth terms;

$$R_y \equiv R_c \left(\frac{C}{Y}\right)_{-1} + R_i \left(\frac{I}{Y}\right)_{-1} + R_g \left(\frac{G}{Y}\right)_{-1} + R_x \left(\frac{EX}{Y}\right)_{-1} - R_m \left(\frac{IM}{Y}\right)_{-1} \quad \cdots\cdots\cdots\cdots\cdots (5)$$

In Equation (5), R_y, R_c, R_i, R_g, R_{ex}, R_m are real growth rates of GDP, private consumption, private investment, government expenditure, exports and imports, respectively. On the other hand, using Equation (4) is applied to Equation (5), the following equations can be obtained:

$$R_y \equiv (R_c - R_m a_c)\left(\frac{C}{Y}\right)_{-1} + (R_i - R_m a_i)\left(\frac{I}{Y}\right)_{-1} + (R_g - R_m a_g)\left(\frac{G}{Y}\right)_{-1} + (R_x - R_m a_x)\left(\frac{EX}{Y}\right)_{-1} \cdots (6)$$

If the growth rate of each element of the final demand is the same as that of import induced from domestic demand, investment, government and exports in each period, the following equation can be obtained. We can suppose $R_c = R_m$, $R_i = R_m$, $R_g = R_m$, $R_{ex} = R_m$.

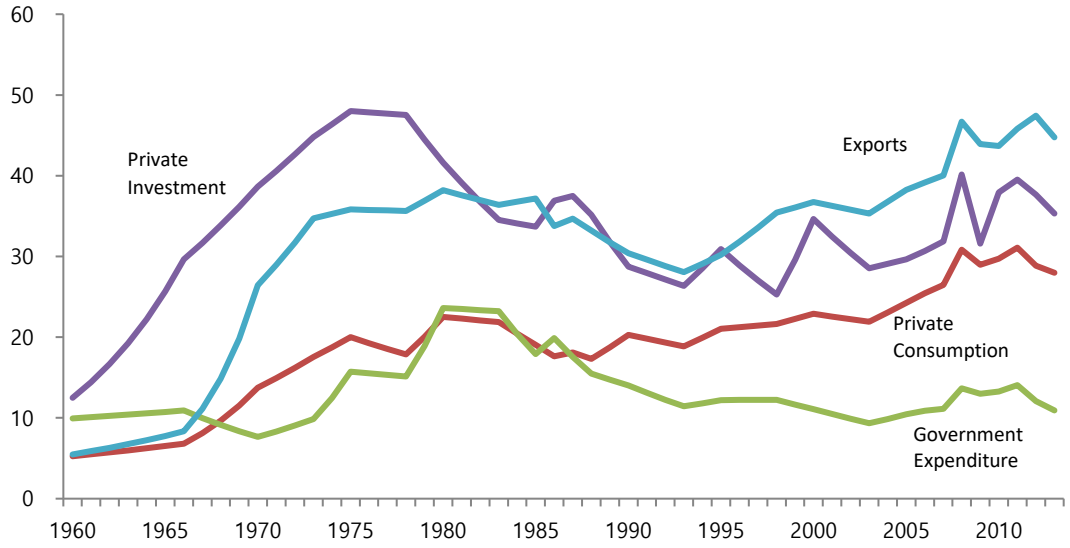
$$R_y \equiv R_c(1 - a_c)\left(\frac{C}{Y}\right)_{-1} + R_i(1 - a_i)\left(\frac{I}{Y}\right)_{-1} + R_g(1 - a_g)\left(\frac{G}{Y}\right)_{-1} + R_x(1 - a_x)\left(\frac{EX}{Y}\right)_{-1} \cdots (7)$$

1.2 Empirical Results

Figure 3 contains our estimates of import intensities by expenditure items. As depicted in the Figure, the import intensity of private investment had rapidly increased during the periods of 1960~70s and then declined afterward. The import intensity of exports also increased quickly from the mid-1960s to the mid-1970s, after which it stabilized and then began to increase again since the 2000s. On the other hand, import demands for private consumption have been increasing more gradually than those of private investment and exports.

At Korea's golden age of economic development in 1960s-70s, import intensities virtually for all of expenditure items had simultaneously risen. The increase was most conspicuous for private investment, reaching at almost 50 percent in the mid-1970s. In such situation where domestic demand increases on the back of a rapid rise in direct imports, then the aforementioned traditional method has a non-negligible limitation in capturing the true relative contribution of domestic and external demand to economic growth.

[Figure 3] Import Intensity by Expenditure Category



Note: The figures are based on final and intermediate import demand for each category.
Source: Author's estimation based on input-output tables of the Bank of Korea.

Table 1 reports the relative contributions of expenditure items on both final and intermediate import demands. As for private consumption, intermediate import demand has been much larger than import consumption demand for final goods and services until recently. Private investment follows a similar pattern, with an exception of the year 1970. It is evident that import demand for export has gained more importance in total import demand over time.

[Table 1] Composition of Import Demands by Expenditure Item (%)

	Private Consumption		Government Expenditure		Private Investment		Export
	Final	Intermediate	Final	Intermediate	Final	Intermediate	Intermediate
1960	18.66	**47.78**	7.37	4.38	4.43	13.80	**3.57**
1970	9.83	**29.90**	0.73	2.45	21.62	21.05	**14.42**
1980	3.95	**30.38**	0.02	6.42	13.92	15.99	**29.32**
1990	7.53	**26.31**	0.00	4.39	14.85	19.04	**27.88**
2000	9.92	**23.71**	0.00	2.85	13.94	13.28	**36.30**
2010	9.64	**20.49**	0.00	3.88	8.57	13.07	**44.35**
2014	11.16	**18.22**	0.00	3.51	9.07	11.73	**46.31**

Source: Author's estimation based on Input-output tables of Bank of Korea
Note: The values are calculated for the induced directly or indirectly imports of each component for final demand divided by total imports.

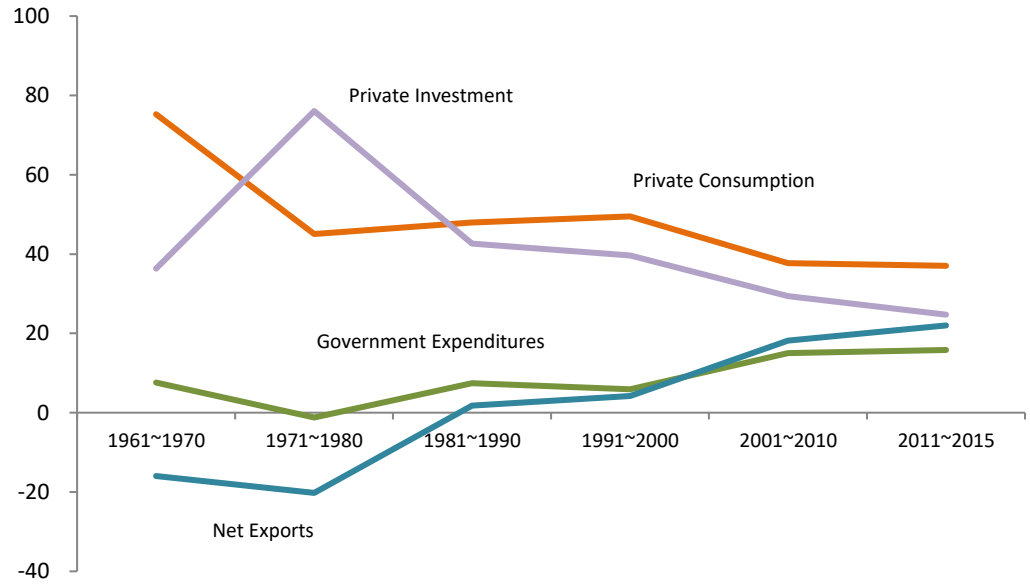
Figure 4 contains the estimation results both from the conventional method as well as from the import-adjusted method for the case of Korea over the periods of 1960-2015.[5] According to the estimation results from the conventional approach, the main contributor of Korea's economic growth at the very early stage of development in the 1960s was shown to be private consumption, and then private investment emerged as the key driver to maintain high growth path in the 1970s. Meanwhile, the relative contribution of net exports was recorded as negative until 1970s when Korea experienced chronical trade current account deficits.

On the other hand, Panel B in the table contains the estimation results based on the import-adjusted methodology. While private consumption and investment still remained as the key drivers of economic growth in 1960~70s, their respective contributions was about 20 percent points lower compared to the estimated results in Panel A. And net exports accounted for around one-fifth of GDP growth for the periods of 1960~90s. The contribution of exports to GDP growth reaches at 50 percent after 2000s, as the expansion of domestic demand is getting slowing down (See Figure 5).

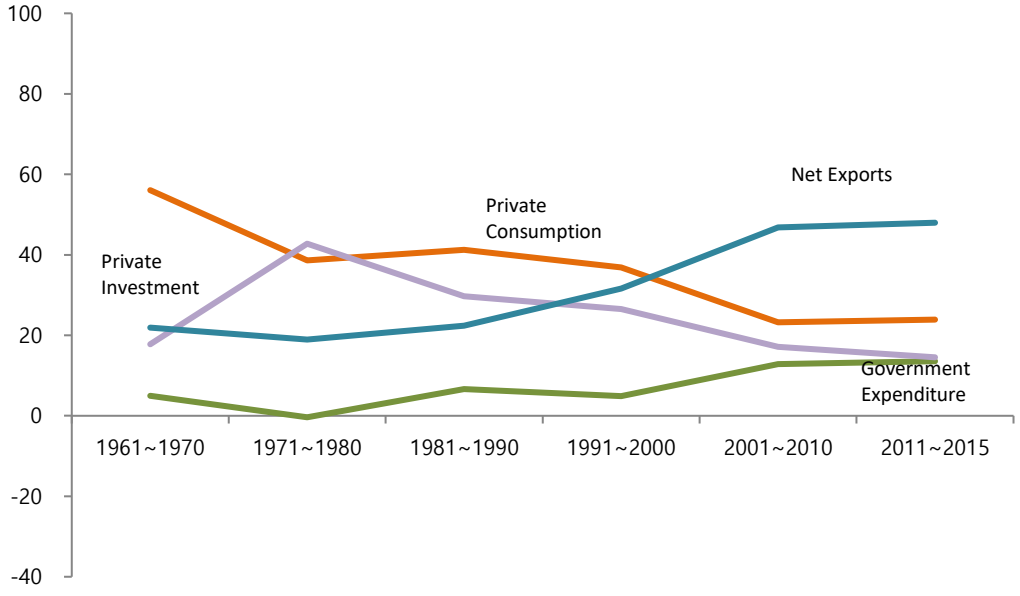
[5] The Bank of Korea started to release Input-output tables in 1960. Other than the benchmark year data for every 5 years, the extended tables are also released for some interim years. For the years that I/O tables are not available, we use the data of the closest year for estimation.

[Figure 4] Relative Contributions of GDP Expenditure Categories to Korea′s GDP Growth

A. The conventional method



B. The import-adjusted method

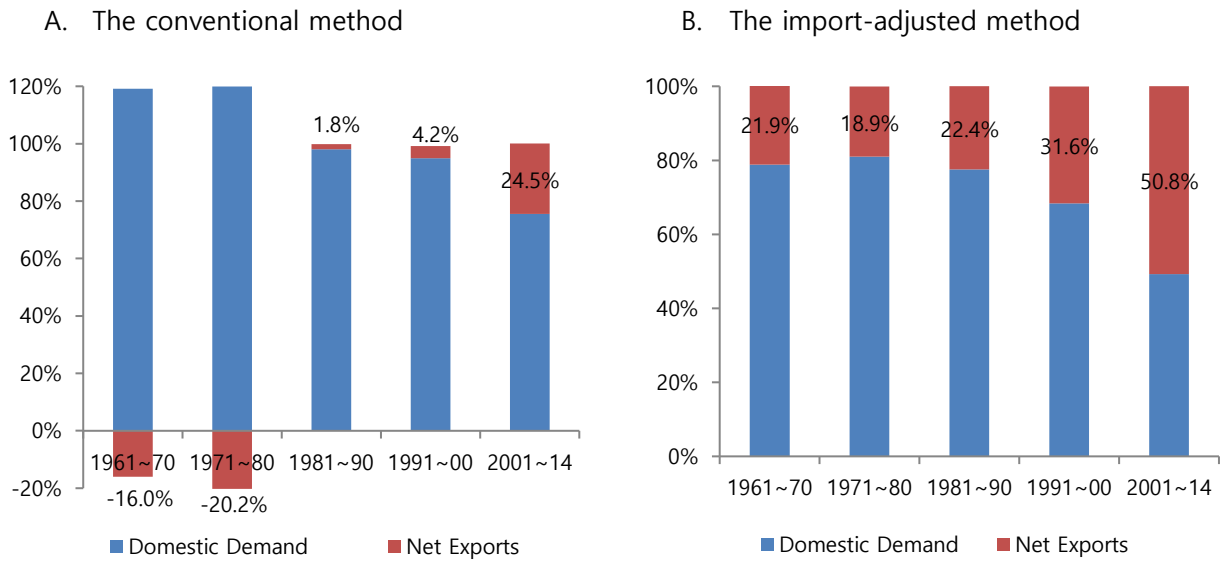


Source: Author′s estimation based on national account data and input-output tables of the Bank of Korea.

The average contribution of net exports to growth over the whole period is 30.3 percent, which means that net exports accounts for 2.3 percent point per annum of Korea's GDP growth. This figure is truly a remarkable one, taken into consideration that the average growth rates of developed and developing countries were 3.17 percent and 3.37 percent over

the last five decades, respectively. Therefore, we can confirm that the role of export activities to Korea's economic development has been indeed substantial.

[Figure 5] Contribution to GDP Growth: Domestic Demand versus Net Exports



2. Sources of Economic Growth II: Decadal Change

2.1 Empirical Strategy

While the import-adjusted method is informative to examine the short-term demand-side contributors to GDP growth, it has certain limitations when we employ this methodology to investigate longer term growth patterns. Most importantly, for the medium to long term period, production technology for an economy might change and so does production structure, which the import-adjusted method does not take into account. It would be quite interesting if we could explicitly see how such production-side changes, along with demand-side factors, contribute to economic growth. In this context, a factor decomposition approach initially developed by Chenery (1960) and later refined by Chenery and Syrquin (1980) and Kubo et al. (1986).

Total gross output X for an economy can be written as the sum of the following four components:

$$X_t \equiv W_t + D_t + EX_t + IM_t \quad \cdots\cdots\cdots\cdots\cdots (8)$$

where the (nx1) vectors W_t, D_t, EX_t and IM_t represent domestic intermediate demand, domestic final demand, exports, and imports at year t, respectively. The A matrix represents the technology of interindustry relations, and has a domestic component and an imported one:

$A_t = A_t^d + A_t^m$. If we plug it into Equation (8), we have

$$X_t \equiv A_t^d X_t + A_t^m X_t + D_t + EX_t - IM_t \quad \cdots\cdots\cdots\cdots\cdots \quad (9)$$

Let $\hat{m}_t$ the share of import in total supply, i.e. $IM_t = \hat{m}_t(W_t + D_t)$. In addition, let $R_t^d = \left(1 - A_t^d\right)^{-1}$,which is the inverse of the identity matrix minus the matrix of domestic input-out coefficients. Then we get

$$\begin{aligned} X_t &\equiv A_t^d X_t + (I - \hat{m}_t)D_t + EX_t \\ &\equiv \left(I - A_t^d\right)^{-1}[(I - \hat{m}_t)D_t + EX_t] \\ &\equiv R_t^d[(I - \hat{m}_t)D_t + EX_t] \quad \cdots\cdots\cdots\cdots\cdots \quad (10) \end{aligned}$$

Between two periods, a change in output ΔX_t depends on changes not only in domestic and external demand, but also in production technology and import intensity. After some algebraic manipulation, the change in outputs can be given by:

$$\begin{aligned} \Delta X_t &= R_{t+1}^d[(I - \hat{m}_{t+1})D_{t+1} + EX_{t+1}] - R_t^d[(I - \hat{m}_t)D_t + EX_t] \\ &= R_{t+1}^d(I - \hat{m}_{t+1})\Delta D_t + R_{t+1}^d \Delta EX_t + R_{t+1}^d(\hat{m}_{t+1} - \hat{m}_t)D_t \\ &\quad - R_{t+1}^d\left(\widetilde{A_{t+1}^m} - A_t^m\right)X_t + R_{t+1}^d\left[\Delta A_t - \left(A_{t+1}^m - \widetilde{A_{t+1}^m}\right)\right]X_t \cdots\cdots\cdots\cdots\cdots \quad (11) \end{aligned}$$

where $\widetilde{A_{t+1}^m} = \left[\left(\frac{A_{t+1}^m}{A_{t+1}}\right)A_t\right]$.

Taking index number problems into account, we apply the simple arithmetical average of the Laspeyres and Paache index results for estimation. As shown in Table 2, the first two terms on the right-hand side of Equation (11) measure output changes induced by domestic demand and exports, given a constant import structure. On the other hand, the next two terms represent the direct/indirect impacts of changes in the import structure of final as well as intermediate goods. So these are the contributions of import substitution to gross output expansion. The last term depicts the overall effects of technological changes, which are represented by changes of domestic and import input-output coefficient matrices.

[Table 2] Factor Decomposition and Determinants of Output Growth

Determinants	Term
Domestic demand expansion	$\mathrm{R}^{\mathrm{d}}_{\mathrm{t+1}}(\mathrm{I}-\widehat{\mathrm{m}}_{\mathrm{t+1}})\Delta\mathrm{D}_{\mathrm{t}}$
Export expansion	$\mathrm{R}^{\mathrm{d}}_{\mathrm{t+1}}\Delta\mathrm{EX}_{\mathrm{t}}$
Import substitution (Final goods)	$\mathrm{R}^{\mathrm{d}}_{\mathrm{t+1}}(\widehat{\mathrm{m}}_{\mathrm{t+1}}-\widehat{\mathrm{m}}_{\mathrm{t}})\mathrm{D}_{\mathrm{t}}$
Import substitution (Intermediate goods)	$-\mathrm{R}^{\mathrm{d}}_{\mathrm{t+1}}\big(\widetilde{\mathrm{A}^{\mathrm{m}}_{\mathrm{t+1}}}-\mathrm{A}^{\mathrm{m}}_{\mathrm{t}}\big)\mathrm{X}_{\mathrm{t}}$
Technological change	$\mathrm{R}^{\mathrm{d}}_{\mathrm{t+1}}\big[\Delta\mathrm{A}_{\mathrm{t}}-\big(\mathrm{A}^{\mathrm{m}}_{\mathrm{t+1}}-\widetilde{\mathrm{A}^{\mathrm{m}}_{\mathrm{t+1}}}\big)\big]\mathrm{X}_{\mathrm{t}}$

Finally, we can easily modify Equation (11) to convert into value-added growth($\Delta\mathrm{V}_{\mathrm{t}}$). Letting $\widehat{A^{v}_{t}}$ the value added share relative to gross output, we have the following:

$$\begin{aligned}\Delta V_t = {} & \widehat{A^{v}_{t+1}}R^{d}_{t+1}(I-\widehat{m}_{t+1})\Delta D_t + \widehat{A^{v}_{t+1}}R^{d}_{t+1}\Delta EX_t \\ & +\widehat{A^{v}_{t+1}}R^{d}_{t+1}(\widehat{m}_{t+1}-\widehat{m}_t)D_t - \widehat{A^{v}_{t+1}}R^{d}_{t+1}\big(\widetilde{A^{m}_{t+1}}-A^{m}_{t}\big)X_t \\ & +\widehat{A^{v}_{t+1}}R^{d}_{t+1}\big[\Delta A_t-\big(A^{m}_{t+1}-\widetilde{A^{m}_{t+1}}\big)\big]X_t+\big(\widehat{A^{v}_{t+1}}-\widehat{A^{v}_{t+1}}\big)X_t \cdots\cdots\cdots\cdots\cdots (12)\end{aligned}$$

[Table 3] Factor Decomposition and Determinants of Value-added Growth

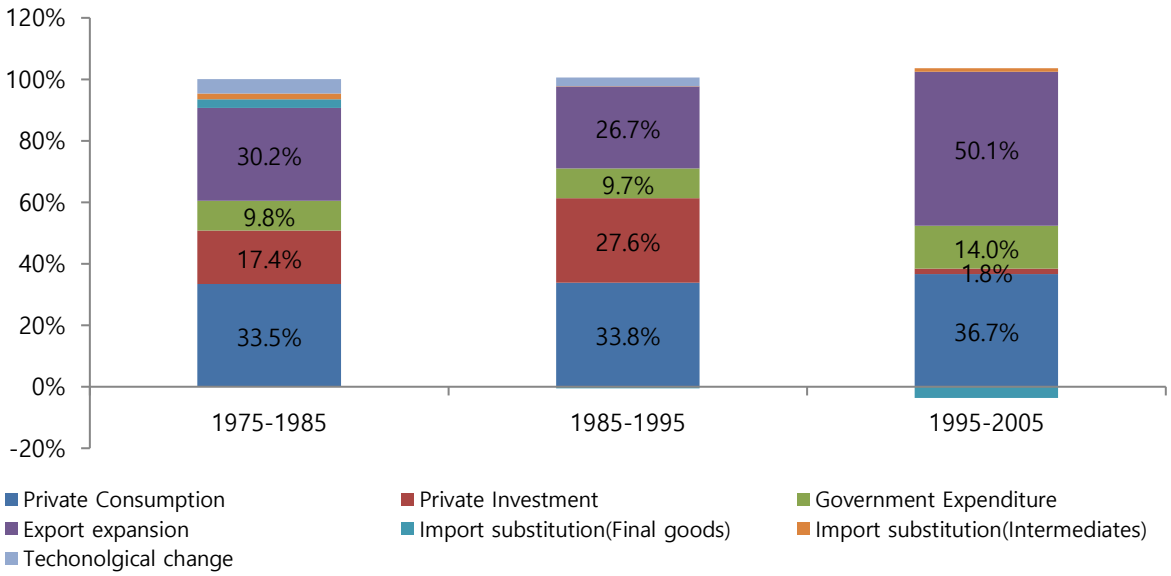
Domestic demand expansion	$\widehat{A^{v}_{t+1}}R^{d}_{t+1}(\mathrm{I}-\widehat{\mathrm{m}}_{\mathrm{t+1}})\Delta\mathrm{D}_{\mathrm{t}}$
Export expansion	$\widehat{A^{v}_{t+1}}R^{d}_{t+1}\Delta\mathrm{EX}_{\mathrm{t}}$
Import substitution (Final goods)	$\widehat{A^{v}_{t+1}}R^{d}_{t+1}(\widehat{\mathrm{m}}_{\mathrm{t+1}}-\widehat{\mathrm{m}}_{\mathrm{t}})\mathrm{D}_{\mathrm{t}}$
Import substitution (Intermediate goods)	$-\widehat{A^{v}_{t+1}}R^{d}_{t+1}\big(\widetilde{\mathrm{A}^{\mathrm{m}}_{\mathrm{t+1}}}-\mathrm{A}^{\mathrm{m}}_{\mathrm{t}}\big)\mathrm{X}_{\mathrm{t}}$
Technological change	$\widehat{A^{v}_{t+1}}R^{d}_{t+1}\big[\Delta\mathrm{A}_{\mathrm{t}}-\big(\mathrm{A}^{\mathrm{m}}_{\mathrm{t+1}}-\widetilde{\mathrm{A}^{\mathrm{m}}_{\mathrm{t+1}}}\big)\big]\mathrm{X}_{\mathrm{t}}$
Value-added share change	$\big(\widehat{A^{v}_{t+1}}-\widehat{A^{v}_{t}}\big)X_t$

2.2 Empirical Results

Figure 6 contains our estimation results based on Equation (11) for the period of 1975-2005.[6]

[6] The Bank of Korea provides the 1975-1980-1985, 1985-1990-1995 and 1995-2000-2005 linked Input-Output Tables in terms of constant prices. Unfortunately, constant prices-based Input-Output

[Figure 6] Factor Decomposition Results I: Output Decomposition

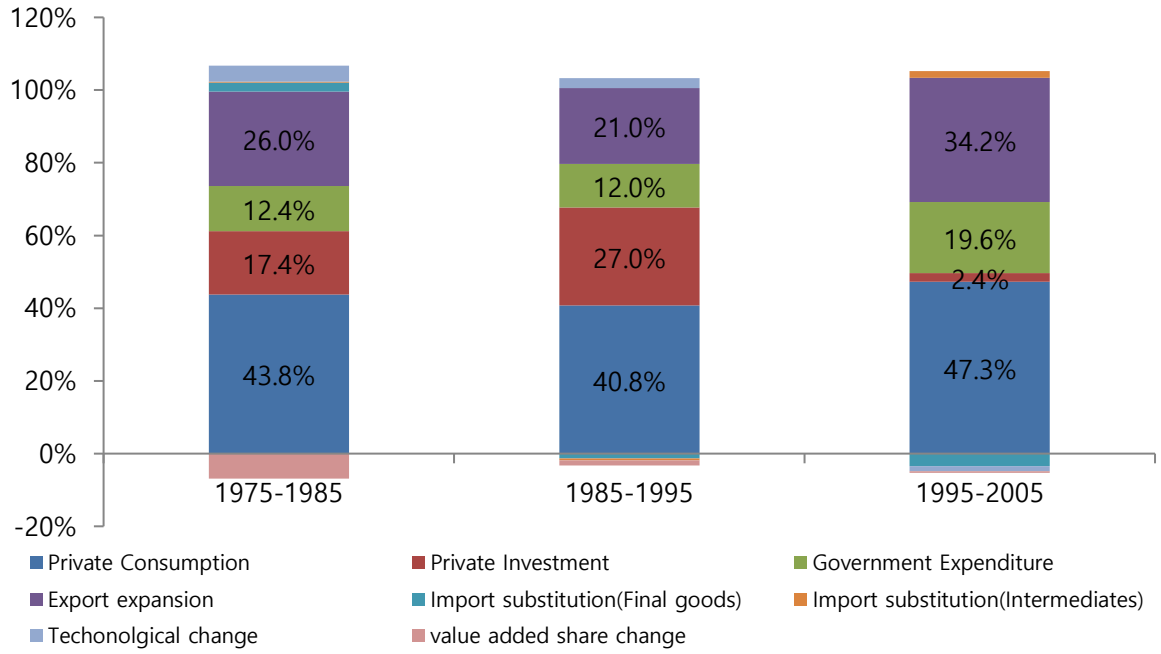


In terms of gross output changes, domestic demand expansion accounted for 60.5 percent over the period of 1975-85, while the contribution of export expansion is 30.2 percent. Among domestic demand components, the contribution of private consumption (33.5 percent) was the highest, followed by private investment (17.4%). On the other hand, the effects from import substitution and technological changes to gross output have been minimal throughout the whole period. For the period of 1995-2005, gross output increases induced by export expansion reached at 50.1 percent.

On the other hand, Figure 7 shows the relative contributions of each component to value-added growth. The impacts of private consumption bigger for value-added growth compared to output growth. The relative shares of export expansion to value-added growth range from 21.0 percent for 1985-95 to 34.2 percent for 1995-05. Even though estimation spans are different from those from the import-adjusted analysis, the sizes of exports' contribution to GDP growth are pretty similar to each other.

Tables are not available prior to or after these periods. Due to this data constraint, we will rely on estimation results pursued by Kim (1995) for the period of 1955-1975, and compare with our findings.

[Figure 7] Factor Decomposition Results II: Value-added Decomposition



In this paper, we further investigate how much each industry contributes to output and value-added growth. The estimation results are reported in Table 4. As we may expect, manufacturing, especially heavy and chemical industries, has been the leading sector for exports-led economic growth, and its relative contribution to gross output amounted to over 70 percent of the total export-induced effects. The importance of heavy and chemical industries has been getting larger over time.

[Table 4] Relative Contributions of Sectoral Export Expansion to Growth

	Output (%)			Value added (%)		
	1975-85	1985-95	1995-05	1975-85	1985-95	1995-05
Agriculture/Mining	1.2%	1.5%	0.4%	2.5%	3.1%	1.0%
Manufacturing	74.2%	72.6%	76.5%	53.6%	54.7%	54.8%
Light Manufacturing	24.2%	13.7%	3.9%	19.3%	11.7%	5.0%
Heavy & Chemicals	50.0%	58.9%	72.6%	34.3%	43.0%	50.0%
Services	20.0%	19.9%	19.4%	39.9%	39.1%	41.5%
Others	4.8%	5.8%	3.7%	4.0%	3.1%	2.8%

As reported in Table 4, the impacts of manufacturing were smaller for value-added growth compared to gross output growth, while those of services sector were much larger. We can interpret this finding as evidence that the service sector provides substantial amount of intermediate inputs to manufacturing exports, such as storage/distribution services, engineering/technical services, and producer services, and thus such indirect contributions from the service sector to overall exports-induced growth are great and even getting more important over time. Finally, we estimate sources of sectoral output and value-added growth and report these results in Appendix.

IV. Summary and Conclusion

This paper empirically examines the impact of exports on economic growth, for the case of Korea since its economic take-off period in 1960s. We adopt two GDP decomposition methods to quantify the contributions of export to GDP growth both in the short term and in the medium term. We find that export's contribution to GDP growth has been substantial. According to the estimation results from the import-adjusted GDP decomposition analysis, the average contribution of net exports to Korea's GDP growth for the period of 1960-2014 is 30.3 percent, which means that net exports accounts for 2.3 percent point per annum of Korea's GDP growth. This figure is truly a remarkable one, taken into consideration that the average growth rates of developed and developing countries were 3.17 percent and 3.37 percent over the last five decades, respectively. We find the similar results from the factor decomposition analysis à la Kubo et al. (1986).

In conclusion, our analytic results generally indicate that the contribution of exports to economic growth has been substantial for the case of Korea. It would be definitely interesting to apply similar analytic approaches to other countries and compare the results with the Korean case. For instance, Tregenna (2012) reports relatively a small role of export expansion in South African economic growth since 2000s. On the other hand, Albala-Bertrand (2016) suggest that export demand and heavy industry appear to be the main engines of the Chinese economy over the period of 1995-2010. Further investigation for a larger set of countries would be needed in order to answer the important policy question whether trade openness or exports really matters for achieving sustainable economic growth.

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[Appendix Table 1] Sources of Output Growth by Industry

	All Sectors	Agriculture	Manufacturing			Services
			Total	Light	HCI	
1975-1985						
Private Consumption	33.5%	82.3%	25.1%	38.5%	17.5%	50.6%
Private Investment	17.4%	16.4%	13.4%	9.2%	15.8%	10.5%
Government Expenditure	9.8%	5.5%	4.3%	2.4%	5.3%	15.4%
Export expansion	30.2%	7.3%	41.9%	37.7%	44.3%	21.3%
Import substitution(Final goods)	2.8%	6.7%	4.7%	1.9%	6.3%	0.0%
Import substitution(Intermediates)	1.9%	-13.7%	4.7%	1.8%	6.4%	-0.1%
Technological change	4.7%	-4.4%	6.0%	8.6%	4.6%	2.5%
1985-1995						
Private Consumption	33.8%	159.8%	26.3%	61.4%	17.1%	49.1%
Private Investment	27.6%	30.7%	27.3%	13.0%	31.1%	15.4%
Government Expenditure	9.7%	19.8%	3.8%	4.6%	3.6%	15.5%
Export expansion	26.7%	42.7%	38.2%	34.6%	39.1%	15.7%
Import substitution(Final goods)	-0.5%	-26.5%	0.4%	-6.3%	2.2%	-1.2%
Import substitution(Intermediates)	0.1%	-50.2%	1.6%	-6.2%	3.6%	-0.5%
Technological change	2.9%	-76.2%	2.6%	-1.0%	3.6%	6.1%
1995-2005						
Private Consumption	36.7%	360.5%	21.1%	78.2%	15.0%	48.7%
Private Investment	1.8%	-55.2%	0.1%	3.3%	-0.3%	5.1%
Government Expenditure	14.0%	59.1%	6.0%	11.5%	5.4%	19.6%
Export expansion	50.1%	95.4%	78.5%	41.4%	82.6%	21.0%
Import substitution(Final goods)	-3.6%	-78.7%	-5.8%	-19.6%	-4.3%	-1.1%
Import substitution(Intermediates))	1.2%	-46.8%	1.9%	3.6%	1.7%	0.5%
Technological change	0.0%	-234.3%	-1.8%	-18.5%	0.1%	6.3%

[Appendix Table 2] Sources of Value-added Growth by Industry

	All Sectors	Agriculture	Manufacturing			Services
			Total	Light	HCI	
1975-1985						
Private Consumption	43.8%	119.8%	26.3%	44.1%	16.3%	61.2%
Private Investment	17.4%	14.5%	14.1%	10.2%	16.3%	12.6%
Government Expenditure	12.4%	9.5%	4.0%	2.8%	4.7%	17.9%
Export expansion	26.0%	11.7%	38.2%	38.5%	38.1%	23.9%
Import substitution (Final goods)	2.5%	12.6%	5.0%	0.7%	7.3%	-0.1%
Import substitution (Intermediates)	0.3%	-21.6%	3.1%	1.7%	3.9%	-0.1%
Technological change	4.4%	-9.9%	6.9%	7.9%	6.4%	3.3%
value added share change	-6.9%	-36.7%	2.6%	-5.7%	7.2%	-18.8%
1985-1995						
Private Consumption	40.8%	409.5%	23.6%	50.8%	15.1%	55.0%
Private Investment	27.0%	83.0%	22.7%	9.9%	26.6%	16.8%
Government Expenditure	12.0%	58.5%	3.2%	3.4%	3.2%	16.5%
Export expansion	21.0%	119.1%	28.2%	25.3%	29.1%	16.6%
Import substitution (Final goods)	-1.4%	-67.8%	-0.8%	-4.8%	0.6%	-1.3%
Import substitution (Intermediate)	-0.5%	-109.7%	0.8%	-3.6%	2.1%	-0.5%
Technological change	2.7%	-277.3%	3.1%	0.5%	3.9%	6.1%
value added share change	-1.4%	-115.3%	19.3%	18.5%	19.5%	-9.1%
1995-2005						
Private Consumption	47.3%	413.9%	25.0%	97.1%	17.0%	52.3%
Private Investment	2.4%	-79.1%	-2.0%	4.5%	-2.8%	5.5
Government Expenditure	19.6%	78.7%	7.2%	15.9%	6.3%	22.0%
Export expansion	34.2%	135.3%	63.5%	56.5%	64.3%	20.2%
Import substitution (Final goods)	-3.5%	-98.0%	-8.3%	-23.6%	-6.6%	-1.0%
Import substitution (Intermediate)	1.8%	-71.1%	4.3%	2.8%	4.5%	1.0%
Technological change	-1.4%	-371.6%	-9.9%	-32.5%	-7.4%	5.6%
value added share change	-0.5%	91.9%	20.2%	-20.7%	24.8%	-5.5%