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CAPITAL IMPORTS, EMPLOYMENT AND ECONOMIC GROWTH
IN A DUALISTIC OPEN ECONOMY: THE CASE OF KOREA

DISSERTATION

Presented in Partial Fulfillment of the Requirements for
the Degree Doctor of Philosophy in the Graduate
School of The Ohio State University

By

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* * * * *

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1979

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LIST OF ABBREVIATIONS

AER : American Economic Review
AESM : Annals of Economic and Social Measurement
EDCC : Economic Development and Cultural Change
EJ : Economic Journal
IEJ : Indian Economic Journal
ILR : International Labor Review
JDS : Journal of Development Studies
JET: Journal of Economic Theory
JIE : Journal of International Economics
JPE : Journal of Political Economy
MS : Manchester School
OEP : Oxford Economic Papers
QJE : Quarterly Journal of Economics
RES : Review of Economic Studies
RESTAT: Review of Economics and Statistics

KDI : Korea Development Institute
EPB : Economic Planning Board (of Korea)
CHAPTER I
INTRODUCTION

The theory of economic dualism deals with the interaction between a traditional sector and a growing modern sector in the process of a economic development. The central feature of dualism is the co-existence of a large agricultural sector and an active and dynamic industrial sector (Fei and Ranis, 1969). The two sectors are distinguished by differences in production functions, factor intensities and rate of technical progress. The pioneering works on dual economy models are Lewis (1954), Ranis and Fei (1961) and Jorgenson (1961, 1967). But the basic idea can be traced to Evgeny Probrazenski, an early Soviet economist (Dixit, 1973).

Since the Solow-Swan type neo-classical growth model deals with only one aggregated sector, it is generally not accepted in application to the developing economy, which has at least two non-aggregative sectors. Accordingly, many economists have developed dualistic economic models to overcome such difficulties and to get closer to the realities in explaining the growth process in developing countries. Many important contributions have been made by other economists, including Zarembka (1970, 1972); Sato and Niho (1971); Kelly, Williamson and Cheetham (1972); Dixit (1970, 1973); and many others. But the major shortcoming of
previous models is that they are closed. For the developing countries, foreign trade has very important effects on development and growth. Foreign capital flows, including advanced technology, have a significant role to play in the growth of less developed countries. In this context, it is desirable to open up the model and, consequently, to develop models of the dualistic open economy. The most interesting such works are those of Paauw and Fei(1973); Bardhan(1970); Hornby(1968); and Mingo(1975).

Analytical models of a developed economy are concerned with allocation of the national product between consumption and investment(Jorgenson,1967). The Uzawa models which specify investment and consumption goods sectors are less useful for studying the low-income economy where the focus is on the relative shift from agricultural or traditional activity to industrial or modern activity(Kelly-Williamson-Cheetham,1972). In models of a less developed economy, the analysis is concerned with the relationship between the growth of income and the growth of population(Jorgenson, 1967). According to some theories of developmental economics the growth of population is a contributing factor because it provides human resources for the growing economy(Sato-Niho,1971). In the Fei-Ranis and Jorgenson type economies(dualistic economy with surplus labor), economic development consists of the reallocation of surplus agricultural workers,
whose contribution to output may have been negligible, to industry where they become productive members of the labor force (Fei-Ranis, 1964).

The dual economy models introduced by Fei-Ranis, Jorgenson and others showed only the conditions for emergence of the industrial sector. But in our theoretical model, the growth path of a dual economy with international trade after the emergence of the industrial sector is developed.

The main objectives of this paper can be briefly stated as follows:

I. Characterization of the Korean economy

II. Explanation of the source of development and growth of the Korean economy in the 1960s and 1970s

III. Development of a dualistic model which is believed to supply a better planning model in the future.

Characteristics of the Korean economy

(1) A dual economy:

Until the early 20th century, the Korean economy consisted primarily of household or cottage industries producing basic consumer goods. But after the Japanese take-over of Korea (1904), modern factories, trade facilities and transportation and communication systems were introduced and established. Yet, there exists an enormous sector where the traditional
production techniques which have been used for several centuries are still applied. Our discussion of the Korean economy is divided into subsectors as follows:

i) Production functions

ii) Labor productivity

iii) Openness to the international market

With the study of these characteristics in mind, the Korean economy is divided into a Y-sector (a traditional sector which is mainly an agricultural sector) and an X-sector (a modern industrial sector). Those two sectors are basically distinguished by production functions. The X-sector experiences a higher rate of technical progress, and labor is asymmetrically allocated with surplus labor in the Y-sector. X-sector is mostly exposed to the international market and the major contribution to the growth of the Korean economy is provided by the X-sector. Consequently, the share of the X-sector in GNP has continuously increased while that of the Y-sector has continuously decreased.

(2) Well-educated labor;

Korea has an exceptionally well-educated labor force relative to other countries at comparable per capita GNP. According to the study by Harbison and Myer(1964), Korea is ranked at level III (semi-advanced country in human resource development) while Korea's per capita GNP is only one-third of the average in that level.
(3) Small farm size;

The average farm size in Korea's agricultural sector is very small compared to other countries. Furthermore, the land is so mountainous that any extension of the cultivative area is seriously limited. This limits Korea's ability to specialize in agricultural goods production. As a result, Korea was a net importer of food and this slowed the growth of the industrial sector throughout the 1960s and the 1970s.

(4) Poor natural resource endowment;

Korea is poorly endowed with natural resources. For example, Korea does not produce crude oil at all, and has to import coal. Imports of crude materials accounted for 34.5% of total imports in 1975. Consequently, the Paauw-Fei type import-substitution or export-promotion growth model is not applicable to Korea.

(5) Openness of the economy;

The Korean economy experienced exceptionally high growth rates for exports during the 1960s and the 1970s. The annual growth rates of exports have been around 30% and the percentage of exports to GNP increased from 5.2% in 1962 to 30.7% in 1974. Imports grew at a comparable rapid rate and the percentage of imports to GNP increased from 16.9% in 1962 to 43.2% in 1974.
Sources of development and growth

We can summarize the major sources of Korea's economic development and growth as follows;

(1) Large foreign capital imports;

Our analysis indicates that foreign capital imports have been the most important factors among others for the development and growth of the Korean economy in the past two decades. Korea imported a tremendous amount of capital during the 1960s and the 1970s (in the form of foreign aid during the immediate post-Korean War period, and in the form of long-term loans after the mid-1960s). There were also several governmental policy initiatives to enhance foreign capital inflow after the mid-1960s. For example, foreign capital imports from abroad are subsidized indirectly by the stable and over-valued foreign exchange rate. Another important policy is the government guarantee system for repayment of foreign loans. This policy enabled Korea's borrowers to borrow easily in the international loan market.

(2) Domestic capital formation;

Domestic capital stock in the industrial sector grew at around 14% annually during the 1966-75 period. (Of course part of that growth consists of imported capital.) To achieve such a rapid accumulation of capital, the
government subsidized domestic capital formation in various ways. For example, the real interest rates on equipment loans by deposit money banks were approximately 2.5%, and they were negative when those loans were made by the Korea Development Bank.

(3) Well-developed human resource;

It is widely recognized that Korea's labor resources contributed greatly to economic development and growth. (Cole and Lyman, 1971) Because of this well-educated labor, the Korean economy has been able to accommodate rapid structural changes in production.

**Salient features in the performance of the Korean economy**

(1) High GNP growth rate;

The Korean economy opened a new chapter in economic growth after the 1st 5-year economic development plan. (The 1st 5-year economic development plan was implemented in 1962 and Korea is in the middle of the 4th 5-year economic development plan period.) The average GNP growth rate during the 1963-75 period was 9.8%, which is considerably higher than the average GNP growth rate before the planning era. (The average GNP growth rate during the 1954-62 period was only 4.2%.) Consequently, the per capita GNP growth rate in the 1963-75 period was 7.3%
while it was only 1.3% during the 1954-62 period.

(2) Completion of the easy import substitution;

The period of the 1950s and the early 1960s is generally referred to as the period of import substitution of non-durable consumer goods. (Kim, K.S. 1975 and Suh, S.T. 1975) As a result, many of the light manufacturing industries that belonged to the category of import substitution industries in the 1950s began exporting in the 1960s.

(3) Rapid growth of exports;

As we indicated earlier, Korea's exports grew more than 30% annually, and the growth rate of manufactured goods export averaged around 67% each year. For that reason recent Korean economic growth has been referred to as "export-led growth".

(4) Fast structural changes;

The ratio of mining and manufacturing products to GNP was 8.7% in 1955, but it has increased to 33.1% in 1975. At the same time, the ratio of primary goods production to GNP decreased from 46.7% in 1955 to 21.6% in 1975.

Basic problems in the Korean economy

Even though the Korean economy has experienced high aggregate growth rates in recent years, several important problems remain:

(1) Under-utilization of labor which is the only surplus production factor in domestic economy;
According to studies by Cho, Y.S. (1963) and Ban, S.H. (1974), the Korean economy has under-employed labor in the agricultural sector. Furthermore, we observed that Korea's labor force is well-educated. Nevertheless, the Korean policies have promoted capital-intensive production methods. This is inconsistent with the economic circumstance in Korea and implies a waste of resources.

(2) Inefficient use of (imported) capital;

It can be easily seen that the optimum amount of foreign capital imports is determined at the point where the marginal efficiency of imported capital equals the social real interest rate, and in equilibrium, the social rate equals the private real rate. But in fact that the private real rates of return on imported capital have been much lower than the social real rate (Table II-22, p.65). This means that Korea has imported foreign capital beyond the socially optimal level. This was the result of various government subsidy policies, and this implies inefficient use of imported capital.

(3) Chronic trade balance deficit;

Even though past economic policies supported import substitution and export promotion (improvement of the balance of trade was one of the development goals in each of the four 5-year economic development plans),
Korea has a chronic trade balance deficit problem. If this situation continues, Korea's borrowing position will deteriorate and future economic growth possibilities will be limited. One of the most important causes of the trade balance deficit has been the pursuasion of capital intensive production techniques and the consequent heavy capital imports requirement. The ratio of imported capital to total imports in Korea was 26.2% in 1975, and the sum of capital imports, imports of raw materials for export and petroleum accounted of 74.6% of total Korea's imports in the same year. Consequently, past export promotion did not contribute greatly to the improvement of the balance of trade deficit.

Implications in the discussion of our model

With the observations of those positive and negative factors for the development and growth of the Korean economy in mind (well-educated labor is positive factor and poor natural resources endowment and mountainous land are negative factors), we develop a dualistic open economy model and address the basic three problems outlined above. The key policy variable is an optimum combination of domestic labor and imported capital. Because of data limitations, extensive regression analysis will not be possible but the basic implications which our model has (Simulation of the model in Ch.V) are as follows:
(1) We can maintain the same (high) rate of GNP growth along the course suggested by our model.

(2) By utilizing resources (labor and imported capital) better, we can enhance the overall efficiency of the domestic economy.

(3) Better utilization of resources implies an adoption of more labor-intensive (by inducing labor from the agricultural sector where they are under-employed to the industrial sector where they are more productive) and less capital intensive production methods, which should alleviate the trade balance deficit problem.

(4) By utilizing domestic resource (labor) better, we can improve export prospects, because we have an international comparative advantage in labor intensive goods production.

(5) By reducing factor market distortions, we can expand the possibilities for growth and development.

I describe the characteristic features and performance of the Korean economy in Chapter II. I also review the current economic planning model of Korea in that chapter. The Korean economy has various features corresponding to the assumptions in dual economy models, and the transition of the Korean economy in the past decade is very similar to the dualistic growth process even though the economic policies during that period did not take into account
the duality of the Korean economy. Korea's economic planning model and development policies were based on the neo-classical Harrod-Domar and two-gap models. Since capital stock dictates the limits to growth, a high priority was given to policies stimulating capital formation. Thus, domestic capital formation and capital imports were subsidized. However, Korea's economic development and growth followed the dualistic process with international trading. The center of gravity of the economy is gradually moving from the static traditional sector to the dynamic industrial sector, and the foreign sector (exports and imports of goods and capital inflow) has played a key role in this transition.

I review and summarize the literature on economic dualism in Chapter III. The purpose of this chapter is to compare and contrast the standard theory with the actual phenomena in Korea. The transition process in Korea is quite similar to the theory in the literature, but a closer analysis shows that Korea's economic situation differs in many respects from the standard assumptions. For example, the necessary and sufficient condition for the development of an industrial sector according to the standard theory is an agricultural surplus and/or raw material exports. But Korea is a net importer of food and raw materials. Consequently, the standard model cannot be directly applied,
and an alternative model is desirable for a better explanation of Korea's economic growth and derivation of policy recommendations in the future.

General assumptions of our theoretical model for the Korean type economy are discussed in Chapter IV. In the first part of Chapter IV, I discuss four major characteristics of the Korean economy. In the second part of Chapter IV, I discuss the neo-classical assumption of a constant capital-output ratio in the industrial sector. Dixit argues that the capital-output ratio is constant asymptotically even in a neo-classical dual model. Dixit's argument is analytically tested and the above neo-classical assumption is accepted in our model. In the third part of Chapter IV, I discuss the growth limit of a closed economy and pave the way to the discussion of an open economy model which is discussed in Chapter V.

Throughout the discussion of economic development and growth, we have three basic strategies;

(1) Labor should migrate toward the industrial sector where it is more productive,

(2) The share of industrial goods production out of total production should be increasing,
(3) In the open economy case, the long-run trade balance equilibrium must be feasible.

In the discussion of a closed economy, we find that the first two goals can be attained in a very limited sense, i.e., more rapid technical progress in the traditional sector than that in the industrial sector is necessary, which is not likely in Korea.

For rapid industrialization and growth, I introduce foreign capital imports into the model. If imported capital can contribute to the reduction of the trade balance deficit, I define the open economy growth policy as feasible. In Chapter V, I discuss the growth path of an open economy. If we can induce agricultural labor to migrate toward the industrial sector whenever a wage rate which is not lower than that in the agricultural sector is offered, the growth rate of the industrial sector can be rewritten in terms of the rate of capital imports. Consequently, if the income elasticity of demand for industrial goods is less than unity, the open economy growth policy is feasible (Fig. V-2). Under such conditions, we derive optimum time paths of capital imports, labor migration and, consequently, economic growth (Fig. V-3).
2-1 General Characteristics

The Traditional Sector

The traditional sector in the Korean economy can be described as follows:

(1) Relatively low farm-household income

To stimulate agricultural production, the Korean government supported farm product prices throughout the 1960's and 70's. The grain price increased 69% between 1970 and 1973, while wholesale prices increased only 32% during the same period. However, farm-household income is far below the salary and wage income in the industrial sector. And the average productivity of labor in the agricultural sector is less than half of the average productivity of labor in the industrial sector. The difference in average productivities between the two sectors has increased in recent years and

1/ The direct comparison of household incomes between the agricultural and the industrial sectors is not quite appropriate to explain the labor productivity difference in two sectors, because some family members of the farm household are employed in businesses other than farming which are included in the category of the industrial sector.
Table II-1

Comparisons of Price Indices and Household Income

<table>
<thead>
<tr>
<th>Year</th>
<th>Grain Whole Farm</th>
<th>Sale</th>
<th>Real Income ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Prices (A)</td>
<td>(B)</td>
<td>(A)</td>
</tr>
<tr>
<td>1961</td>
<td>27.8</td>
<td>35.1</td>
<td>664.3</td>
</tr>
<tr>
<td>1962</td>
<td>29.4</td>
<td>38.4</td>
<td>-</td>
</tr>
<tr>
<td>1963</td>
<td>47.3</td>
<td>46.3</td>
<td>755.7</td>
</tr>
<tr>
<td>1964</td>
<td>60.4</td>
<td>62.8</td>
<td>787.3</td>
</tr>
<tr>
<td>1965</td>
<td>54.7</td>
<td>68.5</td>
<td>618.6</td>
</tr>
<tr>
<td>1966</td>
<td>57.5</td>
<td>74.6</td>
<td>640.8</td>
</tr>
<tr>
<td>1967</td>
<td>64.5</td>
<td>79.4</td>
<td>663.8</td>
</tr>
<tr>
<td>1968</td>
<td>73.1</td>
<td>85.8</td>
<td>714.9</td>
</tr>
<tr>
<td>1969</td>
<td>88.9</td>
<td>91.6</td>
<td>790.8</td>
</tr>
<tr>
<td>1970</td>
<td>100.0</td>
<td>100.0</td>
<td>823.6</td>
</tr>
<tr>
<td>1971</td>
<td>124.9</td>
<td>108.6</td>
<td>1,021.7</td>
</tr>
<tr>
<td>1972</td>
<td>158.3</td>
<td>123.8</td>
<td>1,100.7</td>
</tr>
<tr>
<td>1973</td>
<td>169.0</td>
<td>132.4</td>
<td>1,195.1</td>
</tr>
</tbody>
</table>

Source: Major Statistics of Korean Economy, EPB, 1976

Note: Farm-household income includes not only the income from farming but also the income from side business such as rope production, straw bag production, and other small industries located in farm area. Therefore, if we deduct the side income from the farm-household income, the difference between (A) and (B) will become even larger.

* Korean government started the "New Village Movement" in 1971 to promote the farm-household income. The main purpose of the New Village Movement is to construct new village factories and to specialize them according to the characteristics of those areas. But the employment and product by those industries are included in the industrial sector (Table A3 and A5).
Table II-2

**Average Productivity of Labor**

(1970 U.S.$)

<table>
<thead>
<tr>
<th>Year</th>
<th>Agricultural Sector (A)</th>
<th>Industrial Sector (B)</th>
<th>A/B (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1963</td>
<td>354.1</td>
<td>839.1</td>
<td>42.2</td>
</tr>
<tr>
<td>64</td>
<td>410.1</td>
<td>860.7</td>
<td>47.6</td>
</tr>
<tr>
<td>65</td>
<td>403.4</td>
<td>870.0</td>
<td>46.4</td>
</tr>
<tr>
<td>1966</td>
<td>441.0</td>
<td>925.7</td>
<td>47.6</td>
</tr>
<tr>
<td>67</td>
<td>424.8</td>
<td>973.5</td>
<td>43.6</td>
</tr>
<tr>
<td>68</td>
<td>436.0</td>
<td>1,048.3</td>
<td>41.6</td>
</tr>
<tr>
<td>69</td>
<td>488.1</td>
<td>1,122.6</td>
<td>43.5</td>
</tr>
<tr>
<td>70</td>
<td>482.3</td>
<td>1,172.6</td>
<td>41.1</td>
</tr>
<tr>
<td>1971</td>
<td>494.2</td>
<td>1,257.1</td>
<td>39.3</td>
</tr>
<tr>
<td>72</td>
<td>458.3</td>
<td>1,387.7</td>
<td>33.0</td>
</tr>
<tr>
<td>73</td>
<td>464.2</td>
<td>1,595.6</td>
<td>29.1</td>
</tr>
<tr>
<td>74</td>
<td>488.7</td>
<td>1,688.0</td>
<td>29.0</td>
</tr>
<tr>
<td>75</td>
<td>530.0</td>
<td>1,750.0</td>
<td>30.3</td>
</tr>
</tbody>
</table>

Source: Tables A3 and A5.

reflects capital deepening in the industrial sector. Furthermore, the change in average productivity of labor in Korea's agricultural sector was very low compared to other countries. The average product of labor in agriculture in some selected countries increased more than 20% from 1959-60 to 1963-64, but in Korea, it increased only 13.1% and 2.1% from 1964-67 to 1968-71 period and from 1967-71 to 1972-75 period, respectively.
<table>
<thead>
<tr>
<th>Countries</th>
<th>1959-60 to 1963-64</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>32.5</td>
</tr>
<tr>
<td>Canada</td>
<td>22.2</td>
</tr>
<tr>
<td>Denmark</td>
<td>21.8</td>
</tr>
<tr>
<td>France</td>
<td>23.1</td>
</tr>
<tr>
<td>Germany</td>
<td>27.5</td>
</tr>
<tr>
<td>Italy</td>
<td>37.9</td>
</tr>
<tr>
<td>U.K.</td>
<td>25.5</td>
</tr>
<tr>
<td>U.S.</td>
<td>19.6</td>
</tr>
<tr>
<td>Korea</td>
<td>13.1*</td>
</tr>
<tr>
<td></td>
<td>2.1**</td>
</tr>
</tbody>
</table>


*1964-67 to 1968-71
**1968-71 to 1972-75
(2) Traditional method in farming

Even though the agricultural capital stock increased rapidly in the 1960's, farming tools (farming machines and irrigation) represent only 20% of total agricultural fixed capital (in late 1960's), while the rest of the agricultural capital consists of farm building, perennial trees and cattle. Among farming tools (plowing and levelling machines), only 7.6% are operated by electric power.

Table II-4

Fixed Capital in the Agricultural Sector

<table>
<thead>
<tr>
<th>Year</th>
<th>Total (A)</th>
<th>Farming Machine (B)</th>
<th>Irrigation (C)</th>
<th>Others*</th>
<th>(B+C) / A (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1960</td>
<td>96,265</td>
<td>4,066</td>
<td>4,642</td>
<td>87,557</td>
<td>9.0</td>
</tr>
<tr>
<td>61</td>
<td>90,009</td>
<td>3,410</td>
<td>4,470</td>
<td>82,129</td>
<td>8.8</td>
</tr>
<tr>
<td>62</td>
<td>84,740</td>
<td>5,044</td>
<td>2,181</td>
<td>77,515</td>
<td>8.5</td>
</tr>
<tr>
<td>63</td>
<td>91,040</td>
<td>5,421</td>
<td>1,877</td>
<td>83,742</td>
<td>8.0</td>
</tr>
<tr>
<td>64</td>
<td>70,557</td>
<td>6,973</td>
<td>1,654</td>
<td>61,920</td>
<td>12.2</td>
</tr>
<tr>
<td>65</td>
<td>70,882</td>
<td>7,538</td>
<td>2,725</td>
<td>60,619</td>
<td>14.5</td>
</tr>
<tr>
<td>1966</td>
<td>79,557</td>
<td>8,549</td>
<td>4,933</td>
<td>71,002</td>
<td>10.7</td>
</tr>
<tr>
<td>67</td>
<td>82,651</td>
<td>9,582</td>
<td>5,619</td>
<td>67,450</td>
<td>18.4</td>
</tr>
<tr>
<td>68</td>
<td>85,828</td>
<td>10,628</td>
<td>6,463</td>
<td>88,737</td>
<td>20.0</td>
</tr>
<tr>
<td>69</td>
<td>125,381</td>
<td>12,307</td>
<td>20,015</td>
<td>93,059</td>
<td>25.8</td>
</tr>
<tr>
<td>70</td>
<td>121,530</td>
<td>14,449</td>
<td>14,531</td>
<td>92,550</td>
<td>23.9</td>
</tr>
<tr>
<td>1971</td>
<td>135,396</td>
<td>16,983</td>
<td>11,136</td>
<td>107,277</td>
<td>20.1</td>
</tr>
</tbody>
</table>


*Farm building, perennial trees, and cattle horse power.
Table II-5

Agricultural Implements

<table>
<thead>
<tr>
<th>Year</th>
<th>Plowing &amp; Levelling Machine (A)</th>
<th>(Power Tiller) B/A (%)</th>
<th>Pump Power</th>
<th>Weeder</th>
</tr>
</thead>
<tbody>
<tr>
<td>1961</td>
<td>617,873 (30) (0.0)</td>
<td>3,736</td>
<td>219,774</td>
<td></td>
</tr>
<tr>
<td>1962</td>
<td>844,706 (93) (0.01)</td>
<td>12,292</td>
<td>353,624</td>
<td></td>
</tr>
<tr>
<td>1963</td>
<td>862,645 (386) (0.04)</td>
<td>13,171</td>
<td>305,610</td>
<td></td>
</tr>
<tr>
<td>1964</td>
<td>951,939 (653) (0.07)</td>
<td>15,350</td>
<td>394,720</td>
<td></td>
</tr>
<tr>
<td>1965</td>
<td>979,243 (1,111) (0.11)</td>
<td>26,029</td>
<td>400,530</td>
<td></td>
</tr>
<tr>
<td>1966</td>
<td>1,002,296 (1,555) (0.15)</td>
<td>29,929</td>
<td>430,337</td>
<td></td>
</tr>
<tr>
<td>1967</td>
<td>994,363 (3,819) (0.38)</td>
<td>31,613</td>
<td>450,078</td>
<td></td>
</tr>
<tr>
<td>1968</td>
<td>1,029,154 (6,225) (0.60)</td>
<td>37,796</td>
<td>477,549</td>
<td></td>
</tr>
<tr>
<td>1969</td>
<td>1,022,440 (8,832) (0.86)</td>
<td>49,534</td>
<td>512,199</td>
<td></td>
</tr>
<tr>
<td>1970</td>
<td>1,014,836 (11,884) (1.17)</td>
<td>54,078</td>
<td>511,039</td>
<td></td>
</tr>
<tr>
<td>1971</td>
<td>1,036,439 (16,842) (1.63)</td>
<td>57,896</td>
<td>483,853</td>
<td></td>
</tr>
<tr>
<td>1972</td>
<td>1,031,612 (24,786) (2.40)</td>
<td>60,616</td>
<td>455,382</td>
<td></td>
</tr>
<tr>
<td>1973</td>
<td>1,061,203 (37,660) (3.55)</td>
<td>61,193</td>
<td>436,948</td>
<td></td>
</tr>
<tr>
<td>1974</td>
<td>1,121,744 (85,722) (7.64)</td>
<td>65,993</td>
<td>459,129</td>
<td></td>
</tr>
</tbody>
</table>

Source: Major Statistics of Korean Economy, EPB, 1976

(3) Small farm sizes

The average farm size in Korea's agricultural sector is less than 1 ha\(^2\) which is very small compared to other countries. For example, the average farm size in the Netherlands is 12.7 ha, and in France and Germany, only 10.4% and 17.2% of total farm areas are under 10 ha, respectively. Only 11% of total farm area is under 20 ha in the United Kingdom.\(^3\)

\(^2\)"Major Statistics of Korean Economy", 1976, EPB
\(^3\)"Structural Reform Measures in Agriculture", OECD, 1972
Static Phenomena

(1) Surplus labor in the agricultural sector

There are two different assumptions regarding surplus labor. In the classical model (Lewin, Fei-Ranis), it is assumed that the marginal product of labor in the traditional sector is zero (that redundant labor exists). But in the neo-classical model (Jorgenson), it is assumed that the marginal product of labor in the traditional sector is less than the institutionally determined wage rate (subsistence wage rate), but it is greater than zero. In Korea, the Economic Planning Board (EPB) defines labor employment as follows:  

"All persons of 14 years old and over who did any work during the reference period before census date for pay of profit, including unpaid family workers and persons who had a job but did not work temporarily."

The figures in Table II-6 are based on this definition.

If we compare these figures with "The Report of the Results of Farm Household Economy Survey and Production Cost Survey" which was conducted by the Ministry of Agriculture and Fishery (of Korea), we can find disguised unemployment in the agricultural sector. The explicit comparison was made by Hong, W.T. (1976, p.29), and an adjusted table was constructed by him (Table II-7). Another independent study was made by Ban, S.H. (1974) and it is

4/"Korea Statistical Yearbook", EPB, 1976, p.65
### Table II-6

**Labor Employment**

(thousand persons)

<table>
<thead>
<tr>
<th>Year</th>
<th>(1) Year</th>
<th>(2) Total Labor</th>
<th>(3) Labor Employed</th>
<th>(4) Labor in Primary Sec.</th>
<th>(4)/(3) (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1965</td>
<td>8,343</td>
<td>7,662</td>
<td>4,837</td>
<td>4,825</td>
<td>63.7</td>
</tr>
<tr>
<td>1966</td>
<td>9,071</td>
<td>8,423</td>
<td>4,876</td>
<td>58.6</td>
<td></td>
</tr>
<tr>
<td>1967</td>
<td>9,295</td>
<td>8,717</td>
<td>4,811</td>
<td>55.2</td>
<td></td>
</tr>
<tr>
<td>1968</td>
<td>9,647</td>
<td>9,155</td>
<td>4,801</td>
<td>52.4</td>
<td></td>
</tr>
<tr>
<td>1969</td>
<td>9,888</td>
<td>9,414</td>
<td>4,825</td>
<td>51.3</td>
<td></td>
</tr>
<tr>
<td>1970</td>
<td>10,199</td>
<td>9,745</td>
<td>4,916</td>
<td>50.4</td>
<td></td>
</tr>
<tr>
<td>1971</td>
<td>10,542</td>
<td>10,066</td>
<td>4,876</td>
<td>48.4</td>
<td></td>
</tr>
<tr>
<td>1972</td>
<td>11,058</td>
<td>10,559</td>
<td>5,546</td>
<td>50.6</td>
<td></td>
</tr>
<tr>
<td>1973</td>
<td>11,600</td>
<td>11,139</td>
<td>5,566</td>
<td>50.0</td>
<td></td>
</tr>
<tr>
<td>1974</td>
<td>12,080</td>
<td>11,586</td>
<td>5,584</td>
<td>48.2</td>
<td></td>
</tr>
<tr>
<td>1975</td>
<td>12,340</td>
<td>11,830</td>
<td>5,425</td>
<td>45.9</td>
<td></td>
</tr>
</tbody>
</table>

Source: Major Statistics of Korean Economy, EPB, 1976

### Table II-7

**Adjusted Labor Employment**

(million persons)

<table>
<thead>
<tr>
<th>Year</th>
<th>EPB</th>
<th>Farm House Survey*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1966</td>
<td>4.88</td>
<td>3.42</td>
</tr>
<tr>
<td>1970</td>
<td>4.92</td>
<td>2.80</td>
</tr>
</tbody>
</table>

Source: EPB and Hong, W. T. (1976)

*Based on 8-hour work per day and 280 days per year.
### Table II-8

**Surplus Labor in the Agricultural Sector**  
(1000 persons)

<table>
<thead>
<tr>
<th>Year</th>
<th>Economic Labor Adjusted</th>
<th>Active Labor Adjusted</th>
<th>Surplus Labor</th>
<th>Surplus Labor**</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Actual Number</td>
<td>Man-equivalent Unit*</td>
<td>Labor-input to Farming</td>
<td>(A)</td>
</tr>
<tr>
<td>1960</td>
<td>5,107</td>
<td>4,285</td>
<td>2,234</td>
<td>2,051</td>
</tr>
<tr>
<td>61</td>
<td>5,025</td>
<td>4,228</td>
<td>2,349</td>
<td>1,879</td>
</tr>
<tr>
<td>62</td>
<td>5,249</td>
<td>4,441</td>
<td>2,059</td>
<td>2,382</td>
</tr>
<tr>
<td>63</td>
<td>5,281</td>
<td>4,474</td>
<td>2,239</td>
<td>2,239</td>
</tr>
<tr>
<td>64</td>
<td>5,441</td>
<td>4,606</td>
<td>2,315</td>
<td>2,291</td>
</tr>
<tr>
<td>65</td>
<td>5,437</td>
<td>4,606</td>
<td>2,335</td>
<td>2,271</td>
</tr>
<tr>
<td>1966</td>
<td>5,426</td>
<td>4,509</td>
<td>2,341</td>
<td>2,168</td>
</tr>
<tr>
<td>67</td>
<td>5,315</td>
<td>4,484</td>
<td>2,328</td>
<td>2,156</td>
</tr>
<tr>
<td>68</td>
<td>5,329</td>
<td>4,475</td>
<td>2,168</td>
<td>2,307</td>
</tr>
<tr>
<td>69</td>
<td>5,228</td>
<td>4,332</td>
<td>2,096</td>
<td>2,236</td>
</tr>
<tr>
<td>70</td>
<td>5,109</td>
<td>4,234</td>
<td>2,010</td>
<td>2,224</td>
</tr>
<tr>
<td>1971</td>
<td>4,918</td>
<td>4,050</td>
<td>2,031</td>
<td>2,019</td>
</tr>
</tbody>
</table>


*Actual labor force is converted into man-equivalent unit according to the following Table (which is based on 8-hour work a day and 280 working days a year.)*

<table>
<thead>
<tr>
<th>Ages</th>
<th>14</th>
<th>15-19</th>
<th>20-54</th>
<th>55-59</th>
<th>60-64</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td>M</td>
<td>F</td>
<td>M</td>
<td>F</td>
<td>M</td>
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<td>0.2</td>
<td>0.7</td>
<td>0.6</td>
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</table>

**Adjusted by deducting the family workers employed to side businesses.**
summarized in Table II-8. Both studies show that there are a number of under-employed workers in Korea's agricultural sector.

Jorgenson (1969) argues that the implications of classical assumption (existence of redundant labor in the traditional sector) are declining employment in the agricultural sector, and constant labor productivity in the industrial sector (as long as there exists redundant labor in the agricultural sector.) But, he argues that historical evidence from Japan and other European countries shows that the above assumption is inappropriate. Jorgenson claims that the absolute amount of labor in the agricultural sector is constant or moderately rising in the process of development.

When we look at the absolute number of workers employed in the agricultural sector, we find that it is rising moderately. As Table II-7 shows, when we convert the labor employment data into labor employment based on man-hour input, employment declines almost 30% (because the agricultural labor employment has large seasonal fluctuations). In other words, workers in the agricultural sector are not employed on a full-time basis throughout the year, but only during the planting and harvesting period. Subsequently, if we removed some of them from the agricultural sector, total agricultural output would decline. In other
words, the marginal product of labor in Korea's agricultural sector is not zero. This view was analyzed by Cho, Y.S. (1963) who concluded that there does not exist disguised unemployment as defined in the classical theory in Korea's agricultural sector.

(2) Mountainous land

Korea is one of the most densely populated countries in the world (Table II-9). The land is so mountainous that only one-fifth of total land is under cultivation, and any extension of that area is seriously limited (Table II-10).

Dynamic Phenomena

(1) Center of gravity of the economy moves from the traditional sector to the industrial sector.

When we divide the Korean economy into two sectors— the traditional sector (Y) and the industrial sector (X) — the share of value added of the traditional sector decreased from 61.6% in 1961 to 40.3% in 1970, and to 29.6% in 1975 (Table A6, 6th column). Accordingly, the total output growth was primarily associated with the industrial sector.

(2) Labor force is continuously released from the traditional sector to the industrial sector.

Even though the absolute number of workers employed in
Table II-9

**Population Density**
(persons/km² in 1972)

<table>
<thead>
<tr>
<th>Country</th>
<th>Density</th>
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<td>Taiwan</td>
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<td>Japan</td>
<td>286</td>
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</tr>
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<td>326</td>
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<td>U.K.</td>
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<td>Venezuela</td>
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<td>Canada</td>
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</tr>
<tr>
<td>U.S.A.</td>
<td>22</td>
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</table>


Table II-10

**Utilization Status of National Land Area**
(%)  

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<tr>
<th>Year</th>
<th>Total</th>
<th>Cultivated</th>
<th>Forest</th>
<th>Other</th>
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<td></td>
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<td>21</td>
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<td></td>
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<td>67</td>
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<td>100</td>
<td>22</td>
<td>67</td>
</tr>
<tr>
<td></td>
<td>71</td>
<td>100</td>
<td>23</td>
<td>67</td>
</tr>
<tr>
<td></td>
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<tr>
<td></td>
<td>75</td>
<td>100</td>
<td>23</td>
<td>67</td>
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</table>

Source: Major Statistics of Korean Economy, EPB, 1976
the traditional sector increasing moderately (Table A3, 4th column), labor employment in the traditional sector accounted for 75.6% of the total employment in 1963, 62.5% in 1970 and only 58.2% in 1975 (Table A3, 9th column). Employment in the industrial sector accounted for 24.3% of total employment in 1963, 37.5% in 1970 and 41.8% in 1975.

(3) Decreasing capital-output ratio in the industrial sector.

According to the classical view of dualism, the capital-output ratio in the industrial sector will decrease as long as there exists redundant labor in the traditional sector. In contrast, the neo-classical view says that the capital-output ratio will remain constant. The latter view was criticized by Dixit (1970), who showed that the capital-output ratio should be decreasing in the early stage of development even if we accept the neo-classical assumption. In the case of Korea, the capital-output ratio in the industrial sector decreased continuously (except 1969-71) throughout in 1960's. (Table A5, 7th column)\(^5\)

Openness of the Economy

(1) Increasing export and import ratios to GNP

One of the most salient features of the Korean economy

\(^5\)This is discussed more rigorously in Chapter IV.
is an exceptionally high growth rate of exports. Exports grew more than 30% per annum throughout the 1960's and 70's. Consequently, the percentage of exports to GNP increased from 3.5% in 1962 to 28.4% in 1975. The percentage of imports to GNP increased from 11.6% to 27.5% during the same period.

(2) Rapid growth of manufactured good exports and raw materials and capital good imports.

Exports of raw materials decreased relative to total exports, while exports of manufactured goods increased sharply. Table II-11 shows that the ratio of mining goods exports to total exports decreased from 38.4% in 1961 to 1.3% in 1973. But the ratio of manufactured goods exports to total exports of industrial goods (exports from the X-sector) increased from 52.7% in 1961 to 98.6% in 1973. In other words, exports increased considerably, and export-substitution^6 accelerated during this period.

In Table II-12, Korea's growth rate of manufactured exports is compared with several large less-developed countries. Manufactured goods exports in Korea grew 67% per annum during 1962-69 period compared to 32.5% in Taiwan and 29.5% in Brazil. The share of manufacturing in total

---

^6^Paauw and Fei(1973) define "export-substitution" as the substitution of manufactured goods exports for raw material exports.
### Table II-11
Composition of Exports and Imports by Type (%)

<table>
<thead>
<tr>
<th>Year</th>
<th>Ex/EX</th>
<th>(Exm/EX)</th>
<th>Emfg/Ex</th>
<th>Mk/IM</th>
<th>Mr/IM</th>
</tr>
</thead>
<tbody>
<tr>
<td>1961</td>
<td>81.3</td>
<td>(38.4)</td>
<td>52.7</td>
<td>13.4</td>
<td>-</td>
</tr>
<tr>
<td>62</td>
<td>68.8</td>
<td>(23.0)</td>
<td>66.6</td>
<td>16.5</td>
<td>-</td>
</tr>
<tr>
<td>63</td>
<td>86.7</td>
<td>(17.8)</td>
<td>79.3</td>
<td>20.6</td>
<td>-</td>
</tr>
<tr>
<td>64</td>
<td>88.9</td>
<td>(17.3)</td>
<td>82.5</td>
<td>17.2</td>
<td>1.7</td>
</tr>
<tr>
<td>65</td>
<td>89.9</td>
<td>(13.6)</td>
<td>84.8</td>
<td>12.9</td>
<td>2.2</td>
</tr>
<tr>
<td>66</td>
<td>88.3</td>
<td>(10.8)</td>
<td>87.9</td>
<td>24.0</td>
<td>14.1</td>
</tr>
<tr>
<td>67</td>
<td>89.4</td>
<td>(8.8)</td>
<td>90.2</td>
<td>31.1</td>
<td>13.6</td>
</tr>
<tr>
<td>68</td>
<td>92.6</td>
<td>(7.4)</td>
<td>92.0</td>
<td>36.4</td>
<td>14.6</td>
</tr>
<tr>
<td>69</td>
<td>92.6</td>
<td>(5.7)</td>
<td>93.8</td>
<td>32.5</td>
<td>16.3</td>
</tr>
<tr>
<td>70</td>
<td>93.9</td>
<td>(5.2)</td>
<td>94.4</td>
<td>29.7</td>
<td>19.5</td>
</tr>
<tr>
<td>1971</td>
<td>95.0</td>
<td>(3.4)</td>
<td>96.4</td>
<td>28.6</td>
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<tr>
<td>72</td>
<td>95.9</td>
<td>(2.1)</td>
<td>97.8</td>
<td>30.2</td>
<td>27.3</td>
</tr>
<tr>
<td>73</td>
<td>96.1</td>
<td>(1.3)</td>
<td>98.6</td>
<td>27.3</td>
<td>36.7</td>
</tr>
<tr>
<td>74</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>27.0</td>
<td>29.8</td>
</tr>
</tbody>
</table>

Source: Table A8

**EX** = Total Exports  
**Ex** = Industrial good exports  
**Exm** = Mining good exports  
**IM** = Total Imports  
**Mk** = Capital good imports  
**Mr** = Raw material good imports (for exports)
### Table II-12

**Manufactured Good Exports**  
(Selected Large LDC's)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td></td>
<td>26.0</td>
<td>6.3*</td>
<td>13.7</td>
</tr>
<tr>
<td>Brazil</td>
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<td>29.5</td>
<td>1.7</td>
<td>11.3</td>
</tr>
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<td>Iran</td>
<td></td>
<td>8.7</td>
<td>5.1</td>
<td>3.2</td>
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<td>Malaysia</td>
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<td>10.6</td>
<td>5.4</td>
<td>7.9</td>
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<td>Mexico</td>
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<td>9.4</td>
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<td>12.7</td>
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<tr>
<td>Korea</td>
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<td>76.2</td>
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<td>Taiwan</td>
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<td>32.5</td>
<td>46.2</td>
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<tr>
<td>Yugoslavia</td>
<td></td>
<td>12.1</td>
<td>49.7</td>
<td>59.6</td>
</tr>
</tbody>
</table>

*Source: Tyler, W.G. (1976) p.359 (Table 1)*

* 57 - 62
commodity exports increased from 5.9% in 1955 to 76.2% in 1969 which is the second highest level in the sample.

Imports of capital goods and raw materials for exports increased rapidly relative to total imports. As a result, the ratio of capital good imports to total imports increased from 17.2% in 1964 to 27.3% in 1973. The ratio of raw material imports increased from 1.7% in 1964 to 36.7% in 1973.

2-2 Overview and Performance of the Korean Economy

Overview of the Korean Economy: 1953-75

Until the early 20th century, the Korean economy consisted primarily of household or cottage industries producing basic consumer goods. After the Japanese take-over of Korea (1904), Korea served as a source of agricultural and mineral resources for Japan and as a market for Japanese manufactures.

During the Korean War (1950-53), the physical damage to property in Korea was severe and most heavy industrial plants located in the northern part of the Korean peninsula were occupied by communists after the War. Consequently, the basic problem after the Korean War was to provide for immediate emergency consumption needs and to rebuild the badly damaged economy. For that purpose, large scale economic aid was provided by the U.S. government, the United Nations and other private agencies.
**Table II-13**

**Summary of Foreign Economic Aid Received**

<table>
<thead>
<tr>
<th>Year</th>
<th>Total</th>
<th>U.S.A.</th>
<th>GARICA</th>
<th>ECA/SEC</th>
<th>FLEXCO</th>
<th>AID</th>
<th>SUN</th>
<th>SKO</th>
<th>UNKRA</th>
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</thead>
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<td>179,593</td>
<td>92,703</td>
<td>23,703</td>
<td>49,330</td>
<td>74,448</td>
<td>9,376</td>
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<tr>
<td>1949</td>
<td>116,509</td>
<td>92,703</td>
<td>79,593</td>
<td>23,703</td>
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<td>92,703</td>
<td>79,593</td>
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<td>106,542</td>
<td>92,703</td>
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<td>79,593</td>
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<td>79,593</td>
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<td>49,330</td>
<td>74,448</td>
<td>9,376</td>
<td>122</td>
<td></td>
</tr>
</tbody>
</table>

**Source:** Economic Statistics Yearbook, 1975, BOK

- **GARICA =** Government and Relief in Occupied Area
- **ECA =** Economic Cooperation Administration
- **SEC =** Supplies Economic Cooperation
- **CRIK =** Civil Relief in Korea
- **SUN =** Supplies, United Nations
- **SKO =** Supplies for Korean Organization
- **UNKRA =** United Nations Korean Reconstruction Agency
During and after the Korean War, foreign aid consisted largely of food and consumer goods. Capital imports were mainly for reconstruction and rehabilitation of the war damaged economy and for national defense. Accordingly, annual GNP growth rates during the late 1950's and early 60's were relatively low (about 3.6% annually in the 1958-62 period).

The basic functions of foreign aid in Korea changed as the economic policies of the U.S. and the socio-economic and political conditions in Korea changed. Suh, S.T. (1967) divides the period 1945-75 into five sub-periods of foreign aid according to the basic functions of the aid:

i) The USAMGIK period (U.S. Army Military Government in Korea) (1945-48) and GARIOA and UNKRA

ii) Before the Korean War (1948-50) by ECA of FAA (Foreign Assistant Act of 1948)

iii) The Korean War (1950-53) by SEC, CRIK, UNKRA, and AFAK (Armed Forces Assistance to Korea)

iv) Post-War reconstruction period (1954-60) by CRIK, PL 480, and ECA of MSA (Mutual Security Act of 1954)

v) Rapid industrialization period (1961-present) by AID of FAA (Foreign Assistance Act of 1961)

Broadly speaking, he suggests that, the foreign aid to Korea serves two main objectives: (1) aid for economic...
reconstruction and industrial growth, and (2) aid for economic development and growth (started in 1961 by AID along with the food aid by PL 480).

As a result of both foreign aid and various domestic policies, the Korean economy began a new chapter of economic growth in 1960's. As Table II-15 shows, the average annual growth rate of GNP in the 1960's was 8.7% which is double that of the 1950's (after the Korean War). Since the population growth rate was much less than the GNP growth, the per capita income growth in the 1960's was more than four times that of the 1950's. When we compare the average annual growth rates between the period of development planning and the earlier period, we observe a more than doubling of the average growth rate. Furthermore, during the 1960's and 70's, exports have been growing at around 30% annually compared to 10.5% in the 1950's. The annual import growth rates fluctuated widely throughout the post-war period. Imports in the 1950's depended largely on the availability of foreign aid and imports in the 1960's and 70's depended on the availability of foreign loans and domestic development policies. Based on the average rates of export and import growth, one might suspect that Korea has pursued export promotion as well as import substitution policies during the 1960's and 70's. Even though the Korean

---

### Table II-14

**GNP and Population of Korea**

<table>
<thead>
<tr>
<th>Year</th>
<th>GNP (mill.$)</th>
<th>Growth (%)</th>
<th>Population (mill. persons)</th>
<th>Per Capita GNP ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1953</td>
<td>2,715.8</td>
<td></td>
<td>21.05</td>
<td>130.4</td>
</tr>
<tr>
<td>1954</td>
<td>2,866.0</td>
<td>5.5</td>
<td>21.27</td>
<td>134.7</td>
</tr>
<tr>
<td>1955</td>
<td>3,020.7</td>
<td>5.4</td>
<td>21.50</td>
<td>140.5</td>
</tr>
<tr>
<td>1956</td>
<td>3,033.5</td>
<td>0.4</td>
<td>22.15</td>
<td>137.0</td>
</tr>
<tr>
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<td>3,266.1</td>
<td>7.7</td>
<td>22.82</td>
<td>143.1</td>
</tr>
<tr>
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<td>3,435.8</td>
<td>5.2</td>
<td>23.51</td>
<td>146.1</td>
</tr>
<tr>
<td>1959</td>
<td>3,568.4</td>
<td>3.9</td>
<td>24.22</td>
<td>147.3</td>
</tr>
<tr>
<td>1960</td>
<td>3,637.2</td>
<td>1.9</td>
<td>24.95</td>
<td>145.8</td>
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<tr>
<td>1961</td>
<td>3,813.5</td>
<td>4.8</td>
<td>25.50</td>
<td>148.9</td>
</tr>
<tr>
<td>1962</td>
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<td>3.1</td>
<td>26.23</td>
<td>149.6</td>
</tr>
<tr>
<td>1963</td>
<td>4,276.6</td>
<td>8.8</td>
<td>26.99</td>
<td>158.5</td>
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<td>4,642.6</td>
<td>8.6</td>
<td>27.68</td>
<td>167.7</td>
</tr>
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<td>1965</td>
<td>4,925.0</td>
<td>6.1</td>
<td>28.33</td>
<td>173.8</td>
</tr>
<tr>
<td>1966</td>
<td>5,535.0</td>
<td>12.4</td>
<td>28.96</td>
<td>188.0</td>
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<tr>
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<td>5,965.9</td>
<td>7.8</td>
<td>29.54</td>
<td>198.0</td>
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<tr>
<td>1968</td>
<td>6,719.6</td>
<td>12.6</td>
<td>30.17</td>
<td>217.9</td>
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<tr>
<td>1969</td>
<td>7,728.6</td>
<td>15.0</td>
<td>30.74</td>
<td>245.0</td>
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<tr>
<td>1970</td>
<td>8,336.3</td>
<td>7.9</td>
<td>32.24</td>
<td>258.6</td>
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<tr>
<td>1971</td>
<td>9,101.3</td>
<td>9.2</td>
<td>32.88</td>
<td>276.8</td>
</tr>
<tr>
<td>1972</td>
<td>9,734.8</td>
<td>7.0</td>
<td>33.51</td>
<td>290.5</td>
</tr>
<tr>
<td>1973</td>
<td>11,341.7</td>
<td>16.5</td>
<td>34.10</td>
<td>332.6</td>
</tr>
<tr>
<td>1974</td>
<td>12,316.5</td>
<td>8.6</td>
<td>34.69</td>
<td>355.0</td>
</tr>
<tr>
<td>1975</td>
<td>13,294.7</td>
<td>7.9</td>
<td>35.28</td>
<td>376.8</td>
</tr>
</tbody>
</table>

*All dollar values are in the 1970 U.S. Dollars*

Source: Korea Statistical Yearbook (Various Issues), EPB
Table II-15

Major Indicators of Korean Economy

(1) Various Growth Rates (%)

<table>
<thead>
<tr>
<th>Year</th>
<th>GNP (%)</th>
<th>Per Capita</th>
<th>Primary</th>
<th>Min. &amp; Manuf.</th>
<th>EX (%)</th>
<th>IM (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1954-60</td>
<td>4.3</td>
<td>1.4</td>
<td>2.4</td>
<td>12.4</td>
<td>10.5</td>
<td>0.7</td>
</tr>
<tr>
<td>1961-70</td>
<td>8.7</td>
<td>6.2</td>
<td>4.7</td>
<td>15.9</td>
<td>30.8</td>
<td>21.2</td>
</tr>
<tr>
<td>1971-75</td>
<td>9.8</td>
<td>7.8</td>
<td>4.6</td>
<td>18.4</td>
<td>29.5</td>
<td>12.8</td>
</tr>
</tbody>
</table>

*All are annual average growth rates based on the 1970 constant price.

*EX and IM stand for total exports and imports of products.

(2) Industrial Compositions (%)

<table>
<thead>
<tr>
<th>Year</th>
<th>Primary</th>
<th>Mining and Manufacturing</th>
<th>Social Overhead Capital</th>
</tr>
</thead>
<tbody>
<tr>
<td>1955</td>
<td>46.7</td>
<td>8.7</td>
<td>44.6</td>
</tr>
<tr>
<td>1962</td>
<td>40.3</td>
<td>13.3</td>
<td>46.4</td>
</tr>
<tr>
<td>1966</td>
<td>38.9</td>
<td>15.9</td>
<td>45.2</td>
</tr>
<tr>
<td>1970</td>
<td>28.0</td>
<td>22.8</td>
<td>49.2</td>
</tr>
<tr>
<td>1975</td>
<td>21.6</td>
<td>33.1</td>
<td>45.3</td>
</tr>
</tbody>
</table>

*All values are based on the 1970 constant price.

*All values are ratios of industrial outputs to GNP.
(3) Various Ratios to GNP(%)  

<table>
<thead>
<tr>
<th>Year</th>
<th>Tax*</th>
<th>Domestic</th>
<th>Foreign</th>
<th>EX**</th>
<th>IM**</th>
</tr>
</thead>
<tbody>
<tr>
<td>1955</td>
<td>6.1</td>
<td>4.9</td>
<td>7.0</td>
<td>1.4</td>
<td>11.2</td>
</tr>
<tr>
<td>1962</td>
<td>10.8</td>
<td>1.6</td>
<td>10.8</td>
<td>3.5</td>
<td>11.6</td>
</tr>
<tr>
<td>1966</td>
<td>10.8</td>
<td>11.8</td>
<td>8.5</td>
<td>7.1</td>
<td>13.8</td>
</tr>
<tr>
<td>1970</td>
<td>15.4</td>
<td>16.3</td>
<td>9.7</td>
<td>14.7</td>
<td>24.8</td>
</tr>
<tr>
<td>1975</td>
<td>17.1</td>
<td>18.0</td>
<td>11.3</td>
<td>28.4</td>
<td>27.5</td>
</tr>
</tbody>
</table>

*Based on current market price  
**Based on the 1970 constant price  

(4) Labor Employment(%)  

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Labor</th>
<th>Employed Labor</th>
<th>Employed in Primary Sector</th>
<th>Employed in Non-Primary Sector</th>
</tr>
</thead>
<tbody>
<tr>
<td>1963</td>
<td>100</td>
<td>91.8</td>
<td>58.0</td>
<td>33.8</td>
</tr>
<tr>
<td>1966</td>
<td>100</td>
<td>92.9</td>
<td>53.8</td>
<td>39.1</td>
</tr>
<tr>
<td>1970</td>
<td>100</td>
<td>95.5</td>
<td>48.2</td>
<td>47.3</td>
</tr>
<tr>
<td>1975</td>
<td>100</td>
<td>95.9</td>
<td>44.0</td>
<td>51.9</td>
</tr>
</tbody>
</table>

SOURCE: Korea Statistical Yearbook (Various Issues), EPB
government has used various measures for import substitution. The ratio of imports to GNP has increased as GNP increased. This is due in part to the fact that the Korean economy is poorly endowed with natural resources, and has had to import capital and various intermediate goods in order to develop import substitutes. Given the high rate of export growth, the ratio of exports to GNP increased from 1.4% in 1955 and 3.5% in 1962, to 28.4% in 1975. The rapid rise in the ratio of exports to GNP through 1975 suggests that exports have played an important role in the recent remarkable growth of the Korean economy.

The changes in industrial components of total value added have been even more remarkable. The share of primary sector output (agriculture, forestry and fishery) in GNP decreased from 46.7% in 1955 to 40.3% in 1962 to 21.6% in 1975. The share of mining and manufacturing increased from 8.7% in 1955 to 13.3% in 1962 and to 33.1% in 1975. Social overhead and other service sector components remained a fairly constant share of GNP (around 46%) throughout the post war period.  

9/Some economists suggest that the growth pattern of the Korean economy was unusual. (e.g., Frank, Kim, Westphal (1975, p. 98) say that the speed of structural changes of the Korean economy is unusually fast.) When we compare the change of the industrial composition of the Korean economy with Chenery and Taylor’s findings (Chenery and Taylor, 1968), we find that the Korean economy follows the standard pattern. According to Chenery and Taylor, the development patterns are fairly similar between the cross-section
The ratios of tax and savings to GNP increased steadily and that fact is pointed out as one of the most important factors influencing Korea's superior economic performance, because of the saving constraint on economic growth in Korea.

The observed primary sector and manufacturing sector growth rates and labor migration from the primary sector to non-primary sector in the Korean economy correspond to the dualistic process of growth and structural change. The structural changes that occurred in the 1960's were widely recognized as essential elements in the process of moving from impoverishment and stagnation toward self-sustaining growth.

_Policy Instruments for Economic Development and Growth_

(1) Inward- and outward-looking development strategies and their limits

Inward-looking development strategy is represented by domestic import substitution. Outward-looking strategy is usually represented by the size of the share of exports to GDP. But there are some arguments about the importance

(cont.) and the time series data. One of their findings is that the shares of primary (including mining) and manufacturing sectors are equal at 27% when the per capita income is $280. Those shares were equalized in Korea at around 26% (in 1972) and the per capita GNP at that time was $290.

10/ Strout (1969), p.286
and/or the interpretation of these development strategies. For example, Bhagwati, J. and Cheh, J. (1972) show from their cross-sectional analysis of LDC's that large countries (in terms of population and GDP) tend to have lower export shares, and small countries tend to have higher export shares. A country which adds very little value added to domestic materials or imported materials and hence has a low ratio of manufacturing value added in GDP could have a very high ratio of exports to GDP. Balassa, B. (1972) tried to explain the change of development strategies historically. He noted that several Latin American and Asian countries, in the post-war period, carried out an "inward-looking" import substitution strategy in manufacturing behind high protective barriers, and he argued that that was successful during the period of easy import substitution when imports of non-durable consumer goods and the intermediate goods used in manufacturing were replaced by domestic production that required unskilled and simi-skilled labor rather than sophisticated technological methods. However, he argued with special reference to Korea and Taiwan that once practically all such imports had been replaced, they started to develop new sources of industrial growth by turning to import substitution in other intermediate products such as machinery and durable consumer goods. Accordingly, they needed skilled
workers and technicians along with capital intensive sophisticated technological methods of production. Consequently, policies to stimulate investment were emphasized.

Since Korea (as well as Taiwan) has poor natural resource endowments, she had to import most intermediate and capital goods to achieve import substitution in machinery and durables. Therefore, export-promotion (outward-looking) strategy had to accompany import substitution in the later stage of development, because exports were the eventual source of foreign exchange for imports of intermediate and capital goods in the long-run.11

The Korean economy seems to have followed exactly the same path as Balassa pointed out. The period of the 1950's and early 60's in Korea (more specifically during 1953-61) is generally referred to as the period of import substitution of non-durable consumer goods.12 The Korean government accomplished that easy import substitution by adopting a multiple foreign exchange rate system. By extending controls over the foreign exchange rate, the government applied a preferential exchange rate for urgent and necessary imports and established high rates for luxury and competitive goods imports. In addition, internal tax

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11/ The need of foreign exchange in Korea was particularly severe since, as Fei and Ranis(1975) pointed out, Korea had to import agricultural goods as well as industrial intermediate and capital goods as income increased.
12/ Kim, K.S. (1975) and Suh, S.T. (1975)
exemption and preferential loans were offered to the producers of import competitive goods, and high tariffs and a strong quota system were employed to protect domestic import substitution industries. As a result, many of the light manufacturing industries that belonged to the category of import substituting industries in the 1950's began exporting in the 1960's. That gradual shift may be an indication of the success of import substitution policies in Korea.13

As foreign aid tapered off and as import substitution on non-durable consumer goods neared completion, the Korean economy initiated export promotion in industrial intermediate and durable consumer goods. The first step in export promotion was devaluation of the Korean "won". As the Korean won became over-valued in the course of import substitution, exports were discouraged. Devaluation of the Korean won occurred twice in 1961, from 65 won to 100 won per U.S. dollar in January and again from 100 won to 130 won per dollar in May. The critical reform of the foreign exchange system followed in 1964. The Korean won devalued again from 130 won to 250 won per dollar in May 1964 and a unitary floating exchange rate system was formally put into effect in March 1965. The floating exchange system was not a perfectly freely fluctuating .

system, but rather a controlled (or a dirty float) system and the foreign exchange rate was pegged at 370 Korean won per dollar in June, 1971 and again devalued to 400 won per dollar in 1972. The floating rate under control was 484 won per dollar as of late 1975 (the basic exchange rate by the Bank of Korea). After the adoption of this floating exchange rate system, the Korean government gradually relaxed trade control and a switch was made from the "positive list system" to the "negative list system" reflecting a general move toward free trade.

As Table II-16 shows, the main source of imports in the 1950's was foreign aid and, after 1964, the importance of foreign aid as the source of import funds decreased rapidly. As the export-import ratio shows, exports became an increasingly important source of import funds, and foreign loan took the place of foreign aid, particularly after 1966.

In addition to devaluing the Korean won with respect to the U.S. dollar, the Korean government adopted several other measures to encourage exports despite an over-valued Korean won. For example, imports of intermediate goods for export production were exempted from tariffs, and

14/Under the positive list system, only those commodities listed in the trade program could be imported. In contrast, under the negative system, those commodities listed in the trade program required government approval to import and others not listed were automatically approved.
Table II-16

Imports by Source of Funds

<table>
<thead>
<tr>
<th>Year</th>
<th>Total</th>
<th>Commercial</th>
<th>Foreign Aid</th>
<th>Loans</th>
<th>Others</th>
<th>EX/IM</th>
</tr>
</thead>
<tbody>
<tr>
<td>1953</td>
<td>345.4</td>
<td>153.6</td>
<td>191.8</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1954</td>
<td>243.3</td>
<td>93.9</td>
<td>149.4</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1955</td>
<td>341.4</td>
<td>108.6</td>
<td>232.8</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1956</td>
<td>386.1</td>
<td>66.2</td>
<td>319.9</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1957</td>
<td>442.2</td>
<td>46.9</td>
<td>374.0</td>
<td>-</td>
<td>21.2</td>
<td>-</td>
</tr>
<tr>
<td>1958</td>
<td>378.2</td>
<td>48.7</td>
<td>311.0</td>
<td>-</td>
<td>18.5</td>
<td>-</td>
</tr>
<tr>
<td>1959</td>
<td>303.8</td>
<td>81.0</td>
<td>210.7</td>
<td>-</td>
<td>12.1</td>
<td>-</td>
</tr>
<tr>
<td>1960</td>
<td>343.5</td>
<td>97.2</td>
<td>231.9</td>
<td>-</td>
<td>14.4</td>
<td>-</td>
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<tr>
<td>1961</td>
<td>316.1</td>
<td>103.1</td>
<td>196.8</td>
<td>-</td>
<td>16.2</td>
<td>14.4</td>
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<tr>
<td>1962</td>
<td>421.8</td>
<td>179.0</td>
<td>218.5</td>
<td>4.5</td>
<td>19.7</td>
<td>14.0</td>
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<td>560.3</td>
<td>232.7</td>
<td>232.6</td>
<td>52.1</td>
<td>42.8</td>
<td>17.5</td>
</tr>
<tr>
<td>1964</td>
<td>404.4</td>
<td>184.5</td>
<td>142.6</td>
<td>34.6</td>
<td>42.6</td>
<td>32.6</td>
</tr>
<tr>
<td>1965</td>
<td>463.4</td>
<td>248.4</td>
<td>135.5</td>
<td>31.5</td>
<td>48.2</td>
<td>42.1</td>
</tr>
<tr>
<td>1966</td>
<td>716.4</td>
<td>401.9</td>
<td>143.6</td>
<td>108.4</td>
<td>62.5</td>
<td>36.8</td>
</tr>
<tr>
<td>1967</td>
<td>996.2</td>
<td>673.5</td>
<td>119.2</td>
<td>167.3</td>
<td>36.2</td>
<td>36.8</td>
</tr>
<tr>
<td>1968</td>
<td>1,462.9</td>
<td>964.4</td>
<td>125.7</td>
<td>299.6</td>
<td>73.1</td>
<td>36.8</td>
</tr>
<tr>
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<td>1,823.6</td>
<td>1,087.1</td>
<td>120.5</td>
<td>475.7</td>
<td>140.4</td>
<td>39.9</td>
</tr>
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<td>1970</td>
<td>1,984.0</td>
<td>1,256.3</td>
<td>161.2</td>
<td>400.2</td>
<td>166.4</td>
<td>48.9</td>
</tr>
<tr>
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<td>2,394.3</td>
<td>1,615.6</td>
<td>105.6</td>
<td>541.4</td>
<td>131.8</td>
<td>52.0</td>
</tr>
<tr>
<td>1972</td>
<td>2,522.0</td>
<td>1,702.2</td>
<td>21.7</td>
<td>628.6</td>
<td>169.4</td>
<td>74.0</td>
</tr>
<tr>
<td>1973</td>
<td>4,240.3</td>
<td>3,318.8</td>
<td>-</td>
<td>628.4</td>
<td>292.9</td>
<td>85.2</td>
</tr>
<tr>
<td>1974</td>
<td>6,851.8</td>
<td>5,554.5</td>
<td>-</td>
<td>638.8</td>
<td>658.5</td>
<td>70.0</td>
</tr>
<tr>
<td>1975</td>
<td>7,274.4</td>
<td>5,903.0</td>
<td>-</td>
<td>886.7</td>
<td>484.7</td>
<td>75.0</td>
</tr>
</tbody>
</table>

1/Based on customs clearance c.i.f.
2/Relief goods and disposed by U.N. Forces in Korea
3/Sum of AID, PL480 and others
4/Ratio of total exports to total imports which is based on balance of payments

Source: Korea Statistical Yearbook, (Various Issues), EPB
exporters were permitted to convert their export earnings into foreign exchange certificates that were bought and sold at a high premium on the exchange market. Furthermore, the government granted direct subsidies to exporters and allowed them loans from commercial banks at preferential interest rates.15

In line with this export promotion strategy of the 1960's, various policies to promote import substitution of durables and intermediate goods were adopted. Together, export promotion and import substitution in the 1960's resulted in a remarkable change in the composition of GNP. (Table II-15-2)

Briefly speaking, to enhance the rapid development and growth of the industrial sector (and the economy as a whole) once the easy import substitution was accomplished, Korea had to import capital goods and intermediate goods to further import substitution in durable consumer goods and other equipment. Foreign aid which had been the most important source of imports in the 1950's tapered off in the 1960's. Korea could not depend on such foreign aid forever, so the government turned its development strategy to export promotion along with the import substitution. Korea also found it necessary to import raw materials and

15/McKinnon(1976) points out that the preferential interest rates allowed exporters is the main source of inconsistency among the external trade policy and internal monetary policy. This is discussed in more detail in the next sub-section.
**Table II-17**

**Types of Exports**

(In million $)

<table>
<thead>
<tr>
<th>Year</th>
<th>Total</th>
<th>Commercial</th>
<th>Bonded Process</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Million$</td>
<td>Million$</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(%)</td>
<td>(%)</td>
<td></td>
</tr>
<tr>
<td>1953</td>
<td>39.6</td>
<td>39.6</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1954</td>
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<td>-</td>
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<td>-</td>
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<td>86.8</td>
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<tr>
<td>1964</td>
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<tr>
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<td>259.6</td>
<td>49.8 (15.6)</td>
<td>10.9</td>
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<tr>
<td>1968</td>
<td>455.4</td>
<td>356.3</td>
<td>87.0 (19.1)</td>
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<tr>
<td>1969</td>
<td>622.5</td>
<td>478.9</td>
<td>130.7 (21.0)</td>
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<tr>
<td>1970</td>
<td>835.2</td>
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<tr>
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<tr>
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<tr>
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<td>4,460.4</td>
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<td>61.5</td>
</tr>
<tr>
<td>1975</td>
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<td>3,899.7</td>
<td>1,101.5 (21.7)</td>
<td>79.8</td>
</tr>
</tbody>
</table>

*Source: Korea Statistical Yearbook, 1976, EPB*
Table II-18

Imports by Type of Goods

<table>
<thead>
<tr>
<th>Year</th>
<th>Capital Goods</th>
<th>Raw Materials for Exports</th>
<th>Raw Materials for Domestic Use</th>
<th>Petroleum</th>
<th>Total</th>
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<tbody>
<tr>
<td>1961</td>
<td>13.4</td>
<td>-</td>
<td>86.6</td>
<td>-</td>
<td>100</td>
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<td>62</td>
<td>16.5</td>
<td>-</td>
<td>76.7</td>
<td>6.7</td>
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<tr>
<td>63</td>
<td>20.6</td>
<td>-</td>
<td>75.2</td>
<td>4.2</td>
<td>100</td>
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<tr>
<td>64</td>
<td>17.2</td>
<td>1.7</td>
<td>74.7</td>
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<td>100</td>
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<td>65</td>
<td>12.9</td>
<td>2.2</td>
<td>78.6</td>
<td>6.2</td>
<td>100</td>
</tr>
<tr>
<td>1966</td>
<td>24.0</td>
<td>14.1</td>
<td>56.2</td>
<td>5.7</td>
<td>100</td>
</tr>
<tr>
<td>67</td>
<td>31.1</td>
<td>13.6</td>
<td>49.3</td>
<td>6.0</td>
<td>100</td>
</tr>
<tr>
<td>68</td>
<td>36.4</td>
<td>14.6</td>
<td>44.0</td>
<td>5.0</td>
<td>100</td>
</tr>
<tr>
<td>69</td>
<td>32.5</td>
<td>16.3</td>
<td>45.3</td>
<td>5.9</td>
<td>100</td>
</tr>
<tr>
<td>70</td>
<td>29.7</td>
<td>19.5</td>
<td>44.1</td>
<td>6.7</td>
<td>100</td>
</tr>
<tr>
<td>1971</td>
<td>28.6</td>
<td>21.1</td>
<td>42.4</td>
<td>7.9</td>
<td>100</td>
</tr>
<tr>
<td>72</td>
<td>30.2</td>
<td>27.3</td>
<td>33.9</td>
<td>8.6</td>
<td>100</td>
</tr>
<tr>
<td>73</td>
<td>27.4</td>
<td>36.7</td>
<td>28.9</td>
<td>7.0</td>
<td>100</td>
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<tr>
<td>74</td>
<td>27.0</td>
<td>29.8</td>
<td>28.3</td>
<td>14.9</td>
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<tr>
<td>75</td>
<td>26.3</td>
<td>30.0</td>
<td>25.4</td>
<td>18.3</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: Major Statistics of Korean Economy, 1976, EPB

intermediate goods for the production of exportables.

Export promotion itself was limited by the foreign exchange constraint. Once again, the logical chain can be summarized as follows: Korea needed capital goods imports to effect import substitution and economic growth. Korea had to promote exports, but to promote exports, it
Figure II-1
Imports by Types
was necessary to import more capital equipment, intermediate inputs and raw materials. In addition, Korea had to increase agricultural imports as the economy and income grew.

Table II-17 shows the increasing weight of bonded good exports out of total exports. There were no bonded good exports in the 1950's and the weight was only 1.8% in 1962, but it increased to 23.9% in 1974 and 21.7% in 1975. And as Table II-18 and Fig.II-1 show, the weight of capital goods imported to total imports increased from 13.4% in 1961 to 36.4% in 1968 (as the peak) and 26.3% in 1975. The weight of raw materials imports used for exportables production increased throughout the 1960's and 70's (1.7% in 1964 to 30% in 1975). In contrast, the relative weight of raw material imports for domestic use decreased from 86.6% in 1961 to 25.4% in 1975. The increase of net food imports as the economy and income grew was one of the factors which tightened the foreign exchange constraint.

(2) Monetary policies in the 1960's

Another remarkable policy change in the 1960's was the financial reformation in September 1965. The main

16/ The weight of raw material exports (mining products) out of total exports is more than 50% up to 1957 and around 40% up to 1961 but it reduced to 1.3% in 1975. (Table A8)
17/ This is discussed in more detail in Chapter IV.
purpose of that reformation was to increase and mobilize domestic investment funds and to reduce the dependency of domestic investment on foreign saving. The financial reformation involved raising the (nominal) interest rate so that it kept pace with the domestic rate of inflation and induced the individual consumer to save through organized financial institutions. That was the impetus for growth of the Korean financial system and, as a result, the financial system has been one of the leading forces in Korea's highly successful economic development and growth.

In the course of the financial reformation, the (nominal) interest rates on loans increased from 16% to 26% (while the preferential rates to exporters remained at low levels) and the interest rate on savings was raised to 36% maximum. Because of this drastic change in banking interest rates on loans, business firms turned to foreign loans and direct investments from abroad, and savers switched their savings from high risk unorganized money markets to organized money markets with low risk. The former effect led to a further freeing up of the economy and the latter effect improved domestic fund mobilization and allocation through organized channels. Consequently, funds could be efficiently allocated to meet more urgent needs.

As Table II-19 shows, bank savings deposits doubled in 1966, just after the financial reform, (compared to
### Table II-19

**Time and Savings Deposit**

<table>
<thead>
<tr>
<th>Year</th>
<th>Deposits (in bil. won)</th>
<th>Deposits GNP (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1961</td>
<td>5.4</td>
<td>1.8</td>
</tr>
<tr>
<td>1962</td>
<td>12.2</td>
<td>3.5</td>
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<tr>
<td>1963</td>
<td>12.8</td>
<td>2.6</td>
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<td>1964</td>
<td>14.5</td>
<td>2.1</td>
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<td>1965</td>
<td>30.6</td>
<td>3.8</td>
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<tr>
<td>1966</td>
<td>70.1</td>
<td>6.8</td>
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<tr>
<td>1967</td>
<td>128.9</td>
<td>10.2</td>
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<tr>
<td>1968</td>
<td>255.5</td>
<td>16.0</td>
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<tr>
<td>1969</td>
<td>451.5</td>
<td>21.7</td>
</tr>
<tr>
<td>1970</td>
<td>576.3</td>
<td>22.3</td>
</tr>
<tr>
<td>1971</td>
<td>708.7</td>
<td>22.5</td>
</tr>
<tr>
<td>1972</td>
<td>911.5</td>
<td>23.6</td>
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<tr>
<td>1973</td>
<td>1,214.2</td>
<td>24.8</td>
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<tr>
<td>1974</td>
<td>1,450.6</td>
<td>21.5</td>
</tr>
<tr>
<td>1975</td>
<td>1,910.6</td>
<td>21.0</td>
</tr>
</tbody>
</table>

Source: Major Statistics of Korean Economy, 1976, EPB

1965) and grew to 6 times its original volume in 1975. The ratio of savings deposit to GNP was only 2.1% in 1964 and 3.8% in 1965; but, it increased to 6.8% in 1966 and 22.3% in 1970. It appears that this financial reform was very successful in its primary purpose of mobilizing domestic investment.
But the high interest rates on domestic loans weakened the competitive ability of domestic industries in general. In addition, to guarantee the profits of commercial banks, the Korean government could not maintain high interest rates on savings. Thus, the interest rates to loans declined to 22% in 1971 and 19% in 1972 and 15.5% in 1973. (The interest rates on loans for exports remained around 6% regardless of the financial reform.) The interest rates on time deposits have declined from 25.2% in 1968 to 21.3% in 1971, and 15% in 1974.

The financial reform did not induce all domestic funds to enter the organized money market. So, the government introduced another reform in August 1973. This time, the government froze all high interest rate bearing private liabilities for five years. (That is, the government suspended repayment of all loans from private lenders for five years.) This second action by the government contributed greatly to the improvement of business firms' financial structure.

Even though the financial reform in 1965 was considered very important to economic development in Korea, it conflicted with some other development policies. The most serious conflict is pointed out by McKinnon (1976). The relationship between the domestic inflation rate and real interest rate is discussed in Chapter IV.
finance extended to the exporters for a variety of purposes (raw materials purchased, extension of trade credit to consumers, and so on) carried a nominal interest rate of 6% in comparison to the standard bank lending rate of 15.5% in 1973. The immediate impact of that kind of interest rate differential is that the demand for export credit will increase rather than diminish (because exports have been growing relative to GNP). Insofar as credit subsidies to exporters create a balance of payments surplus, the resulting accumulation of exchange reserves expands the monetary base and results in the central bank's loss of monetary control and virtually guarantees continued rapid price inflation in Korea. Consequently, even though the 1965 monetary reform aimed at channelling savings to the organized money markets and mobilizing funds to mid-term or long-term projects such as plant and equipment expenditures, the above contradiction among monetary tools leads to a somewhat negative effect which deviated from the original purpose. Furthermore, the inflationary pressure (generated by the foreign sector) made it more difficult to channel the increased flow of savings into long-term projects.
Economic planning is a political-economic process that draws together the techniques of economic analysis and the forces of consensus-building, decision-making, and action-taking that are the heart of the political process. Korea's economic development and growth in the 1960's and 70's was largely the outcome of a series of economic development plans which started in 1962.

The Economic Planning Models

(1) The Mahalanobis-Feldman model

For the capital-limited economy, we can refer to the "Mahalanobis-Feldman Model" The general assumptions of this model are:

i) Two sectors: consumption good and investment good sectors

ii) Leontief type production functions with surplus labor

iii) Constant average productivities of capital in both sectors in the planning period.

From these assumptions, the structural equations in the model can be written as follows:

19/ Cole and Lyman (1971) p.203
20/ Bronfenbrenner (1960) and Ezekial (1966)
\[ Y_t = C_t + I_t \]
\[ C_t = F(K,L) = f(K) \]
\[ I_t = I(K,L) = i(K) \]
\[ K_t = K(I) \]

where

- \( Y \) is total output,
- \( C \) is consumption good output,
- \( I \) is investment good output, and
- \( K \) is the total capital stock.

Consequently,

\[ C_t = f(K) = f[K(I)] = c(I) \]
\[ I_t = i(K) = i[K(I)] = i(I) \]

Now, for the growth of the economy,

\[ \Delta I_t = \beta_i \lambda_i I_{t-1} \]
\[ \Delta C_t = \beta_c \lambda_c I_{t-1} \]

Thus,

\[ \Delta Y_t = \Delta I_t + \Delta C_t = (\beta_i \lambda_i + \beta_c \lambda_c)I_{t-1} \]

where \( \beta_i \) and \( \beta_c \) are average productivities of capital in their respective sectors and \( \lambda_i \) and \( \lambda_c \) are investment fund allocation coefficients (\( \lambda_i + \lambda_c = 1 \)). Therefore,
From this equation, we can determine the critical value of \( \lambda_1 \). In other words, if

\[
\lambda_1 = \frac{\alpha_0 Y_0 \beta_c}{\beta_1 c_0 + \alpha_0 Y_0 \beta_c}
\]

the economic growth rate is constant. If \( \lambda_1 \) is larger than the above critical value, the growth rate accelerates and vice versa. This conclusion results in the "Mahalanobis Paradox": even though capital is more productive in the consumption good production industry, the more investment funds are allocated to the investment good production industry, the higher the economic growth rate in the long-run.

The main weakness of this model is that the demand side is not explicitly dealt with and only the supply of output determines the growth rate of the economy. But the value of this model lies in its demonstration of the importance of investment for long-run economic growth.

21/ Recall \( \dot{Y}/Y = \dot{I}/I \), and

\[
Y_1 = Y_0 + \Delta Y_1 = Y_0 + (\beta_1 \lambda_1 + \beta_c \lambda_c) I_0
\]
\[
Y_2 = Y_1 + (\beta_1 \lambda_1 + \beta_c \lambda_c) I_1 = Y_1 + (\beta_1 \lambda_1 + \beta_c \lambda_c)(1+\lambda_1 \beta_1) I_0
\]

since \( I_1 = (1+\lambda_1 \beta_1) I_0 \), and so on and so forth. Finally,

\[
Y_t = Y_0 + (\beta_1 \lambda_1 + \beta_c \lambda_c)[1+(1+\lambda_1 \beta_1)+ \cdots +(1+\lambda_1 \beta_1)^{t-1}] I_0
\]

Thus,

\[
Y_t = Y_0 \left[1 + \alpha_0 \frac{\beta_1 \lambda_1 + \beta_c \lambda_c}{\lambda_1 \beta_1} (1+\lambda_1 \beta_1)^{t-1}\right], \quad \text{where} \quad \alpha_0 = I_0/Y_0.
\]
(2) The Harrod-Domar Model

One of the most popular theories in modern economic development and growth literature is the Harrod-Domar model. The two-gap model of Chenery and Strout (1966) is the open economy model of Harrod-Domar. The economic development plans of Korea during the 1960's and 70's were, I would say, largely based on these two theories.

The Harrod-Domar model22 can be described by the following structural equations:

Leontief type production function:

$$Y_t = \min. \left( \frac{K_t}{\nu}, \frac{L_t}{b} \right)$$

Saving Function:

$$S_t = sY_{t-1}$$

Output market equilibrium condition:

$$I_t = S_t$$

Demand for Capital:

$$K_t = \nu Y_t$$

Supply of Capital:

$$K_t = K_{t-1} + I_t$$

where $\nu$ is average capital-output ratio, $b$ is average labor-output ratio, $s$ is average propensity to save.

22/Harrod (1939) and Domar (1946)
For the equilibrium growth path, the following condition must be fulfilled:
\[ I_t = \Delta K_t = v \Delta Y_t = S_t = s Y_{t-1} \]
Consequently,
\[ \frac{\Delta Y_t}{Y_{t-1}} = \frac{s}{v} \]
or, from
\[ K_t = v Y_t \]
\[ \frac{dK_t}{dt} = I_t = v \frac{dY_t}{dt} = S_t = s Y_{t-1} \]
Thus,
\[ \frac{dY_t}{dt} = \frac{s}{Y_{t-1}} \]
This result indicates that the economic growth rate depends positively on the propensity to save and negatively on the capital-output ratio. Once again, the model demonstrates the importance of the supply of investment funds in promoting rapid growth.

The Chenery-Strout's "Two-Gap Model" shows the possibility of higher economic growth in such a savings-constrained economy by introducing foreign saving. From the simple national income account,
\[ M - X = I - S, \]
the left-hand side is an external gap and the right-hand side is an internal gap. Assume \( \bar{M} \) and \( \bar{I} \) are required imports and investment for the target GNP growth and if \( \bar{M} - X \) is
larger than $\overline{I}-S$ ex ante, the external gap binds the rate of economic growth and vice versa.

These principles have supplied the theoretical background for the economic development plans and policy formation in Korea. But as will be pointed out in the next sub-section, the above models do not explain the effects we have seen in the previous section of intra and inter-industrial change on economic growth. Furthermore, these models cannot explain the role of international trade in the economic development and growth the Korean economy experienced in the 1960's and 70's. Only capital formation (investment and saving) plays a key role in the Harrod-Domar and Two-Gap models, and the role of labor which was Korea's most important growth factor is ignored.²³

Review of Korea's Planning Model

Various policy models were developed and proposed in the early 60's by many Korean and foreign economic advisers (especially by economists from the World Bank Group). Among

²³/A more extensive application of the two-gap model to the Korean economy was conducted by Kim, S.H. (1970). He concludes that foreign capital played an important role in Korea's economic development, and if the total investment had been financed solely by domestic savings, the average growth rate would have been 2.9% during 1957-68, but with the help of foreign capital, the actual growth was 7.4%.
them, the model which most contributed to the formulation of the second and third five-year economic development plans is the "Adelman and Kim Model". The "Macro-planning Model for the Third Five-Year Plan" is merely an extension and elaboration of the original Adelman and Kim model.

The Adelman and Kim model is based on Chenery-Strout's two-gap approach. The main question in the Second Five-Year Plan was "How to maximize the growth rate?". With the growth rate spurt in 1963, policy makers were concerned that the high rate of growth had caused the domestic inflation and also resulted in an enormous foreign debt. The two-gap approach to economic development plans is consistent with these facts.

Adelman and Kim tried to answer the following three basic questions: (1) Is there sufficient potential savings to finance the investment requirements necessary to attain the target economic growth rate for the Korean economy? (2) Which sets of money and fiscal policies must be adopted for the goal? (3) In the short-run, which combination of policies and targets appear optimal for minimizing net foreign capital inflows?

The model consists of primary, mining and manufacturing, social overhead and service sectors, and in each

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25/ Economic Planning Board (of Korea), 1972
sector Leontief type production functions are assumed, where labor input is not scarce. This was the first macro-economic model ever applied to the Korean economy. Although the model works well in forecasting the Korean economy, there are several weak points when explaining the development of the Korean economy. This becomes clear upon examination of the structural equations.

The frame-work of Korea's planning model can be summarized as follows:

Notations

\[ V = \text{Gross national product} \]

\[ C = \text{Aggregate consumption} \]

\[ I = \text{Aggregate private investment} \]

\[ S = \text{Total saving (} S_p + S_G \text{)} \]

\[ S_p = \text{Private saving} \]

\[ S_G = \text{Government saving} \]

\[ G = \text{Government expenditure} \]

\[ T = \text{Taxation} \]

\[ EX = \text{Export} \]

\[ IM = \text{Import} \]

\[ M_k = \text{Imports of capital goods} \]

\[ M_c = \text{Imports of consumer goods} \]

\[ i = \text{ICOR (incremental capital-output ratio)} \]

\[ s_p = \text{propensity to save of private sector} \]

\[ s_G = \text{propensity to save of government} \]

\[ p = \text{Domestic price level} \]
Structure of the model

Aggregate supply and demand:

\[ V = C + I + G + EX - IM \]

Demand for investment and supply of savings:

\[ I = i(V) \]

\[ S = S_p + S_G \]

\[ S_p = s_p(V-T) \]

\[ S_G = s_G T \]

Foreign sector:

\[ M_k = M_k(I,p) \]

\[ M_c = M_c(V-T,p) \]

\[ IM = M_k + M_c \]

\[ EX = EX \]

Equilibrium condition:

\[ I - S = IM - EX \quad \text{or,} \]

\[ I - (S_p + S_G) = M_k + M_c - EX \]

Since Korea is considered a labor surplus country, labor supply does not constrain growth, and, accordingly, only the demand for investment equation appears in the model. For a higher growth of output, we need more investment, however, savings depend on disposable income in both private and government sectors. Imports consist of capital goods imports and consumption goods imports. It is assumed that capital good imports depend on the amount of investment required to attain a target growth rate and the domestic
price level, and that consumption goods imports depend on both total disposable income and the domestic price level. The amount of exports is determined exogenously or depends on the social effort (small country assumption).

Broadly speaking, there are three goals in the development plan: First, maximizing the economic growth rate (the highest target growth rate possible); second, minimizing the import-export gap, and third, increasing food production so that domestic production can satisfy domestic consumption.

To achieve the first goal, we need higher domestic investment and/or more foreign capital imports. For the second goal, domestic savings and exports must be increased and imports of consumption goods must be curbed. For those purposes, various policies were inaugurated, i.e., monetary reform for more efficient allocation of limited investment funds (more funds for capital goods producing industries than consumption goods industries as the Mahalanobis-Feldman model shows, and mobilization of more funds for long-run investment), inducement of foreign capital, multiple exchange rate for import substitution (higher foreign exchange rate on consumption goods imports) and various preferential bank rates on the loans for production of exportables, etc. But as we see from the last equation of the model, if domestic savings is maximized, and there
exists a savings constraint, a growth target beyond that constraint leads to larger import-export gap. In other words, the first two goals conflict with each other. The third goal is derived from the second target. That is, approximately 45% of the labor force is employed in the primary sector, yet Korea is a net food importing country. To reduce the pressure on the import-export gap from the primary sector, the government allocates a large part of the government investment to the primary sector.

Table II-20

<table>
<thead>
<tr>
<th>Year</th>
<th>Total</th>
<th>Agri.&amp; Fishery</th>
<th>Min.&amp; Manuf.</th>
<th>Electricity</th>
<th>Transportation</th>
<th>Communication</th>
<th>Others</th>
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<tr>
<td>1963</td>
<td>100</td>
<td>26.7</td>
<td>11.9</td>
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<td>19.3</td>
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</tr>
<tr>
<td>1969</td>
<td>100</td>
<td>18.7</td>
<td>8.8</td>
<td>1.1</td>
<td>32.6</td>
<td>10.0</td>
<td>28.8</td>
</tr>
<tr>
<td>1974</td>
<td>100</td>
<td>30.7</td>
<td>6.4</td>
<td>0.5</td>
<td>31.3</td>
<td>12.7</td>
<td>18.4</td>
</tr>
</tbody>
</table>

Source: Hong, W.T. (1976) p.166

The third target also conflicts with the first target. As we pointed out in the previous section, Korea's economic growth was due mainly to the growth of the industrial sector, and the labor migration from the agricultural sector to the industrial sector has greatly contributed

26/ See 4-1 in Chapter IV.
to total economic growth. Even though the agricultural sector is not developed explicitly in the model, more labor is needed for more agricultural production since agricultural production is labor intensive in Korea, and the marginal product of labor in Korea's agricultural sector is not zero.

Moreover, the main characteristics of the Leontief production function are the constant input-output coefficients and non-substitutability between production factors (i.e., labor and capital). The inapplicability of this production constraint for the Korean economy can be indicated by the fact that: the Korean economy has surplus labor.\(^{27}\) The source of economic development and growth should be this surplus labor (based on the classical comparative advantage theory or neo-classical factor endowment theory). Economic growth in Korea was actually fuelled by intra- and inter-industry structural changes. For example, the industrial sector grew very rapidly in the planning periods (1960's and 70's).

The model ignores technical progress. This is the basic reason for the under-estimation of the changes in recent years by the estimated structural equations.\(^{28}\)

\(^{27}\) See 4-1 in Chapter IV.
\(^{28}\) Adelman and Kim (1969) said, "Our previous experience with estimating the structural equations for Korea has
Adelman and Kim claim that the degree of war ravage and post-war dislocation of the Korean economy distorted the results of the model which attempted to include the years before 1956. But, they failed to take into account the technical progress and structural changes of the 1960's. As was pointed out earlier, the Korean economy completed the non-durables import substitution phase of development in the late 50's. Import substitution ofdurables and export promotion were initiated in the mid-60's. The model is aimed at minimizing the net foreign capital inflow, and does not explain the role of labor in the development and growth of the economy. But how can we conceive of a policy-mix for growth and development which disregards the role of labor in a labor surplus economy? Why should net foreign capital be minimized in the short-run in a natural resource and capital poor country? Rather, the optimum amount of foreign capital inflow is the problem which must be solved for in just such a country.

In conclusion, the model focused on the supply side, as does the two-sector model of Harrod-Domar(or Mahalanobis (cont.)indicated that the best fitting equations tend to under-predict changes of most recent years. In view of the planning orientation of this model, it was desirable that variables and statistical procedures be chosen so as to predict recent conditions and likely future changes more accurately than earlier conditions." For this purpose they applied a weighting scheme to improve the forecasting ability of the model.
and Feldman model). With regard to the foreign sector, the focus of attention was on the two-gap. As Westphal and Adelman herself point out, the question "what is the optimum magnitude of foreign capital inflow?" is not answered. 29

**Factor Market Distortions in Korea**

Among the several development goals, the GNP growth rate has been given the top priority. That fact is clear from the Table II-27 (Summary of the Development Plans in Korea) in the next sub-section. Actual GNP growth rates exceeded the planned rates, while the import-export gap was wider than planned throughout the plan periods. In other words, capital formation was treated as the most important factor in the process of economic development and growth. This is reflected in various policy measures.

(1) Foreign capital inducement

Several direct and indirect subsidies were given to foreign capital inducement. 30 As Table IV-7 (p.127) shows, foreign capital imports accelerated after 1965, following the domestic monetary reform. Table II-21 shows the distribution of committed projects by industry. As we see

from this table, more than 95% of total imported capital was allocated to the non-primary sector. That corresponds to the fact that Korea's economic growth was attributable mainly to the industrial sector, and that the industrial capital formation depended largely on imported foreign capital. Furthermore, industrial capital formation through capital imports was subsidized directly and indirectly.

Table II-21

<table>
<thead>
<tr>
<th>Industry</th>
<th>Official Loan</th>
<th>Commercial Loan</th>
<th>Foreign Investment</th>
<th>Total ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agri. Forestry and Fishery</td>
<td>142.4</td>
<td>145.8</td>
<td>7.8</td>
<td>296.0(4.3)</td>
</tr>
<tr>
<td>Mining &amp; manufacturing</td>
<td>773.0</td>
<td>2,163.8</td>
<td>511.6</td>
<td>3,448.4(50.2)</td>
</tr>
<tr>
<td>SOC and other services</td>
<td>1,554.1</td>
<td>1,503.8</td>
<td>69.5</td>
<td>3,127.4(45.5)</td>
</tr>
<tr>
<td>Grand Total</td>
<td></td>
<td></td>
<td></td>
<td>6,871.8(100)</td>
</tr>
</tbody>
</table>

*As of January 31, 1969, the share of foreign capital distributed to primary sector was 5% and out of 5%, 4.9% was the share distributed to fishery industry and only 0.1% was distributed to the agricultural sector. (Brown(1973), p.216)

Source: Major Economic Statistics of Korean Economy, 1976, EPB
Let us define the social interest rate on imported foreign capital as the rate which the economy as a whole has to pay, and the private interest rate as the rate individual borrowers have to pay. Then the social real rate \( r_s \) is,

\[
  r_s = r_n - r_i
\]

where \( r_n \) is nominal rate and \( r_i \) is the rate of inflation of tradable goods in the international market.

And, the private real rate \( r_p \) is,

\[
  r_p = r_n - r_d + r_e
\]

where \( r_d \) is domestic inflation rate, and \( r_e \) is the rate of inflation of foreign exchange rate.

Then, the optimum amount of foreign capital import is determined at the point where the marginal efficiency of imported capital is equal to the social real interest rate, and, in equilibrium, the social real rate is equal to the private real rate.\(^{31}\) In other words, if

\[
  r_s = r_p \quad \text{or} \quad r_d - r_e = r_i,
\]

the optimum amount of capital import is determined by the marginal productivity principle of imported capital. But as we see from the Table II-22, the real private rates

\(^{31}\) Frank, Kim, Westphal(1975), p.111
Table II-22

Social and Private Real Interest Rates on Foreign Loan

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal Rate&lt;sup&gt;1&lt;/sup&gt;</td>
<td>5.6</td>
<td>5.7</td>
<td>6.1</td>
<td>5.9</td>
<td>7.1</td>
<td>7.0</td>
</tr>
<tr>
<td>(-)Price Increase&lt;sup&gt;2&lt;/sup&gt; of Traded Goods</td>
<td>-2.3</td>
<td>-2.3</td>
<td>-2.3</td>
<td>-2.3</td>
<td>-2.3</td>
<td>-2.3</td>
</tr>
<tr>
<td>Real Social Rates</td>
<td>3.3</td>
<td>3.4</td>
<td>3.8</td>
<td>3.6</td>
<td>4.8</td>
<td>4.7</td>
</tr>
<tr>
<td>Nominal Rates</td>
<td>5.6</td>
<td>5.7</td>
<td>6.1</td>
<td>5.9</td>
<td>7.1</td>
<td>7.0</td>
</tr>
<tr>
<td>(-)Rate of Infl.</td>
<td>-11.3</td>
<td>-11.3</td>
<td>11.3</td>
<td>-11.3</td>
<td>11.3</td>
<td>11.3</td>
</tr>
<tr>
<td>(-8.5) (-8.5) (-8.5) (-8.5) (-8.5) (-8.5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rate of Devaluation</td>
<td>3.2</td>
<td>3.2</td>
<td>3.2</td>
<td>3.2</td>
<td>3.2</td>
<td>3.2</td>
</tr>
<tr>
<td>Real Private Rates</td>
<td>-2.5</td>
<td>-2.4</td>
<td>-2.0</td>
<td>-2.2</td>
<td>-1.0</td>
<td>-1.1</td>
</tr>
<tr>
<td>(0.3) (0.4) (0.8) (0.6) (1.8) (1.7)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Frank, Kim, Westphal (1975), p. 116

<sup>1</sup> Weighted annual average interest rate on foreign loan agreement.
<sup>2</sup> Rate of inflation from 1965-70 of wholesale prices of major trading partners.
<sup>3</sup> Rate of inflation of GNP deflator (wholesale price index) of Korea, 1965-70.

are much lower than the real social rates, and consequently, more foreign capital is imported than is socially optimal. The real private rates are negative when we use the GNP deflator as the domestic inflation rate and, they are approximately 0.9% when we use the wholesale price index as the deflator. This is due to the fact that the foreign exchange rate in Korea is relatively stable (relative to domestic inflation rate).
(2) Domestic capital formation

All banking institutions in Korea are under direct control of the government, and accordingly, the interest rates of loans and the structure of loans (short, mid-term, and long-term) are directly influenced by government policies. As Table II-23 shows, deposit money banks (mid-term loan) allocated approximately 16% of their total loanable funds for equipment loans throughout the 1960's and 70's and the ratio was approximately 81% in the case of the Korea Development Bank (long-term loan) during the same period. However, as Table II-24 shows, the real interest rates on equipment loans were approximately 2.5% in the case of deposit money banks and negative in the case of the Korea Development Bank. In other words, the funds for domestic capital formation were supplied with almost no interest. Consequently, there existed a chronic excess demand for loans.

(3) Labor employment

As we have seen before, there is disguised unemployment in the agricultural sector (and even more in the service and domestic trade sectors). However, these workers are ready to migrate to the industrial sector whenever they can find jobs there, regardless of the cost
Table II-23

<table>
<thead>
<tr>
<th>Year</th>
<th>DMB</th>
<th>KDB</th>
</tr>
</thead>
<tbody>
<tr>
<td>1961</td>
<td>7.04(22%)</td>
<td>15.63(77%)</td>
</tr>
<tr>
<td>1962</td>
<td>9.94(23%)</td>
<td>20.66(85%)</td>
</tr>
<tr>
<td>1963</td>
<td>10.80(22%)</td>
<td>23.46(85%)</td>
</tr>
<tr>
<td>1964</td>
<td>10.62(20%)</td>
<td>25.99(82%)</td>
</tr>
<tr>
<td>1965</td>
<td>9.37(13%)</td>
<td>29.44(80%)</td>
</tr>
<tr>
<td>1966</td>
<td>12.32(12%)</td>
<td>37.75(81%)</td>
</tr>
<tr>
<td>1967</td>
<td>17.80(10%)</td>
<td>42.97(82%)</td>
</tr>
<tr>
<td>1968</td>
<td>39.74(12%)</td>
<td>52.46(79%)</td>
</tr>
<tr>
<td>1969</td>
<td>67.56(12%)</td>
<td>77.84(81%)</td>
</tr>
<tr>
<td>1970</td>
<td>86.69(12%)</td>
<td>99.33(77%)</td>
</tr>
<tr>
<td>1971</td>
<td>110.34(12%)</td>
<td>124.43(79%)</td>
</tr>
<tr>
<td>1972</td>
<td>191.68(16%)</td>
<td>184.11(77%)</td>
</tr>
<tr>
<td>1973</td>
<td>285.75(18%)</td>
<td>257.99(81%)</td>
</tr>
<tr>
<td>1974</td>
<td>388.45(16%)</td>
<td>344.82(81%)</td>
</tr>
<tr>
<td>1975</td>
<td>522.99(18%)</td>
<td>485.35(84%)</td>
</tr>
</tbody>
</table>


*Percentage ratio of equipment loans to total loans.
Table II-24

Weighted Average Interest Rates on Loans

<table>
<thead>
<tr>
<th>Year</th>
<th>DMB Nominal</th>
<th>DMB Real*</th>
<th>KDB Nominal</th>
<th>KDB Real*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1961</td>
<td>13.3</td>
<td>0.1</td>
<td>5.0</td>
<td>-8.2</td>
</tr>
<tr>
<td>62</td>
<td>13.4</td>
<td>4.0</td>
<td>5.0</td>
<td>-4.4</td>
</tr>
<tr>
<td>63</td>
<td>13.1</td>
<td>-7.5</td>
<td>6.0</td>
<td>-14.6</td>
</tr>
<tr>
<td>64</td>
<td>13.3</td>
<td>-21.3</td>
<td>6.0</td>
<td>-28.6</td>
</tr>
<tr>
<td>65</td>
<td>16.2</td>
<td>6.2</td>
<td>7.5</td>
<td>-2.5</td>
</tr>
<tr>
<td>1966</td>
<td>21.4</td>
<td>12.5</td>
<td>7.5</td>
<td>-1.4</td>
</tr>
<tr>
<td>67</td>
<td>21.8</td>
<td>15.4</td>
<td>7.5</td>
<td>1.1</td>
</tr>
<tr>
<td>68</td>
<td>21.2</td>
<td>13.1</td>
<td>7.5</td>
<td>-0.6</td>
</tr>
<tr>
<td>69</td>
<td>20.5</td>
<td>13.7</td>
<td>7.5</td>
<td>0.7</td>
</tr>
<tr>
<td>70</td>
<td>17.6</td>
<td>8.4</td>
<td>7.8</td>
<td>-1.4</td>
</tr>
<tr>
<td>1971</td>
<td>16.4</td>
<td>7.8</td>
<td>8.3</td>
<td>-0.3</td>
</tr>
<tr>
<td>72</td>
<td>17.7</td>
<td>3.7</td>
<td>10.0</td>
<td>-4.0</td>
</tr>
<tr>
<td>73</td>
<td>13.9</td>
<td>7.0</td>
<td>10.1</td>
<td>-3.2</td>
</tr>
<tr>
<td>74</td>
<td>14.0</td>
<td>-28.1</td>
<td>10.6</td>
<td>-31.5</td>
</tr>
</tbody>
</table>

Source: Hong, W.T. (1976) p. 151

* Real rates are the nominal rates less the rate of wholesale price increase.
of living in urban areas.\textsuperscript{32} In other words, both the existing wage rate and expected future income increases stimulate labor migrations.\textsuperscript{33} Although the industrial wage rate is determined exogenously - by the minimum wage law\textsuperscript{34} the industrial entrepreneurs determine the size of labor employment according to the productivity of labor. Therefore, we can graph the following labor market in Korea. Fig.II-2 shows the determination of labor employment in the industrial sector. If we measure the real wage rate on the vertical axis and the amount of labor employment on the horizontal axis, $MPP_{LX}$ represents the demand for labor. The supply of labor is considered to be very

\textsuperscript{32}/It was true in Korea during the 1950's and 60's that the income of many wage earners in urban areas could only meet the cost of living except food which was a relatively small part of their total expenses. To make a living in the urban area, they had to depend on food (mainly rice and barley) which was sent by relatives who were still in the rural area.

\textsuperscript{33}/A similar hypothesis was tested in Korea by Kim,D.Y. and Lee,H.K.(1976), and they concluded that the migration of both male and female laborers depend primarily on the employment opportunity, and secondly on the wage differential between the two sectors. This result reflects the phenomenon of a rapidly growing industrial sector in urban area.

\textsuperscript{34}/The minimum wage law in Korea regulates not only the minimum wage rate but also the working conditions of low income workers. Labor unions also exist in Korea. The main function of the union is seeking out violations of the law, and making suggestions to the government and managerial groups for favorable wage policies and better working conditions.
Fig. II-2

Wage Rate Policy and Employment
elastic. (Let us assume as an extreme case which is horizontal at the given wage rate.) If, initially, the wage is \( w_{x1} \), the industrial entrepreneurs will employ \( L_{x1} \) unit of labor. But if the government raises the wage rate from \( w_{x1} \) to \( w_{x2} \), they will employ \( L_{x2} \) which is less than \( L_{x1} \). In other words, if the government raises the wage rate, it will reduce labor employment, and if the government maintains the existing low wage rate, wage earners in the industrial sector will remain near the subsistence level.

In the dynamic context, if demand for industrial goods increased in a certain period, labor demand would shift outward. From Fig. II-2, let us assume that demand for labor increased from \( MPP_{Lx} \) to \( MPP''_{Lx} \) due to the increase of industrial output. This increase of labor demand (shift of \( MPP_L \) curve) can be met partially by labor productivity increases (\( MPP_{Lx} \rightarrow MPP^1_{Lx} \)) and the rest is met by employing more labor (\( MPP^1_{Lx} \rightarrow MPP''_{Lx} \)). Consequently, when we take into account the labor productivity increase, the net increase of job opportunities is represented by the shift of \( MPP^1_{Lx} \) to \( MPP''_{Lx} \). If wage rate is constant over time, and demand for labor increased from \( MPP_{Lx} \) to \( MPP''_{Lx} \) during a certain period of time, then the actual increase of job opportunities is \( (L_{x4}-\bar{L}_{x1}) \), where \( \bar{L}_{x1} \) is efficiency unit of labor. But if the government raises the wage rate from the level of A to the level B during
the same period, the actual increase of job opportunities is only \((L_{x3} - \bar{L}_{x1})\). Alternatively, if we assume the industrial production function has the following form:

\[ X = e^{\lambda t} K_x \sigma_1 L_x^{\sigma_2} \]

and if no capital is imported from abroad, then the demand for labor can be written as,

\[ L_x = \frac{\sigma_2 X}{w_x} \]  \((at \, t=t_0, \, L_{x0} = \bar{L}_{x0})\)

and the demand for labor will shift outward as the industrial output\((X)\) increases. Consequently, the growth rate of labor employment can be written as

\[ \frac{\dot{L}_x}{L_x} = \frac{X}{X} - \frac{w_x}{w_x} - \frac{\lambda}{\sigma_2} \]

since, \(\frac{\dot{L}_x}{L_x} = \frac{L_x}{\bar{L}_x} + \frac{\lambda}{\sigma_2}\)

where \(X/X\) is the growth rate of industrial output due to the increase of demand. As argued above, this can be split into the labor productivity increase \((\lambda/\sigma_2)\) and the net increase of labor employment. Therefore, if the government fixes the wage rate in the short-run \((w_x/w_x=0)\), the labor employment growth rate is the output growth rate less the labor productivity increase rate. But if the government allows the wage rate to increase as much as

\[ 25/\text{Since } w_x = \text{MPP}_{Lx} = \sigma_2 X/\bar{L}_x, \text{ we can obtain the above equation by rearranging this relationship.} \]
the labor productivity increases \((w_x/w_x=\lambda/\sigma^2)\), labor employment will rise at very low rate (if any). In Fig. II-2, the former case is represented by the movement from point A to point C, and the latter case is represented by the movement from point A to point B.

Even though the productivity of labor is considered relatively high (well-educated labor in Korea), the level of the industrial wage rate in Korea is very low. The low wage rate in Korea is due to the fact that the size of the industrial sector is very small (relatively to the labor force), and the demand for labor was consequently very small. (Table II-25, Table II-26)

Since the industrial wage rate is not high enough to meet the cost of living in urban area, workers want to increase the wage rate as the industrial output increases. That pressure for wage rate increases is illustrated by the movement from point A to point B in Fig. II-2. When we consider this phenomenon together with the low interest rates on the equipment bank loans and private borrowing from abroad, we can understand why there are factor market distortions in Korea and capital intensive production in the industrial sector.
Table II-25

Index of Labor Productivity and Wages

<table>
<thead>
<tr>
<th>Year</th>
<th>All Industry</th>
<th>Manufacturing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Labor productivity</td>
<td>Nominal Wages</td>
</tr>
<tr>
<td>1962</td>
<td>37.3</td>
<td>-</td>
</tr>
<tr>
<td>63</td>
<td>39.5</td>
<td>-</td>
</tr>
<tr>
<td>64</td>
<td>42.9</td>
<td>-</td>
</tr>
<tr>
<td>65</td>
<td>49.7</td>
<td>38.3</td>
</tr>
<tr>
<td>1966</td>
<td>51.8</td>
<td>45.1</td>
</tr>
<tr>
<td>67</td>
<td>60.9</td>
<td>55.7</td>
</tr>
<tr>
<td>68</td>
<td>71.7</td>
<td>69.4</td>
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<tr>
<td>69</td>
<td>88.4</td>
<td>81.1</td>
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<tr>
<td>70</td>
<td>100.0</td>
<td>100.0</td>
</tr>
<tr>
<td>1971</td>
<td>108.9</td>
<td>119.2</td>
</tr>
<tr>
<td>72</td>
<td>117.5</td>
<td>137.6</td>
</tr>
<tr>
<td>73</td>
<td>127.3</td>
<td>150.8</td>
</tr>
<tr>
<td>74</td>
<td>140.0</td>
<td>204.5</td>
</tr>
<tr>
<td>75</td>
<td>155.2</td>
<td>259.3</td>
</tr>
</tbody>
</table>

Average Growth Rates:

<table>
<thead>
<tr>
<th>Period</th>
<th>Average Growth Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>62-66</td>
<td>7.5</td>
</tr>
<tr>
<td>67-71</td>
<td>16.0</td>
</tr>
<tr>
<td>71-75</td>
<td>9.3</td>
</tr>
<tr>
<td>62-75</td>
<td>11.6</td>
</tr>
</tbody>
</table>

Source: Major Statistics of Korean Economy, 1976, EPB

*Nominal wages are divided by Seoul Consumer Price Index to get real wage rates.
Table II-26

Earnings of Workers in Manufacturing Sector

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Korea</td>
<td>0.27</td>
<td>0.29</td>
<td>0.30</td>
<td>0.33</td>
<td>0.43</td>
<td>0.46</td>
</tr>
<tr>
<td>Philippines</td>
<td>0.21</td>
<td>0.22</td>
<td>0.24</td>
<td>0.26</td>
<td>0.27</td>
<td>-</td>
</tr>
<tr>
<td>Japan</td>
<td>1.15</td>
<td>1.34</td>
<td>1.77</td>
<td>2.48</td>
<td>2.92</td>
<td>3.21</td>
</tr>
<tr>
<td>Italy</td>
<td>0.97</td>
<td>1.13</td>
<td>1.35</td>
<td>1.66</td>
<td>1.87</td>
<td>-</td>
</tr>
<tr>
<td>France</td>
<td>0.83</td>
<td>0.94</td>
<td>1.15</td>
<td>1.58</td>
<td>1.74</td>
<td>2.37</td>
</tr>
<tr>
<td>Norway</td>
<td>1.68</td>
<td>1.92</td>
<td>2.23</td>
<td>2.82</td>
<td>3.48</td>
<td>-</td>
</tr>
<tr>
<td>U.K.</td>
<td>1.54</td>
<td>1.75</td>
<td>2.05</td>
<td>2.27</td>
<td>2.61</td>
<td>3.10</td>
</tr>
<tr>
<td>W. Germany</td>
<td>1.62</td>
<td>1.90</td>
<td>2.27</td>
<td>3.00</td>
<td>3.45</td>
<td>3.94</td>
</tr>
<tr>
<td>Canada</td>
<td>2.87</td>
<td>2.98</td>
<td>3.57</td>
<td>3.85</td>
<td>4.46</td>
<td>4.97</td>
</tr>
<tr>
<td>U.S.</td>
<td>3.36</td>
<td>3.57</td>
<td>3.81</td>
<td>4.07</td>
<td>4.41</td>
<td>4.80</td>
</tr>
</tbody>
</table>


Note: Wage and Salaries (in U.S. dollars) per hour.

Summary of Economic Development Plans in Korea

The idea for the first five-year economic development plan of Korea was developed by Seung-Man Rhee regime and Chang Myon administration, but was instituted by the military government led by President Park. After the first five-year economic development plan, two additional development plans were adopted and a fourth five-year plan
began in 1977.

As Table II-27 shows, the annual GNP growth rates exceeded the target rates throughout the three planning periods. But the shapes to the internal economic structural changes were not identical in each planning period. During the period of the first five-year economic development plan (1962-66), the target growth rate of GNP was 7.1% annually and the actual average annual growth rate achieved was slightly higher at 7.7%. But the share of mining and manufacturing output to GNP in 1966 was far short of the target (20.1% vs. 15.9%) while the share of social overhead capital and other service sectors over-attained the target (44.5% vs. 45.2%). The share of the primary sector also exceeded the plan (35.4% vs. 38.9%). Thus, the first planning period can be characterized by the growth of social overhead capital and other service sectors.

The same characteristics emerged from the second planning period (1967-71). The shares of primary and secondary sectors in the target year (1971) are slightly short of plans (34.9% vs. 26.5% and 26.8% vs. 24.4%), but the social overhead capital sector exceeded its planned share (39.2% vs. 49.1%). As a result, the actual GNP growth rate during this period, led by this
<table>
<thead>
<tr>
<th></th>
<th>1st Five-Year Plan (1962-66)</th>
<th>2nd Five-Year Plan (1967-71)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GNP (1970 Mil.$)</td>
<td>3,929</td>
<td>5,533</td>
</tr>
<tr>
<td>Population(mil.persons)</td>
<td>26.1</td>
<td>29.2</td>
</tr>
<tr>
<td>Per capita GNP ($)</td>
<td>150.5</td>
<td>189.5</td>
</tr>
<tr>
<td>Industrial Composition(%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agri.,Forestry &amp; Fishery</td>
<td>36.6</td>
<td>35.4</td>
</tr>
<tr>
<td>Mining &amp; manufacturing</td>
<td>16.5</td>
<td>20.1</td>
</tr>
<tr>
<td>Social overhead capital</td>
<td>46.9</td>
<td>44.5</td>
</tr>
<tr>
<td>Expenditure on GNP(1970 mil.$)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Composition</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Gross investment</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Domestic saving(S)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>S/GNP</td>
<td>(1.6)</td>
<td>(11.8)</td>
</tr>
<tr>
<td>Foreign Sector(1970 mil.$)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Export(EX)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Import(IM)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>(IM-EX)/GNP (%)</td>
<td>(10.8)</td>
<td>(8.5)</td>
</tr>
<tr>
<td>Average Annual GNP Growth rate (%)</td>
<td>7.1(7.7*)</td>
<td>7.0(10.5*)</td>
</tr>
<tr>
<td></td>
<td>3rd Five-Year Plan (1972-76)</td>
<td>4th Five-Year Plan (1977-81)</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>-------------------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td><strong>GNP (1970 mil. $)</strong></td>
<td>9,890</td>
<td>12,632</td>
</tr>
<tr>
<td><strong>Population (mil. persons)</strong></td>
<td>32.4</td>
<td>33.8</td>
</tr>
<tr>
<td><strong>Per capita GNP ($)</strong></td>
<td>305.6</td>
<td>373.3</td>
</tr>
<tr>
<td><strong>Industrial Composition (%)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agri., Forestry &amp; Fishery</td>
<td>26.1</td>
<td>23.3</td>
</tr>
<tr>
<td>Mining &amp; manufacturing</td>
<td>24.0</td>
<td>26.9</td>
</tr>
<tr>
<td>Social overhead capital</td>
<td>49.9</td>
<td>49.8</td>
</tr>
</tbody>
</table>

**Expenditure on GNP (1970 mil.$)**

|                                |      |      |      |      |      |
| Consumption                    | 8,140 | 10,056 | 9,960 | 13,104 | 17,537 |
| Gross investment               | 2,500 | 3,123 | 3,546 | 4,534 | 6,176 |
| Domestic saving (S)            | 1,750 | 2,576 | 3,335 | 3,706 | 6,192 |
| S/GNP                          | (17.7) | (20.4) | (25.1) | (22.0) | (26.1) |

**Foreign Sector (1970 mil.$)**

|                                |      |      |      |      |      |
| Export (EX)                    | 2,005 | 3,485 | 3,780 | 6,069 | 10,423 |
| Import (IM)                    | 2,755 | 4,032 | 3,651 | 6,639 | 10,174 |
| (IM-EX)/GNP (%)                | (7.6) | (4.3) | -(0.9) | (3.4) | -(1.0) |

**Average Annual GNP Growth Rate (%)**

8.6(10.9*)

9.2

**'s are actual values.
1/ Because the 1976 actual data are not available, I compared the 1975 targets and 1975 actual values.
Source: 1st, 2nd, 3rd, 4th Five-Year Economic Development Plan, EPB
social overhead capital sector, was 10.5% while the plan called for 7%. We can see from the table that the growth of the social overhead capital sector was initiated by massive investments in that sector. The target amount of gross investment in 1971, the target year for the 2nd five-year plan, was 1,426 million dollars, but the actual gross investment was 2,411 million dollars, almost 70% above the plan, and out of this investment, 65.1% was allocated to the social overhead capital sector.

To supply these investment funds, the Korean government successfully raised domestic savings, and foreign savings increased drastically (396 million dollars vs. 1,012 million dollars or 5.5% vs. 11.1% of GNP). The drastic foreign capital inflow resulted, partially, from the high domestic interest rate policy after the 1965 monetary reform. 36 A high growth rate of the social overhead capital sector during the second planning period, in turn, paved the way for the higher growth rate of the manufacturing sector in the next planning period. Consequently, the target GNP growth rate in the third planning period could be raised to 8.6% annually (compared to 7.1% and 7% during the previous planning periods). Economic

36/Besides this, the system by which commercial banks guarantee the repayment of foreign loans was authorized in 1966 which also stimulated the foreign lenders to lend. (Frank, Kim, Westphal, (1975), p.105)
growth during the 3rd five-year economic development plan was characterized by growth of the manufacturing sector, which is concomitant with export promotion and import substitution. First of all, the share of the manufacturing in GNP increased to 33.1% in 1975, compared to the target of only 26.9%. Secondly, the amount of exports in 1975 exceeded the target (3,546 million dollars vs. 3.123 million dollars), while imports fell below the target (3,651 million dollars vs. 4,302 million dollars).

Even though the ratio of foreign savings was low (-0.9%) in 1975, GNP growth was 8.3% in that year, nearly achieving the target rate for that period. Such high growth in 1975 with an extraordinarily low rate of foreign saving was possible only because of the amount of domestic saving. The ratio of domestic saving to GNP in 1975 was 25.1%, compared to the target of 20.4%.

In conclusion, the Korean economy has grown dramatically during the first three development plan periods and has led most other developing countries in the world in growth rate throughout the 1960's and 70's. Such success has come through structural changes in the economy, mainly rapid growth of the manufacturing and social overhead capital sectors. Growth of the industrial sector was made possible by massive capital inflows from abroad.
Over-attainment of the GNP growth rate during these periods was due to the higher than targeted rate of foreign capital inflows.

The Korean government is ambitiously planning to attain economic independence (running surplus in the current account of international balance of payment) by the end of the 4th five-year economic development plan (1981) while maintaining the GNP growth rate at 9.2% annually during that same period. But the feasibility and optimality of such targets has not been reviewed anywhere in the documents of the development plans.\(^37\) The role of labor, the only surplus factor of production in Korea, has not been analyzed explicitly, either.

\(^{37}\) Westphal, L. and Adelman, I. (1972) make the same point: "Lacking a discussion of alternatives, particularly along policy lines, Korean planners and policy makers alike were unprepared for the higher than planned growth rates that were actually realized."
CHAPTER III
LITERATURE ON DUAL ECONOMY MODELS

3-1 The Closed Economy Models

The Lewis - Fei and Ranis - Jorgenson Model

(1) Background of the model

The dual economy model rests on the assumption of a labor surplus. When there is a redundant labor force (whose marginal productivity is zero), we have the "classical approach" (Lewis, Fei and Ranis), and when there is non-redundant labor but huge disguised unemployment of labor whose marginal productivity is less than the institutionally determined wage rate, we have the "neo-classical approach" (Jorgenson). Dixit(1970) argued that this kind of classification is not absolutely necessary for the analysis of development. The following graph summarizes the classical model while the neo-classical model can be explained with a slight modification of the graph.

First of all, assume two sectors: the traditional sector (mainly agriculture) and modern sector (mainly industry). In each model, it is assumed that the capital stock is not used for the production of agricultural output.

1 This is discussed more in detail in Chapter IV.
It is used only for the production of industrial output. For simplicity in the graph, we assume no population growth. When there is no capital stock accumulated in the economy, the only factors are labor\( (L) \) and land (pure agrarian economy). Thus, all labor is used in food (agricultural) production. This is represented by \( OY \) in the second quadrant where \( w \) is the institutionally given wage rate. Therefore, \( L_y = P \) where \( P \) is total population and \( L_y^* \) is the redundant labor force. Since \( L_y^* \) is the redundant labor force, it can be released from the agricultural sector to the industrial sector without reducing total food production. This is the way to start industrial development. It is assumed that the amount of land is given and it is not included in the argument of the industrial sector's production function. If more labor is transferred from the agricultural sector, total food production starts to decrease since the marginal product of labor below \( L_y^* \) is no longer zero. That is, \( L_y^* \) is the "Lewis Turning Point (LTP)". The vertical portion of the labor supply curve for the industrial sector in the fourth quadrant\( (w_x \leftarrow w_y) \) implies the migration of redundant labor from the agricultural sector. In other words, as long as there is redundant labor in the agricultural sector, industrialists can employ this labor as much as they want at the given
Fig. III-1
Growth of a Dual Economy

$A_0 = \lambda L_0$
wage rate. For more labor migration from the agricultural sector beyond the LTP, entrepreneurs of the industrial sector have to pay a higher wage, and accordingly, the labor supply curve slopes upward beyond $L^*$. If the wage rate in the industrial sector is high enough, more labor will migrate from the agricultural sector and finally, at $L^{**}$, the marginal productivity of labor in the agricultural sector will equal the institutional wage rate. This is called the "Commercialization Point (CP)". Beyond this point, both the agricultural and industrial sectors compete in the labor market.

(2) Maximum social effort: the necessary and sufficient condition for sustained growth in the industrial sector

Assume $y^+$ is the minimum per capita food consumption at which the population growth rate reaches a given $\epsilon$, and $A_0$ is the minimum food production required to fulfill $y^+$. (That is, $A_0 = y^+L_0$.) Under this premise, the industrial sector's growth rate depends on social effort. If all food consuming units reduce their food consumption to the minimum level of $y^+$, then, the necessary amount of labor in the agricultural sector is $L^*_{y^+}$, and $L_yL^{**}_{y^+}$ can move to the industrial sector for more industrial production. Thus, the point $A_0$ reflects the maximum social
effort for the development of the industrial sector.

Jorgenson imposes stricter assumptions. He assumes that when there is an agricultural surplus, the population growth rate is $\epsilon (>0)$ which is the physiological maximum, per capita food demand is $y^+$, and the income elasticity of food demand is zero. He derives the necessary and sufficient condition for the sustained growth of the industrial sector as follows: The agricultural production function is,

$$Y = e^{\alpha L}y^-$$

where $\alpha$ is a technical progress parameter and $1 - \beta$ is the production elasticity of labor in the agricultural sector. If $y = y^+$, then $\dot{y}/y = 0$ by assumption. Therefore, at the time that an agricultural surplus emerges,

$$\frac{\dot{Y}}{Y} = \frac{\dot{y}}{y} - \frac{\dot{L}}{L} = 0$$

$$\alpha + (1 - \beta)\epsilon_y = \epsilon \quad \text{and} \quad \epsilon_y = \epsilon.$$  

$\epsilon_y$ is the growth rate of the agricultural labor force which is just enough to maintain $y = y^+$. Thus,

$$\epsilon_y = (\epsilon - \alpha)/(1 - \beta)$$

Thus the necessary condition for the emergence of an industrial sector is,

$$\frac{\dot{Y}}{Y} > \epsilon$$

or,

$$\alpha + (1 - \beta)\epsilon_y > \epsilon.$$
Initially $L = L_y$ or $\xi_y = \xi$ and thus
\[ \alpha - \beta \xi > 0 \]
Therefore, this is the necessary and sufficient condition for the sustained growth of the industrial sector. The above condition can be rewritten as,
\[ \xi > \frac{\xi - \alpha}{1 - \beta} \quad (= \xi_y) \]
In other words, the rate of population growth is greater than that of agricultural growth alone. Hence the industrial labor force ($L_x$) is growing faster than total population ($L$). When the production function for the industrial sector is given as,
\[ X = e^{\lambda t} k^{\sigma_1} L_x^{\sigma_2}, \quad \sigma_1 + \sigma_2 = 1 \]
the industrial output growth rate ($X/X$) is positive as long as the above condition is fulfilled and Jorgenson concludes that, provided there is a positive and growing agricultural surplus, the advanced sector continues to grow and the pattern of growth is determined by two initial conditions, the size of the total population at the time that the growth of the advanced sector begins and the size of the initial capital stock. As is shown from the industrial sector growth condition, the critical parameter is the rate of technical progress in the agricultural sector ($\alpha$).

But technical progress in the agricultural sector, $\alpha$, depends largely on the capital intensity of agricultural
production. In this context, the Jorgenson model can be criticized on the grounds that agricultural investment is neglected. Technical progress in the agricultural sector can be accelerated by the accumulation of capital in that sector, which would provide a greater agricultural surplus and easier development of the industrial sector.

Niho (1974) points out that there is considerable historical evidence suggesting that the application of capital inputs in the agricultural sector was an important element in the successful development of modern economies such as Germany, Japan, and the United States. In this case, there arises the problem of optimum allocation of capital between the agricultural sector and the industrial sector. Even in the open economy in which the economy can import food, it is necessary to compare the opportunity cost of industrial products for exports and the cost of domestic food production. If the latter is smaller, agricultural investments are more desirable. This comment is also relevant to the discussion of the Zarembka and the Sato-Niho models which follow.

The Zarembka and the Sato-Niho Models

The main weakness of the Jorgenson model is the lack of a food demand function (he assumed that the income
elasticity of food demand is zero when \( y = y^+ \).

(1) Zarembka model

In his article (1972), Zarembka incorporates the demand function for food into the neo-classical model by permitting non-zero income and price elasticities of food demand. He explains the marketable surplus problem as follows: using the same production functions in the agricultural and industrial sectors as Jorgenson, he assumes that the rural wage rate is simply average agricultural product (since any farm net revenue is the opportunity cost they perceive of moving to an urban area, and the urban wage rate is determined by the marginal productivity of labor). That is,

\[ w_y = \frac{y}{L_y} \]

where \( w_y \) is rural wage rate, and

\[ w_x = \sigma_2 \frac{X}{L_x} \frac{1}{q} \]

where \( w_x \) is urban wage rate and \( q \) is the price of agricultural output in terms of industrial output.

Furthermore, he assumes that the rural wage is a certain fraction of the urban wage rate,

\[ w_y = uw_x, \quad 0 < u < 1 \]
This fraction reflects the fact that peasants require some premium over their agricultural wage to induce them to incur the costs of moving to a less well-known and more risky urban area. Demand for food is a function of the wage rate and the price of food. That is, per capita food consumption in rural and urban areas are determined by \( f_1(w_y, q) \) and \( f_2(w_x, q) \). Since \( w_x = u^{-1}w_y \), and by assuming the same pattern of food consumption in both sectors,

\[
f_1(w_y, q) = c_1 w_y^{a_1} q^{-\gamma_1}
\]

\[
f_2(w_x, q) = c_1 (u^{-1}w_y)^{a_1} q^{-\gamma_1}
\]

Then,

\[
Y - (f_1 L_y + f_2 L_x) = 0, \quad \text{or}
\]

\[
Y = c_1 w_y^{a_1} q^{-\gamma_1} (L_y + u^{-a_1} L_x)
\]

By appropriate transformations and by assuming \( a_1 = 0 \) during the early stage of development (or \( u = 1 \) later when the economy is sufficiently developed), the demand for food can be written,

\[
\frac{Y}{L} = c_1 w_y^{a_1} q^{-\gamma_1} = c_1 q^{-\gamma_1} \left( \frac{Y}{L_y} \right)^{a_1}
\]

Zarembka defines viability of the economy as a sustainable rise in real wages and the condition for that viability
can be derived as follows: since
\[ w_y = \frac{\dot{y}}{\dot{L}_y} = uw_x = u \sigma_2 \frac{\dot{x}}{L_x q} \]
the above condition implies \( \dot{w}_y > 0 \), and thus,
\[ \frac{\dot{w}_y}{w_y} = \frac{\dot{y}}{\dot{y}} - \frac{\dot{L}_y}{L_y} = \frac{(\alpha - \beta \varepsilon) + \beta \eta_1 \frac{\sigma_2}{1 - \eta_1}}{1 - \beta(1 - a_1 - \eta_1)} \]
if \((\alpha - \beta \varepsilon) + \beta \eta_1 \frac{\sigma_2}{1 - \beta} > 0, \quad (\frac{\alpha}{\beta} - \varepsilon) + \eta_1 \frac{\sigma_2}{1 - \beta} > 0 \)
where use has been made of the implication that
\[ 1 - \beta(1 - a_1 - \eta_1) > 0 \quad (see \ Zarembka(1970), p. 113-116) \]
Therefore, even though \( \alpha - \beta \varepsilon < 0 \), if \( \beta \eta_1 \frac{\sigma_2}{1 - \beta} \)
is large enough, the economy is viable.

The result can be compared with Jorgenson's. The necessary and sufficient condition for the sustained growth of industrial sector from the Jorgenson model is
\[ \alpha - \beta \varepsilon > 0 \quad or \quad \frac{\alpha}{\beta} - \varepsilon > 0 \]
This condition can be interpreted in the context of the Zarembka model. That is, if the technical progress of the agricultural sector is such that \( \frac{\alpha}{\beta} > \varepsilon \), then the wage rate in that sector increases even though no labor migrates toward the industrial sector. But Zarembka's
conclusion is as follows: even though the technical progress of the agricultural sector is not large, and so \( \alpha \beta  < \epsilon \), the increase in the marketable food price may induce a rise in wages by discouraging food consumption. That is, if the price elasticity of food demand is large enough, then the food price increase will reduce the amount of food demanded considerably, and consequently, labor will migrate toward the industrial sector so that \( \gamma \alpha \beta  < \epsilon \), even though \( \alpha \beta  < \epsilon \), and the wage rate increases. But, if \( \eta_1 = 0 \) during initial stages of development as some empirical studies suggest, Zarembka's condition reduces to Jorgenson's.

(2) The Sato-Niho model

In their article(1971), Sato and Niho do not assume that the population growth rate is \( \epsilon \) (which is the physiological maximum when \( y = y^* \)), but they apply the Malthusian theory in determining the population growth rate and Engel's law in determining demand for food consumption. They assume the followings:

\[
z = \frac{X + X/q}{L}
\]

where \( z \) is per capita income and

\[
v = \frac{Y}{L}
\]

where \( v \) is per capita food consumption.
Economic Development and Population Growth

Then,

$$\frac{\dot{L}}{L} = \phi(z)$$

$$v = v(z), \quad 0 < v' < 1, \quad v'' < 0$$

They define the first stage of economic development as the period during which $z < \bar{z}$, and $\dot{L}/L = 0$ at $z = \bar{z}$. In other words, $\bar{z}$ is the subsistence level of income. As is shown in the above figure, population declines in the first stage. In the first stage, a purely agrarian economy, they assume $L = L_a$ and corresponding to the same type of production function as Jorgenson's. Since $w_a/q = Y/L = v = z$, where $w_a$ is agricultural wage rate,

$$\frac{\dot{z}}{z} = \frac{\dot{Y}}{Y} - \frac{\dot{L}}{L} = \alpha - \beta \frac{\dot{L}}{L} = \alpha - \beta \phi(z)$$
By definition, \( \phi(z) < 0 \) in the first stage, therefore, as long as the rate of technical progress in the agricultural sector is positive (\( \alpha > 0 \)), per capita income is always increasing. If \( z \) reaches \( \bar{z} \), \( \dot{L}/L \) is zero and thus the necessary condition for the emergence of the industrial sector is \( z > \bar{z} \). The development of the dual economy, the second stage of development, depends on the interactions of three factors; the technical improvement in agriculture, the rate of population growth, and per capita food consumption. With appropriate substitutions and transformation, economic development can be described as follows:

\[
\frac{\dot{z}}{z} = \frac{\alpha - \beta \phi(z)}{\left[v'(z) \frac{z}{v(z)} \right] + (1-\beta)(1-\sigma_1 s)\left[1-v'(z) \frac{z}{v(z)} \right]}
\]

where \( s = L_y/L \).

The condition of economic development is a positive \( \dot{z}/z \) for all \( z \). Therefore, the necessary and sufficient condition for economic development is \( \frac{\alpha}{\beta} > \phi(z) \).

All these models are basically revisions and extensions of the Jorgenson model. In the next section, I introduce the more recent and more complex Kelly-Williamson-Cheetham model.
The Kelly-Williamson-Cheetham Model (K-W-C Model)

The K-W-C model is the most comprehensive of all. Their basic assumptions are that there are:

(1) agricultural and industrial sectors,
(2) homogeneous output and constant returns to scale production functions in both sectors,
(3) diminishing marginal rates of substitutions.

Following assumptions (1) - (3), the production functions are,

\[ Q_i(t) = F_i[x(t)K_i(t), y(t)L_i(t)] \]

where \( Q \) is total output, \( x \) and \( y \) are technical progress parameters in capital and labor, respectively, and \( K \) and \( L \) are capital and labor. (\( i=1,2 \) and \( i=1 \) is the industrial sector and \( i=2 \) is the agricultural sector.)

They assume that the elasticities of substitution of efficiency labor for efficiency capital are

\[ 0 < \sigma_1 < 1 \quad \text{for } i=1 \]
\[ 1 < \sigma_2 < \infty \quad \text{for } i=2 \]

where \( \sigma_i = \frac{F_i^i}{F_i^i} \frac{F_i^k}{F_i^k} \frac{F_i^L}{F_i^L} \)

and subscripts represent derivatives.

They assume that

\[ x(t) = x(0)e^{\lambda_k t} \]
\[ y(t) = y(0)e^{\lambda_L t} \]
Then, the growth rates of the respective sectors are

\[ R_i(t) = \frac{\partial Q_i(t)}{\partial t} \left( \frac{1}{Q_i(t)} \right) \]

\[ = \lambda_k \left( 1 - \alpha_i(t) \right) \lambda_L \]

where \( \alpha_i = F_i^k x(t) k_i(t) \)

or the production elasticity of the efficiency capital stock.

In terms of technical progress, they assume labor-saving biased technical progress in the industrial sector and capital-saving biased technical progress in the agricultural sector. Their factor supply functions are:

\[ K(t) = K(0) + \int_0^t [I(r) - \delta K(r)]dr \]

\[ \lambda = \lambda_1 \lambda_1(t) + \lambda_2 [1 - \lambda_1(t)] \]

where \( \delta \) is the capital depreciation rate, \( \lambda \) is the population growth rate and \( \lambda \) is \( L_1/L \).

Furthermore, they assume competitive factor markets in both sectors and perfect factor mobility across the sectors. Thus,

\[ K(t) = K_1(t) + K_2(t) \]

\[ L(t) = L_1(t) + L_2(t) \]

\[ w_1(t) = P(t) F^1_L \]

\[ w_2(t) = F^1_L \]

\[ r_1(t) = P(t) F^1_k \]

\[ r_2(t) = F^2_k \]
where $P$ is the price of agricultural goods in terms of the industrial goods and $w$ and $r$ are wages and the returns to capital, respectively.

Furthermore, they assume that $w_1(t)y(t) \geq \gamma$, where $\gamma$ is the subsistence level of per capita food consumption, and $r_1(t) > 0$.

Using these assumptions and the production function of agricultural sector, the agricultural output is

$$Q_2(t) = F^2[x(t)K_2(t), y(t)L_2(t)]$$

$$= F^2_k x(t)K_2(t) + F^2_L y(t)L_2(t)$$

$$> w_2(t)y(t)L_2(t) > \gamma L_2(t)$$

by recalling Euler's theorem and $f^2_k = r_2(t) > 0$, $F^2_L = w_2(t) > \gamma/y$. If $Q_2(t) \geq \gamma L_2(t)$, there exists agricultural surplus. This corresponds to Jorgenson's condition of $y > y^+$ for agricultural surplus.

They derive demand functions for goods produced from the Stone-Geary type utility function.

$$\frac{D_{1j}(t)}{L_j(t)} = \frac{B_{1j}}{P(t)} [y(t)w_j(t) - \gamma]$$

$$\frac{D_{2j}(t)}{L_j(t)} = B_{2j}y(t)w_j(t) + (1-B_{2j}) \gamma$$

where $D_{1j}$ is the total $i$th good consumed by the $j$th laborers and $B_{1j}$ is the income elasticity of $j$th laborers for $i$th goods. ($\Sigma B_{ij}=1$)
For capital formation, they assume that only the capitalists save and that rental income is invested.

\[ P(t)I(t) = x(t)[r_1(t)K_1(t) + r_2(t)K_2(t)] \]

\[ \frac{\partial K(t)}{\partial t} = I(t) - \delta K(t) \]

All these structural equations can be summarized as follows: Endogenous variables are \( Q_i(t), K_i(t), L_i(t), w(t), r(t), P(t), D_{ij}(t), I(t) \), and exogenous variables are \( K, L, x, y \):

**Commodity Demands;**

\[ \frac{D_{1j}(t)}{L_j(t)} \frac{B_{1j}}{P(t)}[y(t)w(t) - \gamma] \]

\[ \frac{D_{2j}(t)}{L_j(t)} \frac{B_{2j}}{P(t)}[y(t)w(t) - \gamma] + \gamma \]

**Factor Demands;**

\[ w_1(t) = P(t)F_1^L \]

\[ w_2(t) = P_2^L \]

\[ r_1(t) = P(t)F_1^L \]

\[ r_2(t) = F_2^K \]

**Full employment condition;**

\[ K = K_1 + K_2 \]

\[ L = L_1 + L_2 \]

**Market balance equations;**

\[ Q_1(t) = D_{11}(t) + D_{12}(t) + I(t) \]

\[ Q_2(t) = D_{21}(t) + D_{22}(t) \]
### Comparison of the Jorgenson and the K-W-C Models

<table>
<thead>
<tr>
<th>I. Production Functions</th>
<th>The Jorgenson Model</th>
<th>The K-W-C Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Y = e^{\alpha t} L_y^{1-\beta}$</td>
<td>$Q_i = P_i [x(t)K_i(t), y(t)L_i(t)]$</td>
<td></td>
</tr>
<tr>
<td>$X = e^{\lambda t} L_x^{1-\sigma}$</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>II. Elasticity of Substitution</th>
<th>$\sigma_i = 1, \quad i=1,2$</th>
<th>$0 &lt; # 1 &lt; 1$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\sigma_2 &lt; # 2 &lt; \infty$</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| III. Interpretation of Dualism | Assymetry in the production relations, that is, the traditional sector has no capital stock produced in the modern sector. | Assymetry in technical and behavioral features in both sectors. |

<table>
<thead>
<tr>
<th>IV. Labor Supply</th>
<th>$y \geq y^+, \quad P/P = \zeta$</th>
<th>Exogenously determined</th>
</tr>
</thead>
<tbody>
<tr>
<td>$y &lt; y^+, \quad P/P = r + (1-\zeta)$</td>
<td>Endogenously determined always</td>
<td></td>
</tr>
</tbody>
</table>

| V. Demand Parameters | Identical between sectors. $(y-y^+)$ goes for the industrial sector consumption. | Different demand parameters. |

<table>
<thead>
<tr>
<th>VI. Factor Costs</th>
<th>Labor income in the Agricultural sector is composed of returns to labor. Wages do not need equal across the sectors.</th>
<th>In equilibrium, $w_1 = w_2$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$r_1 = r_2$</td>
<td></td>
</tr>
</tbody>
</table>
Dynamic Properties:
\[ x(t) = x(0) e^{\lambda t} \]
\[ y(t) = y(0) e^{\lambda t} \]
\[ K(t) = I(t) - \delta K(t) \]
\[ L(t) = [\epsilon_1 + \epsilon_2(1-a)]L(t) \]

Based on this brief review of the K-W-C model, I would argue that there are some limitations in applying the model directly to the under-developed economies. First of all, even though the model is a very comprehensive one, it is closed. Secondly, they assume competitive labor markets in both sectors, which may not be true in less-developed countries. In the labor surplus countries, the wage rate in the agricultural sector is higher than the marginal productivity of labor. Furthermore, it is unlikely that wages will be equalized across sectors, at least in the short-run. Thirdly, the labor-saving biased technical progress in the industrial sector is not as likely in labor surplus and resource poor countries. In conclusion, the K-W-C model is less applicable to under-developed economies than to semi-developed economies which have an assymetry in technical and behavioral features in both sectors.
The Paauw and Fei Model

This model depends primarily on the assumptions of the traditional closed dual models: There is a large traditional (mainly agricultural) sector and a small modern (mainly industrial) sector, with the traditional sector providing the means for development and growth. The normal process of development and growth under those conditions is that the economy exports primary goods produced by the traditional sector in exchange for capital goods from foreign countries, while the industrial sector produces consumer and/or capital goods (using imported capital) and then supplies them to the traditional sector. In this situation, we can conceive of three trade strategies for rapid growth: Import Substitution, Export Promotion, and Export Substitution.

The import substitution strategy is illustrated in the following figure. $M_p$ and $M_y$ are producers' goods and consumer goods imports, respectively. Assume "0a" is the residual that the economy can use to import capital goods from foreign countries. The international terms of trade are such that the country can import "dc" capital goods for the production of importables. Therefore, in the
Fig. III-3
Import-Substitution Growth

Fig. III-4
Export-Promotion Growth
next period, they can produce consumption goods by themselves up to an amount "ec" and increase the residual for capital imports to "ae". So, the economy can import capital goods up to a value of "fe" and produce consumption goods "ge" and so on and so forth.

The export promotion strategy is depicted in Fig. III-4. Assume the industrial sector does not produce import substitutes but capital goods which promote the ability to export. If the propensity to import is constant, "OE_3" is a savings line. "t_0t_0" is the import frontier at period 0, and imported consumption goods equal "OM_0". Thus, "M_0t_0" is the value of resources available for capital good imports. But in this case, imported capital goods are used for improved export potential and, consequently, the import frontier shifts to "t_1t_1" in the next period (and to "t_2t_2 in the following period, and so on.) But it is not possible to maintain that strategy in the long-run unless the country has an infinite reserve of natural resources. Therefore, the more practical and usual trade policy of underdeveloped countries is a combination of the two strategies in the short-run. In the long-run, they have to change their policies from primary goods exports to industrial goods exports (export substitution). But that is possible only after market-oriented entrepreneurship has
developed and the traditional agricultural sector has been considerably modernized, since productivity increases are essential to enable food and labor transfers to the industrial sector.

The Hornby and Bardhan Models

(1) Hornby model

This model is applicable to a socialist or planned economy, since it is based on the following assumptions: The industrial sector is owned by the government and only the government sector saves. From those assumptions, the following conditions are derived; the government is a monopolist in the sale of consumer goods and all wage and agricultural incomes are consumed. Hornby assumes a labor surplus economy where \( w_x \) is industrial wage rate (in terms of food) and the labor supply is infinitely elastic at that wage rate. He also assumes identical linearly homogeneous production functions in both capital and consumer goods producing industries.

The model starts by dividing the economy into the agricultural and the industrial sectors. But the government invests not only in the industrial sector but also in the agricultural sector. He argues that the agricultural sector is not homogeneous with the capital stock
spread out evenly over the whole of the farming area, at least in the early stages of growth. Furthermore, the government invests not only in farm capital, e.g., irrigation systems and fertilizer plants, but also in a transportation network. The region which is connected to the market by the transportation network can produce marketable surplus and that region is called the modern agricultural sector. Since he assumes constant returns to scale production functions, the marketable surplus is,

\[ S = h(p) K_{ag} \]

where \( S \) is food surplus, \( h \) is output-capital ratio in the agricultural marketable surplus production which seems to vary as price changes and \( K_{ag} \) is the capital stock in agriculture.

And thus the supply and demand for food is

\[ w_x g(p) = \phi h(p) K_{ag}/L \]

where \( w_x \) is industrial wage rate, \( g(p) \) is the proportion of wage spent on food consumption which seems also to vary as food price changes, \( \phi \) is per capita food imports and \( L \) is the size of industrial labor force.

One of Hornby's contributions is that the market mechanism distributes food. He assumes the following demand function,

\[ pq^{1/e} = A \]
where \( A \) is an arbitrary constant and \( q \) is \( h/g \).

Thus, the supply and demand for consumer goods can be represented as
\[
p(c + c^*) + \phi = w_x
\]
and the foreign exchange budget constraint is
\[
p'c^* + \phi = 0
\]
where \( c \) is per capita domestic production of consumer good and \( p' \) is a world price of consumer good in terms of food, and \( c^* \) is per capita good export.

Consequently, the investment function is
\[
I = \dot{K}_{ag} + \dot{K}_{ind} = L[f(k) - c]
\]
and for balanced growth,
\[
\dot{K}_{ag} = \dot{K}_{ind}
\]
must hold. From the supply and demand equation,
\[
\frac{\dot{K}_{ind}}{\dot{K}_{ag}} = \frac{kh}{\varepsilon w_x - \phi}, \quad \varepsilon w_x - \phi > 0
\]

Thus,
\[
\frac{\dot{K}_{ind}}{\dot{K}_{ind}} = \frac{[f(k)+y\phi-\frac{w_x}{p}]h}{kh+\varepsilon w_x - \phi}
\]

where \( y = 1/p - 1/p' \).

For maximum growth, the above equation must be maximized with respect to \( \phi \), \( k \), and \( p \).

The first-order conditions are
\[
y(f+y\phi-w_x/p)^{-1} = -(hk+\varepsilon w_x-\phi)^{-1}
\]
Dividing the last equation by the second equation,

\[ R = -yh \]

and by manipulating the second equation

\[ \frac{W}{w_X} = \frac{p}{p'} + yp(1-g) \]

where \( R \) and \( W \) are dynamic shadow interest and wage rates.

From this analysis, it is clear that \( R \) is strictly positive and the domestic price \( p \) is higher than the world price unless the elasticity of demand for surplus food\((e)\) is infinite. Whether one uses trade taxes or subsidies to achieve this aim depends on whether one is exporting food or consumer goods. If the tariff is not imposed to affect the quantity of goods exported and imported, the above condition can be attained by controlling the allocation of capital. If it is optimal to import food one starves agriculture of capital.

In this model more food is obtained by exerting government monopsony power in buying food through price policy manipulation and by investing more in the production of agricultural inputs to promote food production and therefore increase sales. But a difficulty arises with these measures which has been referred to
as the Preobrazhensky dilemma of a closed economy. First, if the real wage rate in the industrial sector is institutionally fixed, then the higher food prices which are needed to stimulate more food production and sales raise the industrial wage bill and decrease industrial profit and reinvestment. The result is low capital accumulation. Secondly, more investment in the production of agricultural inputs also reduces industrial capital accumulation. The solution to this dilemma requires the introduction of foreign trade. From Hornby's model, one derives the following conclusions: When e is small, low consumer prices, low investment in the agricultural sector, and free trade according to comparative advantage are recommended policies. When e is very large, high consumer prices, heavy investment in the agricultural sector, and restricted trade with heavy tariffs and subsidies are preferred policies. In the latter case, food importation is advisable even though the country's pre-trade domestic price is lower than the world price. In such a case, government monopoly power is vital for rapid growth.

(2) Bardhan model

Bardhan (1970) introduced a social welfare function for the solution of the dilemma we have just referred to.
But as he indicated, the function ignores the welfare of the agricultural sector, since only consumption in the industrial sector enters as an argument in the function.

These models are more complete than the Paauw-Fei model and introduce the role of international trade in economic growth. More importantly, Hornby emphasizes the market mechanism for the distribution of the agricultural surplus. But as pointed out in the first paragraph of this section, this model assumes a socialistic economy which is not applicable to a number of Asian countries.

The Mingo Model

It seems to me that Mingo's work is even closer to the kind of model we need. The traditional sector of his model produces not only food but also inputs for the industrial product. Under this premise he concludes that the reallocation of factors to the industrial sector is accelerated whenever the region can sell its industrial output on a world market, or, by borrowing abroad, can invest at a level greater than domestic savings. But industrialization is slowed by any increase in the demand for backward sector products. For example, when those products are demanded as inputs for the industrial
production process. Therefore, industrial input requirements are an important determinant of the growth of per capita income and, especially, the borrowing-lending position of the developing country.

The process of economic growth can be presented as follows: His production functions are the same with Jorgenson's.

\[ X = A_1 K^{\alpha} L_x^{1-\alpha} \]
\[ Y = A_2 L_y^{1-\beta} \]

Total income \( Z \) is,

\[ Z = X p_X + Y p_Y + D \]

where \( D \) is a factor income, or

\[ D = r \int_0^t B_c t dt \]

and \( B_c = S - I \).

As mentioned above, the agricultural sector produces food and intermediate goods for industrial products.

\[ Y = Y_f + Y_x \]

where \( Y_f \) is food production and \( Y_x \) is intermediate goods production.

And

\[ Y_f = kL \]
\[ Y_x = uX \]
where \( u = \frac{Y_X}{X} = \frac{X_Y}{X_Y} \), \( \frac{Y_X}{X_Y} \) is an input-output coefficient, \( X_Y \) is the industrial production with agricultural input, and \( \frac{X_Y}{X} \) is a measure of industrial composition.

He assumes full-employment of labor and that labor grows at a constant rate.

\[
L = L_0 e^{rt} \\
L = L_x + L_y
\]

Labor market equilibrium in the industrial sector depends on the productivity principle and the agricultural wage rate is determined by the average productivity of farming:

\[
w_x = (1-\alpha) \frac{X_p X}{L_x} \\
w_y = \frac{Y_p Y}{L_y}
\]

Suppose the industrial sector experiences technical progress which lowers the input-output ratio in farm-product-using-industry. This means less demand for the agricultural product and it will result in a reallocation of labor toward the industrial sector. The expanded industrial labor force attracts foreign investment funds leading to increases in per capita income over and above the rise in per capita income experienced in a Jorgenson type closed dual economy model.
An important and interesting characteristic of the model is that technical progress in the industrial sector is not enough to guarantee industrialization (especially when the input-output ratio between farm product inputs and industrial output is large). The industrialization (labor migration to the industrial sector) will proceed if the rate of technical progress in the agricultural sector is large enough, otherwise, an increase in the rate of technical progress in the industrial sector will cause a reallocation of labor toward the backward sector. The reason for this is that technical progress in the industrial sector implies that more industrial output may be produced with any given capital stock and labor force. In order to take advantage of the technical progress, the industrial sector must release some workers to the backward sector to produce the necessary industry inputs.
CHAPTER IV

NEO-CLASSICAL APPROACHES TO THE DEVELOPMENT OF A
DUALISTIC ECONOMY AND BASIC STRUCTURE OF THE MODEL FOR
THE KOREAN ECONOMY

In this chapter I discuss basic assumptions of the model which is applicable to the Korean economy. As described in Chapter II, the most important factors in the development and growth of the Korean economy were the structural changes in production, labor allocation, import substitution, and export promotion. The main forces behind these changes were foreign capital inflows and mobilization of well-trained labor. Cole, D. and Lyman, p. (1971) point out that shifts in the structure and financing of foreign trade have been among the most notable changes in the Korean economy and have been the major influences on the whole development pattern. Korea has an unbalanced pattern of productive resources: a very limited endowment of natural resources and an abundant and relatively highly trained stock of human resources. Natural resources have made a limited contribution to recent growth and offer little ground for optimism in the future. In this context, appropriate policy

2/Ibid. p. 137
formation for the development and growth of the Korean economy will entail an optimal combination of foreign capital inflows and labor employment.

4-1 Characteristics by Which Korea is Distinguished from the Standard Dual Economy Models

Well-Educated Labor

Korea entered the 1960's with an exceptionally well-educated labor force relative to other countries at comparable per capita GNP. Kim, Y. (1975) tried to estimate the contribution of education to economic growth in Korea and his results were compared with other countries in Table IV-1.  

3 In estimating the contribution of education to economic growth, he followed Denison's approach. It is assumed that education improves the quality of labor. From the Cobb-Douglas production function with constant returns to scale,

\[ Q = AK^\alpha_1(EL)^\alpha_2, \quad \alpha_1 + \alpha_2 = 1 \]

where \( Q \) is total output, 
\( A \) is arbitrary constant, 
\( K \) is total capital stock, 
\( L \) is labor force, and 
\( E \) is quality index of education which is measured as

\[ E = \frac{\sum c_i L_{it}/L_t}{\sum c_i L_{i0}/L_0} \]

where \( c_i \) is per capita expenditure in i-th grade of education and \( L_i \) is the number of employees who finished the i-th grade of education.

(Continued)
### Table IV-1

Degree of Contribution of Education to Economic Growth (%)

<table>
<thead>
<tr>
<th>Contribution of Education</th>
<th>GNP Growth Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Korea (1966-70)</td>
<td>20.3</td>
</tr>
<tr>
<td>U.S. (1955-62)</td>
<td>19.4</td>
</tr>
<tr>
<td>Germany</td>
<td>2.0</td>
</tr>
<tr>
<td>Norway</td>
<td>7.6</td>
</tr>
<tr>
<td>Italy</td>
<td>7.0</td>
</tr>
<tr>
<td>France</td>
<td>5.8</td>
</tr>
</tbody>
</table>

Source: Kim, Y. (1975) p. 58-59

The contributions to growth of various factors can be written as,

\[ \dot{Q} = \dot{\sigma}_K^K + \dot{\sigma}_L^L + \dot{\sigma}_E^E + e \]

where dots represent derivatives in terms of time and \( e \) is the residual. But this direct application of the Denison’s method is not quite acceptable for the following reasons:

1. He took the share of wage income from the national income account as the coefficient of labor (production elasticity of labor) in the Cobb-Douglas production function. But, in the context of a dual economy model where there is disguised unemployment in the agricultural sector, the wage income share out of total output is larger than the production elasticity of labor, since the wage rate in the agricultural sector is larger than the marginal productivity of labor.

2. There are other factors contributing to labor productivity increases, i.e., labor migration from the low labor productivity sector to high labor productivity sector, and importation of advanced techniques from abroad (which is usually referred to as a benefit to late comers).

But the high rate of increase of the labor quality index is very encouraging for the economic development prospects of Korea.
In general, the demand for education in Korea is very high. Ninety-five percent of all children who are 7 years old by 1965 entered elementary school, and that ratio increased to 97.2% in 1975. Table IV-2 shows the ratios of high school graduates of ages 25 and over in the United States and Korea.

Table IV-2

<table>
<thead>
<tr>
<th>25 and over of male who received at least 13 years of education</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S. (1960) 18.3%</td>
</tr>
<tr>
<td>Korea (1970) 16.7%</td>
</tr>
<tr>
<td>(1974) 17.1%</td>
</tr>
</tbody>
</table>

Source: Kim, Y. (1976) p. 10
Denison (1966)

A more interesting study was conducted by Harbison and Myers (1964). They constructed a "Composite index of human resource development", and classified 75 countries in their sample into 4 groups as follows;

<table>
<thead>
<tr>
<th>Rank</th>
<th>Under Developed</th>
<th>Partially Developed</th>
<th>Semi-advanced</th>
<th>Advanced</th>
</tr>
</thead>
<tbody>
<tr>
<td>Per Capita GNP (mean)</td>
<td>$ 84</td>
<td>$ 182</td>
<td>$ 380</td>
<td>$1,100</td>
</tr>
</tbody>
</table>

4/ The 4th Economic Development Plan of Korea, EPB, 1975, p.119
And from their study, they found that the index is significantly correlated with per capita GNP. Several countries are selected and compared with Korea in Table IV-3.

Table IV-3

Human Resource Development and per capita GNP

<table>
<thead>
<tr>
<th>Rank</th>
<th>Per Capita GNP($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Korea</td>
<td>III 144</td>
</tr>
<tr>
<td>Italy</td>
<td>III 516</td>
</tr>
<tr>
<td>Norway</td>
<td>III 1,130</td>
</tr>
<tr>
<td>Germany</td>
<td>IV 927</td>
</tr>
<tr>
<td>France</td>
<td>IV 943</td>
</tr>
<tr>
<td>U.S.</td>
<td>IV 2,577</td>
</tr>
</tbody>
</table>

Source: Harbison and Myer(1964) p.42

Harbison and Myer ranked Korea at level III (semi-advanced country in human resource development), but Korea’s per capita GNP was $144 which is only one-third of the average in that level.

Negative Agricultural Surplus

In most agricultural production oriented and labor surplus economies, the basic source of economic development
is the agricultural sector. By producing surpluses in the agricultural sector and by releasing surplus labor from that sector, the country can begin the development of the industrial sector. Virtually, all of the theoretical models explaining the development of agricultural production oriented and labor surplus economies assume that the agricultural surplus is the initiating factor for economic development. Jorgenson argues that there is no stationary situation for any economy in which the advanced sector is viable, that is, provided that there is positive and growing agricultural surplus, the advanced sector must continue to grow. Kelly and Williamson argue the same point claiming that it is confirmed by historical evidence drawn from the 1870's and 1880's in Japan. Ranis describes the historical role of the agricultural sector in an open economy as follows: At the first stage, the export of agricultural output supports the domestic import substitution. But in the second stage, the role of the agricultural sector as provider of the source of domestic import substitution terminates as the domestic demand for food increases along with income increases. To fill this vacated role, industrial export is promoted. In the final

8/Similar argument was also made by Paauw and Fei(1973).
stage of economic development, the economy turns to food importation, and the newly promoted industrial exports provide the funds for food imports. Ranis also argues that this was the case in Japan and Taiwan.\footnote{Ranis,G.(1972) p.41}

But that description is not accurate in the case of Korea. Agricultural production in Korea was short of the total domestic food demand throughout the 1950's and 1960's and the gap grew as national income increased in the 1970's (Fig.IV-1). In Table IV-4, we see the two different situations of Korea and Taiwan. Fei and Ranis assume that 1955-57 is the initial period of transition, transition from traditional land-based production to modern sector growth, in Korea,\footnote{Fei and Ranis(1974)} and during this period the per capita agricultural good imports were $2.6 but this increased to $5.6 in the 1967-69 period. When we compare this phenomenon with the Taiwanese case, the per capita agricultural good exports were $19.3 during their initial period for transition(1952-54) and it remained at $13.6 in 1967-69 period. This kind of negative role of the agricultural sector in the process of economic development in Korea is very clear in Fig.IV-2. Exports exceeded the imports of non-food products in 1973. But because of food imports, the aggregate balance of trade was still
Table IV-4
Comparisons of Structure and Performance between Korean and Taiwanese Economies

<table>
<thead>
<tr>
<th></th>
<th>Korea (1955-57)</th>
<th>Taiwan (1952-54)</th>
<th>Korea (1967-1969)</th>
<th>Taiwan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Per Capita Agri. Export</td>
<td>-$2.6</td>
<td>$19.3</td>
<td>-$5.6</td>
<td>$13.6</td>
</tr>
<tr>
<td>Internal Terms of Trade ($p_a/p_1$)</td>
<td>96.1%</td>
<td>97.7%</td>
<td>110.5%</td>
<td>96.8%</td>
</tr>
<tr>
<td>Export/GDP</td>
<td>4.1%</td>
<td>9.0%</td>
<td>22.4%</td>
<td>26.3%</td>
</tr>
<tr>
<td>Non-Agri. Consum. goods Import/Import</td>
<td>9.9%</td>
<td>26.5%</td>
<td>6.2%</td>
<td>19.4%</td>
</tr>
<tr>
<td>Investment/GDP</td>
<td>15.9%</td>
<td>17.0%</td>
<td>32.6%</td>
<td>33.1%</td>
</tr>
<tr>
<td>Foreign Saving/Total Investment</td>
<td>126.3%</td>
<td>41.7%</td>
<td>48.0%</td>
<td>-4.4%</td>
</tr>
</tbody>
</table>

Source: Ranis, G. (1972) p. 51

Negative. Exports of industrial goods must be capable of supporting the food imports for external independence in the long-run. Fei and Ranis conclude that the industrial sector (in Korea), instead of being supported by the agricultural sector, is saddled with the responsibility of diverting a part of the import capacity it generates for the purchase of food from abroad. This is the most important reason why the standard dual economy model cannot be directly applied to the Korean economy.

11/Fei and Ranis (1974) p. 47
Figure IV-1
Net Food Imports

In 1970 million $)

Net Import

Total Domestic Demand

Total Domestic Production

Figure IV-2
Net Imports and Exports by Type

Total Imports
Non-food imports
Exports of commodities

(In 1970 million $)
In conclusion, the agricultural sector of the Korean economy has played a relatively negative role. Instead of providing the means for domestic import substitution, Korea has had to import food from the very start and the easy import substitution (import substitution in non-durable consumption good production) was made possible by foreign economic aid. In later stages of economic development, various measures for the development of the agricultural sector were implemented just to reduce the external constraint, i.e., various efforts were made to modernize agricultural production through better irrigation, greater use of fertilizers and pesticides, subsidized prices of agricultural output in order to stimulate more production (2nd row of Table IV-4), etc. The primary role of the agricultural sector in Korean economic development has been to supply labor to the industrial sector.

**Poor Natural Resources**

In the standard (open) dualistic economy model, imports (capital goods and/or raw materials for the use of industrialization) are financed by the export of raw materials and/or agricultural products. This is the case with Venezuela(Table IV-5) and Taiwan(Table IV-4) and

12/The historical record of foreign capital inflows into Korea is reviewed in Chapter II.
### Table IV-5

Comparative Compositions of Commodity Exports: Venezuela and Korea (%)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Food, Beverages &amp; Tobacco</strong></td>
<td>0-1</td>
<td>1.3</td>
<td>1.2</td>
<td>19.2</td>
<td>10.5</td>
</tr>
<tr>
<td><strong>Crude Materials, inedible</strong></td>
<td>2</td>
<td>5.4</td>
<td>5.4</td>
<td>18.6</td>
<td>11.7</td>
</tr>
<tr>
<td><strong>Fuels, Lubricants, Related materials</strong></td>
<td>3</td>
<td>92.4</td>
<td>91.6</td>
<td>0.6</td>
<td>0.8</td>
</tr>
<tr>
<td><strong>Animal &amp; Vegetable Oils and Fats</strong></td>
<td>4</td>
<td>0.0</td>
<td>0.0</td>
<td>0.1</td>
<td>0.0</td>
</tr>
<tr>
<td><strong>Chemicals</strong></td>
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<td>0.1</td>
<td>0.1</td>
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</tr>
<tr>
<td><strong>Manufactured Goods Classified by Material</strong></td>
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<td>0.4</td>
<td>1.2</td>
<td>33.6</td>
<td>27.9</td>
</tr>
<tr>
<td><strong>Machinery, Transport equipment</strong></td>
<td>7</td>
<td>0.2</td>
<td>0.3</td>
<td>3.8</td>
<td>8.5</td>
</tr>
<tr>
<td><strong>Miscellaneous</strong></td>
<td>8-9</td>
<td>0.3</td>
<td>0.2</td>
<td>23.8</td>
<td>39.0</td>
</tr>
<tr>
<td><strong>2-3</strong></td>
<td>97.8</td>
<td>97.0</td>
<td>19.2</td>
<td>12.5</td>
<td>5.1</td>
</tr>
<tr>
<td><strong>5-7</strong></td>
<td>0.7</td>
<td>1.6</td>
<td>37.7</td>
<td>38.0</td>
<td>44.5</td>
</tr>
</tbody>
</table>

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**Table IV-6**

<table>
<thead>
<tr>
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<th></th>
<th></th>
<th></th>
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<tbody>
<tr>
<td><strong>Food, Beverages &amp; Tobacco</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-1</td>
<td>9.8</td>
<td>10.8</td>
<td>10.1</td>
<td>16.1</td>
<td>13.2</td>
</tr>
<tr>
<td><strong>Crude Materials, inedible</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>4.6</td>
<td>3.7</td>
<td>21.5</td>
<td>18.2</td>
<td>15.4</td>
</tr>
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<td><strong>Fuels, Lubricants, Related materials</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>0.8</td>
<td>0.8</td>
<td>5.9</td>
<td>6.1</td>
<td>19.1</td>
</tr>
<tr>
<td><strong>Animal &amp; Vegetable Oils and Fats</strong></td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>4</td>
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<td>1.1</td>
<td>0.5</td>
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<td>0.7</td>
</tr>
<tr>
<td><strong>Chemicals</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>9.9</td>
<td>10.5</td>
<td>18.8</td>
<td>7.5</td>
<td>10.9</td>
</tr>
<tr>
<td><strong>Manufactured Goods Classified by Materials</strong></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>6</td>
<td>21.4</td>
<td>18.8</td>
<td>17.5</td>
<td>15.3</td>
<td>11.9</td>
</tr>
<tr>
<td><strong>Machinery &amp; Transport Equipment</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>43.7</td>
<td>46.7</td>
<td>24.0</td>
<td>32.5</td>
<td>26.2</td>
</tr>
<tr>
<td><strong>Miscellaneous</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>8-9</td>
<td>9.1</td>
<td>8.5</td>
<td>1.7</td>
<td>3.1</td>
<td>2.6</td>
</tr>
<tr>
<td>2-3</td>
<td>5.4</td>
<td>4.5</td>
<td>27.4</td>
<td>24.3</td>
<td>34.5</td>
</tr>
<tr>
<td>5-7</td>
<td>75.0</td>
<td>76.0</td>
<td>60.3</td>
<td>55.3</td>
<td>49.0</td>
</tr>
</tbody>
</table>

other Arab countries. For example, the export of crude materials and fuels was 97% of the total exports for Venezuela during the late 1960's. But in the case of Korea crude material exports accounted for only 19.2% of total exports in 1966, 12.5% in 1969, and 5.1% in 1975. Korea's major crude material exports are tungsten, gin-seng and raw silk. In contrast, the import of crude materials accounted for 27.4% of total imports in 1966, 24.3% in 1969 and 34.5% in 1975. But in Venezuela, those percentages were 5.4% in 1966 and 4.5% in 1969. In short, Korea is a net raw material importing country. Consequently, the Paauw-Fei type import-substitution or export-promotion industrial growth is not applicable.13

Large Foreign Capital Inflow

Because of the negative agricultural surplus, the historical role of the agricultural sector (feeding the labor force migrating from the agricultural sector to the industrial sector) was filled by foreign aid (during the post-Korean War period) and foreign loans (after the mid-60's). There were several governmental policies to enhance foreign capital inflow after the mid-60's. For example, foreign capital imports from abroad were

13/Fig.III-3 and Fig.III-4 in Chapter III.
Table IV-7

Summary of Foreign Capital Inflow*
(In million $)

<table>
<thead>
<tr>
<th>Year</th>
<th>Official Loans</th>
<th>Commercial Loans</th>
<th>Foreign Investment</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1959-62</td>
<td>7.3</td>
<td>-</td>
<td>-</td>
<td>7.3</td>
</tr>
<tr>
<td>1963</td>
<td>42.6</td>
<td>23.6</td>
<td>5.5</td>
<td>71.7</td>
</tr>
<tr>
<td>64</td>
<td>11.6</td>
<td>11.9</td>
<td>0.6</td>
<td>24.0</td>
</tr>
<tr>
<td>65</td>
<td>5.7</td>
<td>36.1</td>
<td>6.3</td>
<td>48.1</td>
</tr>
<tr>
<td>1966</td>
<td>72.8</td>
<td>110.2</td>
<td>14.3</td>
<td>197.3</td>
</tr>
<tr>
<td>67</td>
<td>105.6</td>
<td>124.0</td>
<td>2.3</td>
<td>232.0</td>
</tr>
<tr>
<td>68</td>
<td>70.2</td>
<td>268.4</td>
<td>13.8</td>
<td>352.4</td>
</tr>
<tr>
<td>69</td>
<td>138.9</td>
<td>408.7</td>
<td>7.0</td>
<td>554.6</td>
</tr>
<tr>
<td>70</td>
<td>115.3</td>
<td>366.7</td>
<td>24.3</td>
<td>506.3</td>
</tr>
<tr>
<td>1971</td>
<td>303.4</td>
<td>345.2</td>
<td>34.9</td>
<td>683.4</td>
</tr>
<tr>
<td>72</td>
<td>324.4</td>
<td>326.4</td>
<td>60.7</td>
<td>711.6</td>
</tr>
<tr>
<td>73</td>
<td>368.5</td>
<td>344.4</td>
<td>191.1</td>
<td>904.0</td>
</tr>
<tr>
<td>74</td>
<td>316.6</td>
<td>616.0</td>
<td>162.6</td>
<td>1,095.3</td>
</tr>
<tr>
<td>75</td>
<td>575.6</td>
<td>829.5</td>
<td>61.6</td>
<td>1,466.7</td>
</tr>
<tr>
<td>1959-75</td>
<td>2,459.5</td>
<td>3,813.4</td>
<td>588.8</td>
<td>6,861.8</td>
</tr>
</tbody>
</table>

*Import arrivals

1967-75 Major Statistics of Korean Economy, 1976, EPB

subsidized indirectly by the stable and over-valued foreign exchange rate (relative to domestic price increases). Another important domestic policy to encourage foreign capital imports was the monetary reform in 1965. Through the monetary reform, domestic (nominal)
interest rates on loans were raised sharply which encouraged domestic borrowers to shift from the domestic loan market to foreign loan markets.

Table IV-7 shows a sharp increase of foreign capital inflow after 1965, and also, that the share of commercial loans to total foreign capital imports increased after the monetary reform. Finally, the government guarantee system for loan repayment has supported domestic borrowers whose credit standing in the international loan market is poor. This, of course, encouraged foreign lenders to lend.

4-2 Source of Growth of Korean Economy in the 1960's
- From the Dualistic Point of View

Robinson, S. (1971) measured the sources of growth in under-developed countries using cross-section data. His method can be summarized as follows:
He assumes two sectors—a traditional sector where labor productivity is relatively low and a modern sector where labor productivity is relatively high. From the following aggregate production function,

\[ Q = F(K, L) \]

where \( Q \) is total output,

\( K \) is capital stock,

\( L \) is labor force,

economic growth can be written as,

\[ \frac{dQ}{Q} = \frac{\partial F}{\partial K} \frac{dK}{Q} + \frac{\partial F}{\partial L} \frac{dL}{Q} \]

The equation of economic growth implies no factor (especially labor) movement across sectors. But, if there is labor migration from the traditional sector to the modern sector (and we assume that capital is immobile across sectors), then,

\[ \frac{dQ}{Q} = \frac{dQ^*}{Q} + \frac{p_m w_m - p_a w_a}{w} \frac{wL}{Q} T_L \]

\[ = \frac{\partial F}{\partial K} \frac{dK}{Q} + \frac{\partial F}{\partial L} \frac{dL}{Q} + \frac{p_m w_m - p_a w_a}{w} \frac{wL}{Q} T_L \]

(Original equation)

where \( p_m \) and \( p_a \) are prices of manufacturing goods and agricultural goods,

\( w_m \) and \( w_a \) are marginal product of labor in the respective sectors,
w is the average wage rate and

$T_L$ is the labor migrating rate (percentage change of labor allocation ratio between two sectors)\(^1\)\(^5\)

For empirical measurement, the above equation is rewritten as,

$$g = b_0 + b_1 \frac{dK}{Q} + b_2 \frac{dL}{L} + b_3 T_L$$

where $g$ is economic growth rate,

$b_0$ is arbitrary constant,

$b_1$ is $\partial F/\partial K$,

$b_2$ is $\partial F/\partial L$ and

$b_3$ is $(p_{mw_m} - p_{aw_a})/w$ (or the spread in labor productivity between the two sectors).

If we assume that all of the b's are constant, the economic growth rate depends on the investment rate ($dK/Q$), the labor growth rate ($dL/L$) and the labor migration rate ($T_L$). And, if we assume an open economy case, the equation can be modified as,

$$g = b_0 + b_1 \frac{dK}{Q} + b_2 \frac{dL}{L} + b_3 T_L + b_4 \frac{dK_f}{Q}$$

(equation for empirical estimation)

\(^{15}\)For the proof of this equation, refer to Robinson, S. (1971) p.394-397

\(^{16}\)In the original equation, the weighted average of $dL/L$ and $T_L$ are used (weighted by $L/Q$ and $wL/Q$, respectively). Therefore, if we use unweighted $dL/L$ and $T_L$, estimated $b_2$ and $b_3$ are upward biased. (For a proof, see footnote 19.)
where \( \frac{dK_d}{Q} \) is the domestic investment ratio and \( \frac{dK_f}{Q} \) is the ratio of investment through foreign saving.

From his cross-section data, the estimated coefficients are,\(^{17}\)

\[
\begin{align*}
  b_0 &= 0.738 \\
  b_1 &= 0.083 \\
  b_2 &= 0.444 \\
  b_3 &= 1.815 \\
  b_4 &= 0.318
\end{align*}
\]

Robinson compared this result with time series studies of individual countries and found that there is close agreement between them.\(^{18}\) Thus, when we compare this result with the Korea's time series data, we obtain the following result.

First of all, the average values of variables in the 1964-74 period are

\[
\begin{align*}
  \frac{dK_d}{Q} &= 23.75 \\
  \frac{dL}{L} &= 3.83 \\
  T_L &= 1.38 \\
  \frac{dK_f}{Q} &= 8.88 \\
  \varepsilon &= 10.35
\end{align*}
\]

\(^{17}\)There are some statistical problems in estimating the coefficients. Firstly, foreign exchange rates in underdeveloped countries are generally over-valued, so \( b_4 \) is actually upward biased, and secondly, we added \( \frac{dK_f}{Q} \) which was already included in \( \frac{dK_d}{Q} \) to the original equation to get an equation for empirical estimation, and thus \( b_1 \) is actually under-estimated. (Robinson, S. (1971), p. 399-400)

\(^{18}\)Ibid. p. 407
when we substitute these values in the equation we obtain:

\[ g^* = 0.783 + 1.97 + 1.70 + 2.50 + 2.82 \]
\[ = 9.728 \]

where \( g^* \) is projected growth rate, and therefore the difference between \( g \) and \( g^* \) can be interpreted as the growth due to technical progress.19

This is a very rough model and, consequently, can not be used for normative conclusions.20 But this is very useful way to explain the sources of growth in under-developed countries. When we apply this method to the Korean economy, we find that growth was effected not only through capital formation and labor employment, but also by labor migration from the traditional sector to the industrial sector and by foreign capital inflows. This conclusion leads us to believe that Korea's economic development and growth confirms to the dualistic growth path with surplus labor in the traditional sector (since the labor migration is considered as one of important factors for economic development and growth in a labor surplus dual economy).

19/It does not mean that 2.5\% out of the 10.35\% growth rate of total output is attributable to the labor migration from the traditional sector to the industrial sector. Because, from our original equation, \( \frac{\partial g}{\partial (T_L \cdot wL/Q)} = \frac{g}{[\partial (T_L) \cdot wL/Q + T_L \cdot \partial (wL/Q)]} \). Since we assume \( wL/Q \) is constant, it reduces to \( \frac{\partial g}{\partial T_L} \cdot Q/wL \). Thus, \( \frac{\partial g}{\partial T_L} = b_3 \cdot wL/Q \). If we assume \( wL/Q = 0.6 \) in Korea, \( b_3 = 1.815 \times 0.6 = 1.089 \) or the contribution of labor migration to total economic growth is around 2.5\%x0.6=1.5\%. The same principle can be applied to estimated \( b_2 \).

20/Robinson, S. (1971) p.408
4-3 Structural Change in a Dualistic Economy

Classical and Neo-Classical Assumptions and Their Implications

As already pointed out (in Chapter II and III), the existence of redundant labor in the agricultural sector is assumed in the classical model. This assumption implies that the industrial wage rate is constant over time (or the supply of labor is horizontal to the industrial sector). In other words, industrial entrepreneurs can induce enough labor migration from the agricultural sector to fill their needs at the given wage rate.

The Cobb-Douglas industrial production function (as specified in the classical model) is:

\[ X = e^{\lambda t} K^{\sigma_1} L^{\sigma_2}, \sigma_1 + \sigma_2 = 1 \]

Then, the wage rate \( w \) is,

\[ w = \frac{\partial X}{\partial L} = \sigma_2 \frac{X}{L} = \text{constant} \]

Consequently, \( \frac{\dot{X}}{X} = \frac{\dot{L}}{L} \), or the output-labor ratio is constant. The industrial output growth rate is,

\[ \frac{\dot{X}}{X} = \lambda + \sigma_1 \frac{\dot{K}}{K} + \sigma_2 \frac{\dot{L}}{L} \]

and, by taking into account the constant output-labor
ratio,
\[ \frac{\dot{K}}{K} - \frac{\dot{X}}{X} = \left( \frac{K}{X} \right) / \left( \frac{K}{X} \right) = -\frac{\lambda}{\sigma_1} \]

Since both \( \lambda \) and \( \sigma_1 \) are non-negative (by assumption), the capital-output ratio in the industrial sector must be decreasing. By the same token (constant output-labor ratio), the capital-labor ratio is also decreasing.

In contrast, the neo-classical model assumes a non-zero marginal product of agricultural labor, and consequently, labor migration from the agricultural sector to the industrial sector is induced by offering higher wages (or upward sloped labor supply curve). In addition, another very important assumption in the neo-classical model is that there is a constant output-capital ratio in the industrial sector. Alternatively, it is assumed that the capital-output ratio in the industrial sector is constant asymptotically. Using that assumption and the industrial production function,
\[ \frac{\dot{X}}{X} = \lambda + \sigma_1 \frac{\dot{K}}{K} + \sigma_2 \frac{\dot{L}}{L} \]

\[ \frac{\dot{K}}{K} - \frac{\dot{L}}{L} = (\frac{\dot{K}}{K}) / (\frac{\dot{L}}{L}) = \frac{\lambda}{\sigma_2} \]

Since \( \lambda \) and \( \sigma_2 \) are non-negative (by assumption), the capital-labor ratio in the industrial sector must be increasing.
### Table IV-8

Comparisons of Assumptions between Classical and Neo-classical Models

<table>
<thead>
<tr>
<th></th>
<th>Agricultural Sector</th>
<th>Industrial Sector</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$K \times$</td>
<td>$K \times$</td>
</tr>
<tr>
<td></td>
<td>$X$</td>
<td>$L$</td>
</tr>
<tr>
<td>Classical Model</td>
<td>Redundant labor</td>
<td>$- \frac{\lambda}{\sigma_1} &lt; 0$ decreasing constant</td>
</tr>
<tr>
<td>Neo-Classical Model</td>
<td>Disguised unemployment</td>
<td>constant $\frac{\lambda}{\sigma_2} &gt; 0$ increasing</td>
</tr>
</tbody>
</table>

---

**The Dixit's Argument**

Dixit (1970) criticized the neo-classical "constant capital-output ratio" assumption. He argues that the asymptotic value was used in explaining the dynamic process of economic development. His argument can be restated as follows: Given the population growth rate and the agricultural production function:

$$P = P_0 e^{\alpha t}$$

$$Y = e^{\alpha t} L y^{1-\beta}$$

where $P$ is the population and $Y$ is the agricultural output,

the necessary and sufficient condition for the emergence of the industrial sector in the dual economy is,
\[
\varepsilon > \frac{\varepsilon - \alpha}{1-\beta}
\]

For simplicity, let us use \( \nu = \frac{\varepsilon - \alpha}{1-\beta} \)

where \( \nu \) is the labor growth rate in the agricultural sector.

If the agricultural labor force (\( L_y \)) grows at the rate \( \nu \), then

\[
L_y = L_{y0}e^{\nu t}
\]

where \( L_{y0} \) is the initial labor force in the agricultural sector.

And, the industrial labor force (\( L_x \)) grows as follows:

\[
L_x = P - L_y = P_0e^{\epsilon t} - L_{y0}e^{\nu t}
\]

\[
= P_0(e^{\epsilon t} - e^{\nu t}) \quad (\text{since } P_0=L_{y0} \text{ at } t=0)
\]

Thus,

\[
\frac{\dot{L}_x}{L_x} = \frac{\epsilon e^{\nu t} - \nu e^{\epsilon t}}{e^{\epsilon t} - e^{\nu t}}
\]

This equation implies that

\[
\frac{\dot{L}_x}{L_x}=\begin{cases} 
\infty, & t = 0 \\
\epsilon, & t = \infty
\end{cases}
\]

and \( \frac{\dot{L}_x}{L_x} \) is a monotonically decreasing function.

Using the neo-classical assumption stating that all capital income is saved and invested (\( S = K = \sigma_1X \)), the capital stock growth rate (\( r \)) is,

\[
r (=\dot{K}/K) = \sigma_1 X
\]

21/ This was proved in Chapter III (3-1)
Then, (by recalling the output growth path)
\[
\frac{\dot{X}}{r} = \frac{\dot{X}}{X} - \frac{\dot{K}}{K} \quad \left[= \frac{\dot{X}}{K} \left(\frac{X}{K}\right)\right]
\]
\[
= \lambda - \sigma_2 \left(\frac{\dot{K}}{K} \frac{\dot{L}_X}{L_X}\right), \quad (K_0 \neq 0)
\]

This equation implies that if \(r/r\) is positive the capital stock grows at an accelerated rate and the capital-output ratio (output-capital ratio) is decreasing (increasing).

Therefore,

i) if \(t = 0\),
\[
\frac{\dot{L}_X}{L_X} \to \infty, \quad \text{and} \quad \frac{\dot{X}}{r} \to \infty, \quad \frac{K}{X} \text{ is decreasing.}
\]

ii) since the capital stock grows at an increasing rate and the labor force increases at a decreasing rate, there exists a \(t^*\) such that
\[
\frac{\dot{K}}{K} - \frac{\dot{L}_X}{L_X} = 0, \quad \text{thus,}
\]
if \(t = t^*\),
\[
\frac{\dot{X}}{r} = \lambda > 0 \quad \text{and} \quad \frac{K}{X} \text{ is decreasing.}
\]

iii) since \(\frac{\dot{L}_X}{L_X}\) is monotonically decreasing,
if \(t > t^*\), \(\frac{\dot{K}}{K} > \frac{\dot{L}_X}{L_X}\) and consequently, there exists \(t^{**}\) such that,
\[
\lambda - \sigma_2 \left(r - \frac{\dot{L}_X}{L_X}\right) = 0, \text{ or}
\]
therefore, if $t = t^{**}$, $r/r = 0$ and $K/X$ is constant (instantly).

iv) if $t > t^{**}$,

\[
\frac{\dot{r}}{r} < 0 \quad \text{(since $\frac{\dot{L}_X}{L_X}$ is decreasing)} \quad \text{and} \quad \frac{K}{X} \text{ is increasing.}
\]

v) if $t \to \infty$

\[
r = \varepsilon + \frac{\lambda}{\sigma_2} = \text{constant}, \quad \text{and} \quad \frac{K}{X} \text{ is constant.}
\]

If we assume Harrod-neutral technical progress, the efficiency unit of labor in the industrial sector grows at the rate of $\varepsilon + \lambda/\sigma_2$ as $t \to \infty$, and finally, the steady-state growth path is attained. The above structural changes are summarized in Table IV-9 and depicted in Fig.IV-3.

---

22/If $t \to \infty$, $\frac{\dot{L}_X}{L_X} \to \varepsilon$. Thus, $\frac{\dot{r}}{r} = \lambda - \sigma_2(r - \varepsilon)$

\[
= \lambda + \sigma_2 \varepsilon - \sigma_2 r = a - \sigma_2 r \quad (a = \lambda + \sigma_2 \varepsilon > 0).
\]

Let us put $r = 1/y$, or $\dot{r} = (a - \sigma_2 r)r$, then $\dot{r} = -(1/y^2)y$, or

$\dot{y} = -(ay - \sigma_2)$. Using the integrating factor ($e^{at}y$), and recalling $t \to \infty$, $e^{-at} \to 0$, we can finally get the above equation.
Table IV-9

Structural Changes in the Industrial Sector

<table>
<thead>
<tr>
<th>Condition</th>
<th>$K_x/L_x$</th>
<th>$K_x/L_x$</th>
<th>$K_x/X$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0 &lt; t &lt; t^*$</td>
<td>↓</td>
<td>↓</td>
<td>↓</td>
</tr>
<tr>
<td>$t^* &lt; t &lt; t^{**}$</td>
<td>↑</td>
<td>↑</td>
<td>↑</td>
</tr>
<tr>
<td>$t^{**} &lt; t &lt; \infty$</td>
<td>↑</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$t \to \infty$</td>
<td></td>
<td></td>
<td>const. const.</td>
</tr>
</tbody>
</table>

$L_x$ is an efficiency unit of labor in the industrial sector.

Figure IV-3

Structural Change in the Industrial Sector
Generalization of the Change of Capital-Output Ratio

Let us assume a production function which includes factor augmenting technical progress:

\[ X = f(\lambda_1(t)K, \lambda_2(t)L_x) \]

where output \( X \) is linear homogeneous in capital \( K \) and labor \( L_x \), and \( t \) is time trend which is independent of \( K \) and \( L_x \).

Now let

\[ \bar{k} = \frac{\lambda_1(t)K}{\lambda_2(t)L_x} \]

\[ R = \frac{X}{\lambda_2(t)L_x} = f(\bar{k}) \]

where \( \lambda_1(t)K \) and \( \lambda_2(t)L_x \) are efficiency units of capital stock and labor force.

Then,

\[ \frac{\bar{k}}{R} = \frac{\lambda_1(t)K}{X} \quad \text{or,} \]

\[ \frac{K}{X} = \frac{\bar{k}}{R} \frac{1}{\lambda_1(t)} \]

Consequently, the change in the capital-output ratio can be explained as follows; From the above equation,

\[ \frac{\dot{(K/X)}}{(K/X)} = \frac{\dot{K}}{K} - \frac{\dot{X}}{X} = \frac{\dot{\bar{k}}}{\bar{k}} - \frac{\dot{R}}{R} - \frac{\dot{\lambda_1}}{\lambda_1} \]

Since

\[ \frac{\dot{\bar{k}}}{\bar{k}} = (\frac{\dot{\lambda_1}}{\lambda_1} \frac{\dot{\lambda_2}}{\lambda_2}) + \frac{\dot{k}}{k} \quad \text{or} \quad \text{where} \quad k = K/L_x \]
and
\[
\frac{\dot{R}}{R} = \frac{f''(\bar{k}) \dot{\bar{k}}}{f'(\bar{k})} = f'(\bar{k}) \frac{\ddot{\bar{k}}}{f'(\bar{k})} \frac{\dot{\bar{k}}}{\bar{k}}
\]
\[
= f'(\bar{k}) \frac{\ddot{\bar{k}}}{f'(\bar{k})} \left( \frac{\dot{\lambda}_1}{\dot{\lambda}_1} - \frac{\dot{\lambda}_2}{\dot{\lambda}_2} + \frac{\dot{k}}{k} \right)
\]

Thus,
\[
\frac{\dot{k}}{k} - \frac{\dot{x}}{x} = \left( \frac{\dot{\lambda}_1}{\dot{\lambda}_1} - \frac{\dot{\lambda}_2}{\dot{\lambda}_2} \right) + \frac{\dot{k}}{k} - f'(\bar{k}) \frac{\ddot{\bar{k}}}{f'(\bar{k})} \left( \frac{\dot{\lambda}_1}{\dot{\lambda}_1} \frac{\dot{\lambda}_2}{\dot{\lambda}_2} + \frac{\dot{k}}{k} \right) \frac{\dot{\lambda}_1}{\dot{\lambda}_1}
\]
\[
= \left[ 1 - f'(\bar{k}) \frac{\ddot{\bar{k}}}{f'(\bar{k})} \right] \frac{\dot{k}}{k} - \left( \frac{\dot{\lambda}_1}{\dot{\lambda}_1} \frac{\dot{\lambda}_2}{\dot{\lambda}_2} \right) f'(\bar{k}) \frac{\ddot{\bar{k}}}{f'(\bar{k})} + \frac{\dot{\lambda}_2}{\dot{\lambda}_2}
\]

If we assume the Cobb-Douglas production function with Harrod-neutral technical progress:
\[
X = K^{\sigma_1} (e^{\sigma_2 L_x})^{\sigma_2}, \quad \sigma_1 + \sigma_2 = 1
\]
then,
\[
\frac{\dot{\lambda}_1}{\dot{\lambda}_1} = 0, \quad \frac{\dot{\lambda}_2}{\dot{\lambda}_2} = \frac{\lambda}{\sigma_2}, \quad \text{and}
\]
\[
1 - f'(\bar{k}) \frac{\ddot{\bar{k}}}{f'(\bar{k})} = \sigma_2
\]

Therefore,
\[
\frac{\dot{k}}{k} - \frac{\dot{x}}{x} = (1-\sigma_1) \frac{\dot{k}}{k} - (1-\sigma_1) \frac{\lambda}{\sigma_2}
\]
\[
= \sigma_2 \frac{\dot{k}}{k} - \lambda
\]

Consequently, if
\[
\frac{\dot{k}}{k} > \frac{\lambda}{\sigma_2}, \quad \text{the capital-output ratio is}
\]
\[
\begin{cases}
\text{increasing} & \text{if } \frac{\dot{k}}{k} > \frac{\lambda}{\sigma_2} \\
\text{constant} & \text{if } \frac{\dot{k}}{k} = \frac{\lambda}{\sigma_2} \\
\text{decreasing} & \text{if } \frac{\dot{k}}{k} < \frac{\lambda}{\sigma_2}
\end{cases}
\]
That is, if the rate of capital-labor ratio increase is larger (smaller) than the rate of the labor-augmenting technical progress, the capital-output ratio is increasing (decreasing).

**Structural Change in Korea's Industrial Sector**

In this subsection, I compare the structural change in Korea's industrial sector in the 1960's and 70's with our analysis in previous subsections. As we see from Table IV-10, the growth rate of capital stock \( \frac{K_X}{K_X} \) increased throughout the 1960's, and although the rate was slower after 1969 (with the peak of 19.7% in 1969), it remained at more than 10% in the 1970's. The growth rate of the industrial labor force fluctuated widely but the general trend shows that it has been getting smaller. The population growth rate decreased continuously throughout the 1960's and 1970's. The decreasing population growth rate is generally attributed to effective birth control in Korea. But the actual change was less dramatic than suggested by the table (2.69% in 1961 and 1.73% in 1974). The population growth rates in 1970-74 were based on

<table>
<thead>
<tr>
<th>Year</th>
<th>Kx/Lx ($)</th>
<th>Kx/X (%)</th>
<th>X/Lx ($)</th>
<th>Kx/KX (%)</th>
<th>Lx/Lx (%)</th>
<th>P/P (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1960</td>
<td>2.47</td>
<td>4.3</td>
<td></td>
<td></td>
<td></td>
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<td>4.4</td>
<td></td>
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<td>2.96</td>
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<tr>
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<td>6.2</td>
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<td>2.87</td>
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<td>7.9</td>
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<td>2.88</td>
</tr>
<tr>
<td>64</td>
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<td>2.34</td>
<td>861.5</td>
<td>7.2</td>
<td>4.7</td>
<td>2.56</td>
</tr>
<tr>
<td>65</td>
<td>1,896.8</td>
<td>2.18</td>
<td>871.2</td>
<td>7.0</td>
<td>13.7</td>
<td>2.34</td>
</tr>
<tr>
<td>1966</td>
<td>1,984.7</td>
<td>2.14</td>
<td>926.9</td>
<td>11.0</td>
<td>6.1</td>
<td>2.24</td>
</tr>
<tr>
<td>67</td>
<td>2,039.7</td>
<td>2.10</td>
<td>972.7</td>
<td>14.9</td>
<td>11.8</td>
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<td>1,046.4</td>
<td>17.0</td>
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<td>2.10</td>
<td>1,138.7</td>
<td>19.7</td>
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<tr>
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<td>2,529.2</td>
<td>2.16</td>
<td>1,171.4</td>
<td>18.4</td>
<td>11.9</td>
<td>*4.89</td>
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<td>2,730.8</td>
<td>2.17</td>
<td>1,257.4</td>
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<td>1,402.8</td>
<td>11.7</td>
<td>1.0</td>
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<tr>
<td>73</td>
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<td>1,594.4</td>
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</tr>
<tr>
<td>74</td>
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<td>1.94</td>
<td>1,687.2</td>
<td>11.8</td>
<td>6.6</td>
<td>1.73</td>
</tr>
</tbody>
</table>

Table IV-10

Structural Change in the Industrial Sector

Table A3, Table A5, and Major Statistics of Korean Economy, EPB, 1976

# All dollars are in 1970 U.S. Dollars.

* 70-75 population is adjusted by 1975 census.
1970 population census and the population (according to the census) in 1970 grew 4.89% compared to the 1969 (before census) population. When we compare the population growth rate in 1970 (4.89%) with the population growth rates in other years, it is unreasonably high. In other words, if the 1970 census is more accurate than previous ones, the population growth rates before the census were upward biased. In any case, we will assume that the population growth rates were fairly stable in the 1960's and 70's.

We will now proceed to compare these structural changes in Korea's industrial sector with Fig.IV-5. In Fig.IV-5, when

\[ t^* < t < t^{**}, \]

i) the growth rate of capital stock is higher than that of labor force,

ii) the capital growth rate is increasing,

iii) the capital-output ratio is decreasing \([\frac{\dot{X}}{Kx}>0]\),

and when

\[ t > t^{**}, \]
i) the growth rate of capital stock is higher than that of the labor force,

ii) the capital growth rate is decreasing,

iii) the capital-output ratio is increasing

\( \frac{\dot{X}}{X} - \frac{K_x}{K_x} < 0 \).

When we look at the growth rates of capital stock and labor force in Korea's industrial sector, the capital stock growth rate exceeds the labor growth rate in 1966, and the capital stock growth rate peaks in 1969. Accordingly, when we take into account these two facts, we can deduce that the Korean industrial sector is in the stage beyond t** in terms of Fig.IV-5.

But if \( t > t^{**} \), the capital-output ratio is increasing according to Fig.IV-5, while in the Korean case it decreases until 1968, increases during the 1969-72 period and decreases again slightly. The changes of capital-output ratios do not coincide exactly with Fig.IV-5. This is due to the fact that Korea imported a large amount of foreign capital during that period.

As discussed in Chapter II, the amount of foreign capital inflow was larger than the social optimum
because of various direct and indirect subsidy programs. Consequently, if we lift such subsidies, the capital-output ratio should be fairly stable in the future as discussed in Appendix A.

4-4 Growth of a Closed Economy

Basic Assumptions

In our model for the Korean economy, we have following assumptions:

(A.1) A neo-classical notion of surplus labor is assumed. And the under-employed labor in the traditional sector is ready to migrate toward the industrial sector whenever the wage rate which is not lower than the current wage rate is guaranteed (Ch. II, 2-1). Also, labor is well educated so that the labor that has migrated from the traditional sector can easily be converted for use in industrial goods production with low training cost (Ch.IV, 4-1).

(A.2) For our initial condition, we assume a fairly developed economy. This assumption distinguishes our model from the Jorgenson-Dixit-Zarembka model. The Jorgenson-Dixit-Zarembka model shows only the conditions

24/This was discussed in greater detail in Ch.II (2-3).
25/All assumptions are discussed in various places in previous chapters and the first part of this chapter.
for emergence of the industrial sector, but the basic purpose of our model is to show the conditions for an equilibrium growth path of the economy after the industrial sector has been emerged. (Ch.IV, 4-3)

(A.3) We assume that the capital stock is also an important factor for the agricultural (=traditional) goods production. Asymptotic properties of Dixit and Zarembka are applicable (Ch.IV, 4-3 and Appendix A). In other words, neo-classical savings and investment functions are applicable to both sectors. The duality of our model can be characterized by asymmetric labor allocation and capital-output ratios across sectors. Labor is mobile across sectors but capital is not. In other words, capital stock in the agricultural sector includes basic traditional tools which cannot be shifted toward industrial goods production (Ch.II, 2-1 and Table II-5).

(A.4) The population growth rate is exogenously given, and per capita food consumption is equal and increasing at a constant rate in both sectors.

(A.5) Finally, the natural endowment of the economy (natural resource endowment, nature of terrain, etc.) is such that the development of the traditional sector is considerably limited (Ch.II, 2-1 and Ch.IV, 4-1). Consequently, our development goal is to stimulate the
industrial sector to grow faster than the agricultural sector. For that purpose, we are going to induce under-employed labor in the traditional sector to shift to the industrial sector where labor can be employed more productively. As a result, the development of the economy will be accompanied by an increasing share of labor employed in the industrial sector as well as an increasing ratio of industrial output to agricultural output and/or total output.

**Basic Structural Equations**

We assume two sectors, a traditional sector and an industrial sector, and each sector has a linear homogeneous Cobb-Douglas production function with Harrod neutral technical progress. The production function in the traditional sector is

\[ Y = e^{at} K_y^{\beta_1} L_y^{\beta_2} \quad \beta_1 + \beta_2 < 1 \]

where \( Y \) is total output of the traditional sector; \( K_y \) and \( L_y \) are capital stock and labor force in that sector; \( a \) is the technical progress parameter; and \( \beta_1 \) and \( \beta_2 \) are production elasticities of capital and labor, respectively. (Land is assumed to be constant.)
The production function of the industrial sector is

\[ X = e^{\lambda t} K_x^{\sigma_1} L_x^{\sigma_2} \quad \sigma_1 + \sigma_2 = 1 \]

where \( X \) is the total output of the industrial sector; \( K_x \) and \( L_x \) are capital stock and labor force in that sector; \( \lambda \) is the technical progress parameter; and \( \sigma_1, \sigma_2 \) are production elasticities of capital and labor, respectively.

Neoclassical savings and investment functions are assumed in both sectors (A.3).\(^{26}\)

\[ S_y = q s \beta_1 Y = q I_y \]
\[ S_x = s \sigma_1 X = I_x \]

where \( S_y \) and \( S_x \) are total savings in the agricultural and the industrial sectors; \( q \) is a relative price \((p_y/p_x)\); \( s \) is a marginal propensity to save of capital income earners in both sectors; \( I_y \) and \( I_x \) are total investments in the agricultural and the industrial sectors, respectively.

---

\(^{26}\)Even though we assume that both capital income earners and wage earners save with different propensities to save, investment depends only on the propensity to save of capital income earners (Pasinetti, 1962 and Appendix A). Furthermore, equations (3) and (4) define savings and investment functions in two sectors which imply that savings in the traditional sector are invested in the traditional sector only and vice versa. This assumption is fairly reasonable, because traditional goods producers are generally concerned about the (cont.)
By assumption (A.4), population growth rate (ε) is exogenously given as follows:

\[ (5) \quad P = P_0 e^{\varepsilon t} \]

where \( P \) is total population, and labor force (L) is a constant fraction of total population,

\[ (6) \quad L = \theta P \quad \theta < 1 \text{ and constant.} \]

Labor is being allocated as follows:

\[ (7) \quad L = L_0 e^{\varepsilon t} \]

\[ (8) \quad L_x = L - L_y \]

where \( L_x \) is a labor force in the industrial sector and \( L_y \) is a labor in the traditional sector.

By assumption (A.4), per capita food consumption in both sectors are equal and increase steadily:

\[ (9) \quad q_P^Y = q_P^e v_P^e \]

where \( v_P = Y_0 / P_0 \) which is constant and \( \rho \) is a rate of per capita food consumption increase.

(Cont.) decline in output as their workers migrate toward the industrial sector. Consequently, when they have savings, they buy tools and equipment to increase output.
Consequently,

\[
(10) \quad \frac{q_{Ry}}{L_y} = \frac{q_{Rx}}{L_x} = \frac{qR}{L} = qve^p
\]

where \( R_y \) and \( R_x \) are consumptions of agricultural goods in the agricultural and industrial sectors, respectively; \( R = R_x + R_y \); and \( v = v_p/\theta = Y_0/L_0 \).

By assumption, wage rate in the traditional sector is determined as follows,

\[
(11) \quad w_y = q(1-\beta_1)Y/L_y
\]

where \( w_y \) is a wage rate in the agricultural sector and recall that

\[
MPP_{L_y} = \frac{\partial Y}{\partial L_y} = \beta_2 Y/L_y \leq (1-\beta_1)Y/L_y
\]

but wage rate in the industrial sector is determined by the marginal productivity principle,

\[
(12) \quad w_x = MPP_{L_x} = \sigma_2 X/L_x
\]

where \( w_x \) is a wage rate in the industrial sector.

By assumption (A.1), wage rates in the two sectors have following relationships;

\[
(13) \quad w_y = \omega w_x \quad \sigma < \omega < 1
\]
The terms of trade between two sectors can be defined as

\[(14) \quad q = \frac{U_y}{R_x}\]

where \(U_y\) is a total demand of industrial goods by the agricultural sector.

Finally, by asymptotic properties of the capital-output ratio, output growth rates in two sectors can be written as,

\[(15) \quad \frac{\dot{y}}{y} = \frac{\alpha}{1-\beta_1} + \frac{\beta_2}{1-\beta_1} \varepsilon_y\]

\[(16) \quad \frac{\dot{x}}{x} = \frac{\lambda}{\rho_2} + \varepsilon_x\]

where \(\varepsilon_y\) and \(\varepsilon_x\) are growth rates of agricultural and industrial labor forces, respectively.

If we define \(\iota = L_y/L\),

\[(17) \quad \iota = \varepsilon_y + (1-\iota)\varepsilon_x\]

**Growth Path of a Closed Economy and its Limit**

We shall analyze the closed economy first to show the limit to growth when there is no international trading. From assumption (A.4) and equation (10), the equilibrium condition of the agricultural goods market can be written as
\[ R = Y = L \text{ve}^{\rho t} \]

And for the equilibrium growth path, the above condition should be fulfilled for all \( t \). Consequently,

\[ \frac{a}{1-\beta_1} + \frac{\beta_2}{1-\beta_1} \varepsilon_y = \varepsilon + \rho \quad \text{or} \]

\[ (c.1) \varepsilon_y = \frac{(\varepsilon + \rho)(1-\beta_1) - a}{\beta_2} \]

Condition (c.1) shows a required \( \varepsilon_y \) for the agricultural goods market equilibrium when all other parameters are given. Next, we are going to see the condition for labor migration toward the industrial sector when condition (c.1) is fulfilled. Even though the growth rate of agricultural labor is positive (\( \varepsilon_y > 0 \)), if it is smaller than the total labor growth rate (\( \varepsilon_y < \varepsilon \)), it implies labor migration toward the industrial sector. In other words, \( \varepsilon_y < 0 \) is one of our development goals (A.5).

\[ \frac{i}{t} = \varepsilon_y - \varepsilon = \frac{(\varepsilon + \rho)(1-\beta_1) - a}{\beta_2} - \varepsilon \]

\[ = \frac{(1-\beta_1-\beta_2)\varepsilon + (1-\beta_1)\rho - a}{\beta_2} \]

Consequently, for \( \varepsilon_y < 0 \),

\[ (c.2) \varepsilon < \frac{a - (1-\beta_1)\rho}{1-\beta_1-\beta_2} \]
If condition (c.2) is fulfilled, the agricultural labor can migrate toward the industrial sector without disturbing the equilibrium situation of the agricultural goods market. From conditions (c.1) and (c.2) we see that the technical progress(\(a\)) in the agricultural sector is a very important factor in attaining our development goals. In brief, if \(a\) is relatively large, required agricultural labor force growth rate (required to maintain agricultural goods market equilibrium) can be smaller. Also, if \(a\) is relatively large, condition (c.2) can easily be achieved.

It is easy to show that condition (c.2) is also a sufficient condition for the production of an agricultural surplus. We can have an agricultural surplus if agricultural goods production is larger than the agricultural goods consumption in the agricultural sector. That is, if

\[
Y > R_y (= L_y v e^{\rho t}) \quad \text{or,}
\]

\[
\frac{Y}{L_y} > v e^{\rho t} \quad \text{or,}
\]

\[
\left( \frac{a}{l - \beta_1} + \frac{\beta_2}{l - \beta_1} e^y - e^y \right) t > v e^{\rho t}, \quad t \neq 0
\]

agricultural surplus exists. Therefore, to have agricultural surplus for all \(t \ (t \neq 0)\),
must be fulfilled. By taking condition (c.1) into account and by rearranging the above inequality, we can derive condition (c.2). In other words, if condition (c.2) is fulfilled, the agricultural sector will produce a surplus and labor can be released from the agricultural sector to the industrial sector. The agricultural surplus is used to feed the increasing industrial labor force.

If we assume \( \rho = \beta_1 = 0 \) (Jorgenson's assumption), condition (c.2) reduces to the Jorgenson's necessary and sufficient condition for the emergence of the industrial sector. Broadly speaking, this means that an extended form of Jorgenson's condition holds in our closed economy model.

Our next concern is to analyze the long-run growth path of the industrial sector when condition (c.2) is fulfilled. If condition (c.2) is fulfilled, the agricultural surplus is positive. That is,

\[
U_y = q(Y - R_y) = q(Y_0 e^{(\varepsilon + \rho)t} - R_0 e^{(\varepsilon_y + \rho)t})
\]

\(27\) Nevertheless, condition (c.2) is not a sufficient condition for an increasing ratio of industrial output to agricultural output. (See condition c.4)
Thus,

\[ \dot{U}_y = \frac{Y_0(e+\rho)e(e+\rho)t - R_0(e_y+\rho)e(e_y+\rho)t}{Y_0e(e+\rho)t - R_0e(e_y+\rho)t} \]

Since \( e_y < e \) by condition (c.2),

\[ \lim_{t \to \infty} \frac{\dot{U}_y}{U_y} = 0 = e + \rho \]

and from equation (10),

\[ (c.3)' \quad \frac{\dot{R}_x}{R_x} = e_x + \rho \]

Conditions (c.3), (c.3)' and equation(14) say that the industrial labor which is increasing at the rate of \( e \) asymptotically can be fed by the agricultural surplus. In other words, along the equilibrium growth path (\( q/q = 0 \)), the industrial labor force can only grow at the rate of \( e \) in the long-run. By equation(2) (production function in the industrial sector) and condition(c.3), we can derive a long-run growth rate of industrial output.

\[ \lim_{t \to \infty} \frac{\dot{X}}{X} = \frac{\lambda}{\sigma_2} + e \]

Those asymptotic conditions are basically the same as Dixit's.\(^{28}\) Even though we have capital stock in the agricultural goods production, the growth rates

\(^{28}\)Dixit(1970), pp.230-231
of output and capital stock in the industrial sector are asymptotically equal with the growth rate of efficiency units of labor in the industrial sector \((\lambda/\sigma_2 + \varepsilon)\).

All of the above solutions are for equilibrium growth path \((\dot{q}/q = 0)\). If \(q\) moves in favor of the agricultural sector \((\dot{q}/q > 0)\) it will destroy the industrial entrepreneurs' motivation to produce industrial goods. Conversely, if \(q\) moves against the agricultural sector \((\dot{q}/q < 0)\), it will be very difficult to maintain the agricultural goods output level which is sufficient to feed the whole population (without importing of foods). For example, as we see from equations (11) and (13), if \(q\) increases, industrial entrepreneurs have to pay higher wage to induce labor migration toward the industrial sector. But if \(q\) decreases, as we see from equation (14), the agricultural sector has to produce more surplus to obtain industrial goods from the industrial sector.

Let us look at the condition for a stable relative price (or \(q/q = 0\)). From equation (11), \(q\) can be rewritten as
and by substituting equation (13) into (11)', we can obtain

\[ q = \frac{\omega}{1-\beta_1} w_x \frac{L_y}{y} \]

Since the marginal productivity principle is applied to the labor employment in the industrial sector, \( \frac{w_x}{w_y} = \frac{\lambda}{\sigma_2} \). Therefore,

\[ \frac{\dot{q}}{\dot{a}} = \frac{\lambda}{\sigma_2} + \varepsilon_y - (\varepsilon + \rho) \]

and by condition (c.1),

\[ \frac{\dot{q}}{\dot{a}} = \frac{\lambda}{\sigma_2} + \frac{1-\beta_1-\beta_2(\varepsilon + \rho)}{\beta_2} - \frac{a}{\beta_2} \]

Consequently,

\[ \frac{\dot{q}}{\dot{a}} \geq 0 \text{ if } \frac{a}{\beta_2} - \frac{\lambda}{\sigma_2} \leq \frac{1-\beta_1-\beta_2}{\beta_2} (\varepsilon + \rho) \]

and for an equilibrium growth path (\( \frac{\dot{q}}{\dot{a}} = 0 \)),

\[ (c.4) \quad \frac{a}{\beta_2} - \frac{\lambda}{\sigma_2} = \frac{1-\beta_1-\beta_2}{\beta_2} (\varepsilon + \rho) > 0 \]

That is, the technical progress in the agricultural sector must be relatively larger than that in the industrial sector, which is unlikely in the development of a dual economy with surplus labor in the agricultural sector.
If the technical progress in both sectors are such that the relative price moves in favor of the agricultural sector ($q/q > 0$), a reallocation of labor will occur that is contrary to our development goals. From equation (14),

$$\frac{\dot{U}_y}{U_y} = \frac{\dot{a}}{q} + \frac{\dot{R}_x}{R_x} = \frac{\dot{a}}{q} + (\varepsilon_x + \rho)$$

and from condition (c.3),

$$\lim_{t \to \infty} \frac{\dot{U}_y}{U_y} = \varepsilon + \rho$$

Thus, in the long-run,

$$\frac{\dot{q}}{q} = \varepsilon - \varepsilon_x$$

Consequently, if $q/q > 0$, this will cause a backward flow of labor ($\varepsilon - \varepsilon_x > 0$).

Finally, if we define $m$ as

$$m = qX/Y, \text{ and } q/q = 0,$$

$$\frac{(m)}{m} = \lim_{q \to 0} t \to \infty \frac{X - \dot{Y}}{X} = \frac{\lambda}{\sigma_2} - \rho$$

and by condition (c.4),

$$\frac{\lambda}{\sigma_2} = a - \frac{(1-\beta_1-\beta_2)(\varepsilon + \rho)}{\beta_2}$$
Therefore,
\[
\left( \frac{m}{m} \right)_{q=0} = \frac{a-(1-\beta_1-\beta_2)(\varepsilon+p)}{\beta_2} = \frac{a-(1-\beta_1)p-(1-\beta_1-\beta_2)e}{\beta_2} > 0
\]

since \( \beta_2 > 0 \), and \( a-(1-\beta_1)p > (1-\beta_1-\beta_2)e \) by condition\( (c.2) \).

In other words, only when technical progress in both sectors is such that the economy follows an equilibrium growth path (or only when condition\( (c.4) \) is fulfilled), can the industrial sector grow faster than the agricultural sector. In conclusion, the equilibrium growth of our closed economy model can attain our development goals under very limited circumstances. In other words, when both conditions\( (c.2) \) and \( (c.4) \) are fulfilled, we can attain our development goals \( (A.5) \). But condition \( (c.4) \) is very restrictive and unlikely to be satisfied in a country like Korea. However, \( \beta_2 \) (production elasticity of capital in the agricultural sector which determines the level of savings and investment in that sector) could be increased as the agricultural sector is being developed. This would increase the feasibility of industrial growth and labor migration.
It is empirically observed that the first step of economic development and growth in any country, even in a labor rich country, is capital accumulation. This is clearly a contradiction to the classical comparative advantage theory of international trade. Chenery (1961) points out that "the classical analysis focuses on long-run tendencies and equilibrium conditions, while modern theories of growth are concerned with the interaction among producing and consuming units in a dynamic system". Furthermore, he argues that "growth theory either ignores comparative advantage and the possibilities of trade completely, or it considers mainly the dynamic aspects, such as the stimulus that an increase in exports provides to the development of related sectors or the function of imports as a carrier of new products and advanced technology". In this context Rao (1968) explains the role of exports in economic development as follows: Primarily, every developing country requires foreign supplies of machinery equipment, and technical know-how, and exports are the best wares for financing
imports. Secondly, the developing country has to resort to foreign loans and foreign participation in economic activity. Those loans carry interest and the principal has to be paid. Foreign participation involves the remittance of profits. All this requires foreign exchange, which can only be acquired by an increase in exports. More importantly, Rao points out that there is no autonomous tendency on the part of a developing economy to increase its export capacity. Therefore, the increasing rate of export is just the reflection of the social effort for development and growth.

As pointed out by Fei and Ranis (1974), the agricultural sector, under similar conditions to those in Korea, pulls down the growth of the industrial sector.\(^1\) The way to break through that barrier is to open the economy and export industrial products in exchange for food imports. As we discussed in Chapter II, Korea emphasized capital formation throughout the 1960's and 70's and economic growth was largely attributable to such activities. But, once the capital stock reaches

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\(^1\)See footnote 11, pp.125(Ch.IV). They did not discuss this phenomenon analytically in their paper, but our discussion of a closed economy model(Ch.IV) explains how Korea's agricultural sector can have a negative role in economic development.
a certain level (i.e., capital-output ratio becomes fairly stable), labor transfers are required to maximize economic growth and to exploit a country's comparative advantage.

In this chapter, we are going to discuss a growth policy for a dualistic open economy like Korea. Korea has a fairly well developed industrial sector and it is more likely that the technical progress in the industrial sector is faster than that in the agricultural sector. Consequently, we are going to export industrial goods in exchange for agricultural goods along the equilibrium growth path of the economy. Furthermore, we are going to import foreign capital for rapid industrialization and growth. In this context, the main purpose of our discussion of the open economy model is to analyze whether or not self-sufficient growth is feasible (or capital imports and export-led growth is feasible). The "self-sufficiency" can be defined as a long-run trade balance equilibrium in an open economy. The importance of capital imports for industrialization of the economy and the trade balance equilibrium were already discussed with reference to Rao's argument. But it is crucial in the case of Korea, where natural resource endowments are poor. If the trade balance is getting larger and larger as the economy grows, the future growth of
the economy will become uncertain, and our open economy growth policy infeasible.

5-1 Further Assumptions for an Open Economy Model

(A.6) We are going to further assume that the imported capital is used for industrial goods production only. This assumption is consistent with the assumption (A.5) which implies that the country we are concerned with cannot be specialized in agricultural goods production. The amount of capital imports is determined by the central authorities, and the country is assumed to be a price taker in international markets.2

(A.7) From assumption (A.3), the constant capital-output ratio and the capital-efficiency-unit-of-labor ratio can be written as follows:3

\[
\begin{align*}
    c &= \frac{X}{K_x} = \frac{dX}{dK_x} = \text{constant} \\
    \tilde{k} &= \frac{K_x}{\frac{A_t}{\sigma_2}e^{L_x}} = \text{constant}
\end{align*}
\]

---

2/ See Ch.II, Table II-21 for the case of Korea
3/ See the discussion for the structural change in Korea's industrial sector (Ch.IV, 4-3).
(A.8) We assume that the rate of technical progress in the industrial sector is larger than that in the agricultural sector \((\lambda/\sigma_2 > a/\beta_2)\).

(A.9) Finally, our development goal in the open economy model is to attain a self-sufficient growth path (as well as those goals described in assumption (A.5) in Chapter IV). In other words, rapid industrialization and growth as well as achievement of the trade balance equilibrium in the long-run are our development goals in the open economy. Trade balance equilibrium in each year is not necessary.

5-2 Capital Imports and Growth: Outline of the Approach

In this section, I show the role of capital imports for the growth of a labor surplus economy using comparative statics analysis. While this has been done by Johnson, H. (1971), I extend the use of the analysis to the labor surplus dualistic open economy. The notation used in the diagram is the same as Johnson's.
First of all, let us assume the "Heckscher-Ohlin World": two-good($X_1, X_2$), two-factor($K, L$), two-country world, with constant returns to scale production functions which are identical across countries, and make Samuelson's strong factor-intensity assumption in which $X_1$ (capital good) is capital intensive and $X_2$ (consumption good) is labor intensive. Finally, assume that the economy imports $X_1$ and exports $X_2$ (or a labor rich country).

In Fig. V-1, $OM_K$ is total output in terms of capital and $OM_L$ is total output in terms of labor. Thus, $M_KM_L$ is the budget constraint on the economy and the slope of $M_KM_L$ is the factor-price ratio. Since we assume competitive markets, cost ratios in the two industries must be equal, and $M_KM_L$ is the common tangent line to isoquants, I-I and II-II. $R_{X1}$ and $R_{X2}$ are factor intensity lines for the $X_1$ and $X_2$ industries, respectively, and $R$ is the overall capital-labor ratio of the economy. Before capital importation $OB$ is $X_1$ production and $OC$ is $X_2$ production. Now, if the country imports capital, the budget constraint shifts to $M'_K M'_L$ and the overall capital-labor ratio becomes $R'$. If we assume full-employment initially of both factors, the production of $X_1$ and $X_2$ after capital importation becomes $OB'$.
Figure V-1

Capital Imports and Growth
and OC': more capital goods production ($X_1$-importables) and less consumption goods production($X_2$-exportables). This is simple the Rybczynski's theorem. Considerable import substitution takes place but, at the same time, the amount of exports decreases considerably. But in the labor surplus dual economy, where there is huge disguised unemployment in the traditional sector, and where workers are ready to migrate to the industrial sector, capital importation may stimulate that labor to migrate toward the industrial sector.

If we assume a constant wage rate(an extreme case), industrial entrepreneurs will employ more labor from the agricultural sector, thus, the budget constraint will shift again to $M_K^*M_L^*$ and the overall capital-labor ratio will shift back to the original position $R$. Consequently, the country will produce $OB''$ of $X_1$ and $OC''$ of $X_2$ which means there is considerable import substitution along with greater $X_2$ exports. More exports suggest the possibility of more import substitution and future economic self-sufficiency.

In brief, we have two questions to be answered in our open economy model: First, how much foreign capital should we import? Imported capital creates
employment opportunities to induce labor migration from the agricultural sector and permits a higher growth rate for the industrial sector, both of which enhance chances of attaining our development goals described in assumption (A.5). Second, is such a growth policy feasible in the long-run?

5-3 Capital Imports and the Growth Rate of the Industrial Sector

When we have imported capital stock in our production function, the net domestic income in the industrial sector \( V_D \) can be rewritten as follows:

\[(18) \ V_D = X - rF \]

where \( F \) is total imported capital stock and \( r \) is the equilibrium interest rate in the international loan market.

Consequently, the total domestic savings in the industrial sector in an open economy can be rewritten as

\[(19) \ S_x = s(\sigma_1X - rF) \]

and, capital formation is

\[4/\text{Definition of "capital imports" (F) is capital stock imports which is financed by long-term foreign loans and direct investments.} \]

\[5/\text{Since we are concerned with an equilibrium growth path we can assume that } q=1 \text{ =constant, i.e., fixed world terms of trade over the planning period.}\]
(20) \[ I_x = S_x + M_k = s(\sigma_1 X - rF) + M_k \]

where \( M_k = dF \).

Let us define \( \overline{H} \) as

(21) \[ \overline{H} = F/K_x \quad \text{or} \quad F = \overline{H} K_x, \quad \overline{H} < 1 \]

where \( \overline{H} \) is the share of total imported capital out of total domestic capital stock.

Then, returns to domestically accumulated capital and to imported capital will be divided proportionately as \( \overline{H} \), or

(22) \[ rF = \overline{H} \sigma_1 X. \]

By our assumption of constant output-capital ratio,

\[ \dot{X} = cK_x = c \left[ s(\sigma_1 X - rF) + M_k \right], \]

since

\[ F/X = \overline{H}\sigma_1/r \quad \text{(from eq. (22))} \]

and

\[ M_k/X = M_k/F \cdot F/X = f \overline{H} \sigma_1/r \]

where \( f = \dot{F}/F = M_k/F \) which is a policy variable,

\[ \frac{\dot{X}}{X} = \sigma_1 c \left[ s + \left( \frac{f}{r} - s \overline{H} \right) \right] \]
By observing that \( \sigma_1 c = r \),

\[
(23) \quad \frac{\dot{X}}{X} = rs + (f - rs)H
\]

Equation (23) implies that the growth rate of the industrial sector can be written in terms of the rate of capital imports if some agricultural labor can be induced to migrate toward the industrial sector whenever they are offered a wage rate which is not lower than the current wage rate in the agricultural sector (A.1). From equations (21) and (23) and by our assumption of constant capital-output ratio,

\[
(24) \quad \frac{\dot{H}}{H} = (f - rs) - (f - rs)H.
\]

The solution of the above differential equation is

\[
(25) \quad H = \frac{A e^{(f-rs)t}}{1 + Ae}
\]

where \( A = \frac{H_0}{1 - H_0} \), \( H_0 < 1 \).

---

6/ Since \( \sigma_1 = \frac{\partial X}{\partial Kx} \cdot \frac{Kx}{X} \), \( r = \frac{\partial X}{\partial Kx} \), and by definition \( c = \frac{X}{Kx} \), \( r = \sigma_1 c \).
From equation (25),

\[
\lim_{t \to \infty} H = \begin{cases} 
1, & \text{if } f - rs > 0 \\
0, & \text{if } f - rs < 0 \\
Ho, & \text{if } f - rs = 0
\end{cases}
\]

which means that, if the growth rate of foreign capital imports is larger (less) than \( rs \) (interest rate in the international loan market times marginal propensity to save), the share of imported capital (which is financed by long-term foreign loan) is increasing (decreasing).

In other words,

\[(c.5) \quad \frac{\partial \overline{H}}{\partial t} \geq 0, \quad \text{if } f - rs \geq 0 \]

and a large \( \overline{H} \) may mean, in turn, an uncertainty of the future growth.

The momentum of the growth accelerator can be shown as follows; From equation (23),

\[(c.6) \quad \frac{\partial \left( \frac{X}{X_f} \right)}{\partial t} = (f - rs) \frac{\partial \overline{H}}{\partial t} \]

Since condition (c.6) is non-negative for all \( f \) \((\geq 0)\), the momentum depends on the size of \( f \). If \( f \) is very large, we can accelerate the growth rate of the industrial sector considerably even in the short-run.
5-4 Feasibility Problem

If capital importation, which would induce labor migration from the agricultural sector and accelerate the growth of the industrial sector, stimulates the exports of industrial goods such that the exports are enough to finance the imports of capital and agricultural goods in the long-run, our open economy growth policy is feasible.

Let us define the net industrial goods exports \( E_X \) as

\[
(26) \quad E_X = X - X_D
\]

where \( X_D \) is total domestic demand for industrial goods.

And, an industrial goods demand function with constant elasticities is assumed as follows;

\[
(27) \quad \frac{X_D}{P} = z^{u_1}(1/q)^{-u_2}, \quad 0 < u_1 < 1, \quad u_2 > 0
\]

where \( z \) is per capita income \( (z = (qX+Y)/P) \), and \( u_1 \) and \( u_2 \) are income and price elasticities of industrial goods demand. (But \( q=0 \) along the equilibrium growth path.)

Total imports \( M \) consist of agricultural goods imports and capital goods imports.
(28) \[ M = M_y + M_k \]

where \( M_y = Y_D - Y \) (agricultural goods imports).

Consequently, trade balance deficit \( D \) can be defined as

(29) \[ D = M - E_x = (Y_D - Y) + M_k - (X - X_D) \]

Therefore,

(30) \[ D_m = \frac{\partial D}{\partial M_k} = 1 - \frac{\partial Y}{\partial M_k} - \frac{\partial X}{\partial M_k} + \frac{\partial X_D}{\partial M_k} \]

(Recall \( Y_D \) is independent of \( M_k \)).

Since

(i) \[ \frac{\partial X}{\partial M_k} = c \]

(ii) \[ \frac{\partial Y}{\partial M_k} = -\beta_2 \frac{1}{k} e^{-\frac{\lambda t}{\sigma^2}} \frac{Y}{L_y} \]

(iii) \[ \frac{\partial X_D}{\partial M_k} = u_1 z u_1^{-1} \left( \frac{\partial X}{\partial M_k} + \frac{\partial Y}{\partial M_k} \right) \]

\[ D_m = (1-c) + \beta_2 \frac{1}{k} e^{-\frac{\lambda t}{\sigma^2}} \frac{Y}{L_y} + u_1 z \left( c - \beta_2 \frac{1}{k} e^{-\frac{\lambda}{\sigma^2}} \frac{Y}{L_y} \right). \]

And again,

\[ \frac{Y}{L_y} = \nu e^{(\frac{\alpha}{1-\beta_1} + \frac{\beta_2}{1-\beta_1} \bar{\varepsilon}_y - \varepsilon_y) t} \]

\[ \frac{z}{p} = \nu e^{(\frac{\alpha}{1-\beta_1} + \frac{\beta_2}{1-\beta_1} \bar{\varepsilon}_y - \varepsilon) t} + m_0 \nu p e^{[rs + (f-rs) \bar{H} - \bar{\eta}] t} \]
Finally, equation (30) can be rewritten as;

\[(31) \quad D_m = (1-c) + \beta_2 v_{\frac{1}{k}} e^{at} - u_1 \beta_2 v_{\frac{1}{k}} e^{at} (v_p e^{bt} + m_0 v_p e^{ht}) u_1^{-1} \]

\[+ u_1 c (v_p e^{bt} + m_0 v_p e^{ht}) u_1^{-1} \]

where

\[a = \frac{\alpha}{1-\beta_1} - \frac{\beta_1 - \beta_2}{1-\beta_1} \varepsilon_y = \frac{\lambda}{\sigma_2} \]

\[b = \frac{\alpha}{1-\beta_1} - \frac{\beta_2}{1-\beta_1} \varepsilon_y - \varepsilon \]

\[h = rs + (f-rs)H - \varepsilon \]

In an extreme case such as \(u_1 = 1\), \(D_m\) equals unity and our open economy growth policy is not feasible. In other words, if income elasticity of demand for industrial goods is unity, capital imports cannot create a sufficient exporting ability in the economy to reduce the trade balance deficit in the long-run. But if \(u_1\) is less than unity, \(D_m\) varies as \(t\) changes. Let us look at the change in \(D_m\) as \(t\) changes when other parameters are given.

\[(32) \quad \frac{\partial D_m}{\partial t} = \alpha \beta_2 v_{\frac{1}{k}} e^{at} (1-u_1 z u_1^{-1}) - u_1 (u_1-1) z u_1^{-2} \]

\[+ (b v_p e^{bt} + (h+t(f-rs)H) v_p e^{ht}) \]

\[+ (\beta_2 v_{\frac{1}{k}} e^{at} - c) \]
Since

(i) the rate of technical progress in the industrial sector is larger than that in the agricultural sector, \( a \) is negative

(ii) the growth rate of agricultural output is less than \( \varepsilon + \rho \) (\( \beta_y \) is positive) but larger or smaller than \( \varepsilon \), \( b \) can be positive or negative

(iii) the growth rate of industrial output is larger than \( \varepsilon \) (by assumption), \( h \) is positive.

And,

(iv) \( (f - rs) \frac{\partial H}{\partial t} > 0 \) for all \( t \) and \( f \)

(v) \( (1 - u_1 z) > 0 \)

(vi) even though \( b < 0 \), \( be^{bt} \to 0 \) as \( t \to \infty \).

Therefore, if

\[(c.7) \quad \beta_2 v^* \frac{1}{k} e^{at} - c < 0\]

\( D_m \) decreases. In other words, if condition \((c.7)\) is fulfilled our open economy growth policy is feasible. Let us look at condition \((c.7)\) if it holds when income elasticity is less

---

7/By our assumption \((A.8)\), \( a/\beta_2 < \lambda/\sigma_2 \), and \( a/(1 - \beta_1) < a/\beta_2 \).

8/In our open economy model, we assume that \( 1/y < \varepsilon + \rho \) but it can be larger or smaller than \( \varepsilon \) depending on the size of foreign capital imports which, in turn, induce labor migration toward the industrial sector.
than unity and other parameters are given.

Recall that

\[ v e a t = \frac{Y}{L_y} e^{-\frac{\lambda}{\sigma_2} t} \]

\[ c = (k)^{-\sigma_2} \]

2/ Thus, condition (c.7) can be rewritten as,

\[ \frac{\beta_2 \frac{Y}{L_y} e^{-\frac{\lambda}{\sigma_2} t}}{k} \left< (k)^{-\sigma_2} \right> \]

or

\[ \frac{\lambda}{\sigma_2} t \]

\[ \sigma_1 \frac{L}{e} = k \sigma_1 e^{\lambda t} > \beta_2 \frac{Y}{L_y} \]

where \( k = K_x/L_x = \tilde{k} e \).

2/ From equation (2), \( X = K_x \sigma_1 (e^{\lambda t/\sigma_2 L_x})^{\sigma_2} \)

By our assumption,

\[ c = \frac{X}{K_x} = \frac{dX}{dK_x} = \sigma_2 \left( K_x \right)^{-\sigma_2} e^{\lambda t/\sigma_2} + \sigma_2 K_x \left( \frac{dL_x}{dK_x} \right)^{\sigma_2} e^{\lambda t/\sigma_2} \]

\[ = \sigma_1 \frac{1}{k} \sigma_2 + \sigma_2 (k) \sigma_1 \frac{1}{k} \]

\[ = \sigma_1 (k)^{-\sigma_2} + \sigma_2 (k)^{-\sigma_2} = (k)^{-\sigma_2} \]
Since
\[ \frac{3X}{3L_x} = \sigma_2 e^{\lambda t} \left( \frac{Kx}{Lx} \right)^{\sigma_1} \]

the above condition can again be rewritten as

\[ \sigma_1 e^{\lambda t} = \frac{1}{\sigma_2} \frac{3X}{3L_x} > \beta_2 \frac{Y}{L_y} \]

By our assumption (A.1) (or eq. 13) and since \( \sigma_2 < 1 \),

\[ \frac{1}{\sigma_2} \frac{3X}{3L_x} > \frac{3X}{3Y_x} > (1 - \beta_1) \frac{Y}{L_y} > \beta_2 \frac{Y}{L_y} \]

that is, our feasibility condition (c.7) is fulfilled.

---

**Figure V-2**

_Effects of Capital Imports on Trade Balance_
The feasibility condition can be summarized as follows: If the income elasticity of demand for industrial goods \( u_1 \) is equal to unity, the open economy growth policy is not feasible. \( D_m(u_1=1) \) in Figure V-2 shows that capital imports cannot reduce trade balance deficit. But if \( u_1 < 1 \), the open economy growth policy is feasible. There are two possible situations.

**Case 1.** \( u_1 < 1, \ b > 0 \)

If a lot amount of foreign capital is being imported \((f > r_s)\), and as a result, a large amount of agricultural labor is induced toward the industrial sector such that

\[
\frac{\alpha}{1-\beta_l} + \frac{\beta_2}{1-\beta_l} \varepsilon_y < \varepsilon
\]

b is negative. \( D_m(b < 0) \) represents this situation. In the short-run, the economy will be characterized by an increasing share of imported capital stock out of total capital stock (increasing \( K \)), an expanding trade balance deficit, and a high growth rate of the industrial sector.

**Case 2.** \( u_1 < 1, \ b > 0 \)

If the foreign capital imports are moderate so that

\[
\varepsilon + \rho > \frac{\alpha}{1-\beta_l} + \frac{\beta_2}{1-\beta_l} \varepsilon_y > \varepsilon
\]
the growth rate of the industrial sector will be low, but the trade balance deficit will decline even in the short-run \( (D_m(b > 0)) \) in Figure V-2).

Again, it should be noted that \( a \) (the rate of technical progress in the agricultural sector) is very important for a high growth rate in the industrial sector and rapid reduction of the trade balance deficit.

In brief, only the second of our two questions\(^9\) is answered. That is, only when the income elasticity of demand for industrial goods \( (u_1 \) which is an exogeneous variable in our model) is less than unity, will our open economy growth policy be feasible. Once the feasibility of the open economy growth policy has been established,\(^{10}\) the policy authority has to determine the optimal foreign capital import rate (question 1) for an optimal growth path of the economy.

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\(^9\)/Bottom of p.173 and first paragraph of p.174.
\(^{10}\)/For recent trend of Korea, see Table All.
5-5 Optimum Growth Path

In previous sections (comparative dynamic analysis) we showed three conditions for feasibility of an open economy growth policy:

(i) \( u_1 < 1 \): income elasticity of industrial goods demand must be less than unity

(ii) \( \frac{\alpha}{\beta_2} < \frac{1}{\sigma_2} \): technical progress rate in the industrial sector must be larger than that in the agricultural sector

(iii) \( w_x > w_y \): wage rate in the industrial sector must be larger than that in the agricultural sector

If those three conditions are fulfilled, foreign capital imports accelerate the growth of the industrial sector as well as contribute to the long-run trade balance equilibrium (export-led economic growth is feasible.) Now, we assume that those three conditions hold during the planning horizon in which we are going to seek optimum growth path.

Adjustment Process

As we see from condition 6(p.177), the momentum of the growth accelerator of the industrial sector depends on the size of foreign capital imports (recall that \( f = \frac{dF}{F} = M_k/F \)).

\(^{11}\)The first condition is derived from our model and the remaining two conditions are given by our assumptions (see also (c.7) p.181)
In other words, when we import foreign capital, the capital stock in use in the industrial sector increases and the increased capital stock in the industrial sector widens the wage differential between sectors, which, in turn, stimulates labor to migrate from the agricultural sector to the industrial sector. Along this course, the capital imports induce rapid growth of the industrial sector (dualistic development and growth). However, labor is not instantaneously mobile while the capital stock increases due to capital imports are instantaneous. Thus, we assume the labor migration function as follows:

\[(33) \quad -dL_y = dL_x = \phi (\bar{w}) L_y = \phi \left( \bar{w}(\bar{a}, M_k) \right) = \Phi (M_k) L_y \]

where \( \bar{w} = w_x - w_y \): wage differential across sectors
and \( \bar{a} = \frac{\lambda}{\sigma_2} - \frac{\alpha}{\beta_2} \): rate of technical progress difference in two sectors (which is constant),
and \( \phi \) function is assumed to have following properties:

\[ \Phi_{M_k} > 0 \quad \Phi_{M_k M_k} < 0 \]

Next, we assume the cost of labor migration function as follows:

\[(34) \quad C = C(L_x) \quad C' > 0 \quad C'' < 0 \]

---

12/In Ray model (Ray, Edward J. 1977, 1979), it is assumed that \( C'' > 0 \), and he justified this assumption by referring (cont.)
Furthermore, we assume that

\[(35) \bar{w}(a, 0) > 0 \text{ but } \phi[\bar{w}(a, 0)] = 0\]

\[(36) \phi[(\bar{w} > c')] \geq 0\]

and labor does not flow backward even though \(\bar{w} < c'\).

**Objective of Planning**

Our production function of the industrial sector with the Harrod-neutral technical progress can be rewritten as follows:

\[
(37) \quad X = K_x (e^{\frac{\lambda}{\sigma_2}} L_x) = K_x \frac{\sigma_1 - \sigma_2}{\sigma_2} L_x
\]

where \(\tilde{L}_x = e^{\frac{\lambda}{\sigma_2}} L_x\), efficiency unit of labor in the industrial sector

and

\[
(8)' \quad L_y = L - L_x
\]

to the increasing congestion costs. But the situation of labor migration in our model is not quite similar with Ray model. The migration costs consist of three parts: transportation costs, costs from congestion and training costs to be hired in the industrial sector. The first one is constant over time, the second one is not serious in our model because labor is induced to migrate toward the industrial sector only when new jobs are created by imported capital (see also the constraint on the optimum growth path p.189), but the third one is not increasing as more workers migrate toward the industrial sector. In other words, the per capita training cost is a non-increasing function of the size of labor to be trained.
Consequently, the labor migration function in efficiency units is

\[(38) \ -\dot{L}_y e^{\lambda t} = \dot{L}_x e^{\lambda t} = e^{\sigma_2 t} \Phi(M_k)L_y\]

or \(\dot{L}_y = \dot{L}_x = \Phi(M_k)\overline{L}_y\)

where \(\overline{L}_y = L_y e^{\sigma_2 t}\); efficiency units of labor in the agricultural sector when they are employed in the industrial sector.

And, we have the following constraints (or characteristics) along the optimum path of the economy:

First of all, the capital-efficiency-unit-of-labor ratio in the industrial sector is constant along the optimum path (see assumption A.7, p.169).

\[(39) \overline{k} = \frac{K_X}{\overline{L}_X} = \frac{K_X}{L_X}\]

Because the structure of the industrial sector is specified as eq. (39), capital imports must be consistent with that ratio along the optimum path for the efficient use of imported capital.

Secondly, the wage rate in the agricultural sector is determined as

\[w_y = (1-\beta_1) \frac{Y}{L_y}\]

during the planning horizon.\(^{13}\) This implies that;

---

\(^{13}\)The planning horizon is defined as a period in which those three conditions for feasible open economy growth policy hold.
(i) The wage rate in the agricultural sector is higher than the productivity of labor in that sector even in the terminal year $T$, since

$$w_y = (1 - \beta_1) \frac{\bar{y}}{L_y} > \beta_2 \frac{\bar{y}}{L_y} = \overline{w}_y$$

where $\bar{w}_y$ is the productivity of labor in the agricultural sector. This is true as long as the families in the agricultural sector ignore the opportunity cost of land which is inherited for many generations.

(ii) Consequently, the underemployment in the agricultural sector still exists even in the terminal year $T$.

Now, let $T$ represent the point in time when labor migration induced by capital imports is completed and $j$ represent the social rate of time preference (which is assumed to be identical with private rate). Then, our objective is to maximize the present value of GNP($V$);

$$\text{(40) Max. } V = \int_0^T \left[ X - rF + Y - C(L_x) \right] e^{-jt} dt$$

To determine the optimal growth path of the economy, we have the policy problem of choosing the optimal time path for $M_k$ (the amount of capital imports, which is a control variable) and $\bar{L}_x$ (efficiency unit of labor in the industrial sector, which is a state variable).
From equations (37) and (39), $X$ (output in the industrial sector) along the optimum growth path can be rewritten as,

$$(41) \quad X = \kappa \sigma^1 \widetilde{L}_X$$

Consequently, the appropriate Hamiltonian equation would be

$$(42) \quad H = \left[ \kappa \sigma^1 \widetilde{L}_X - rF + Y - c(\dot{L}_X) \right] e^{-jt} + \Lambda \Phi(M_k) \widetilde{L}_y$$

where $\Lambda$ is the present value of marginal product of labor in the industrial sector which is adjusted by the rate of time preference.\textsuperscript{14}

Our transversality conditions are

$$L_x(0) = \text{given}$$

$$\overline{w}(T) = C$$

**Optimal Growth Policy**

To derive optimum policy, we are going to optimize the above Hamiltonian over $\Lambda$, $M_k$ and $L_x$;

\textsuperscript{14}/If we define $V^*(\widetilde{L}_X, t) = \text{Max.} \, V(\widetilde{L}_X, M_k, t)$, $\Lambda$ is,

$$\Lambda = \partial V^*/\partial \widetilde{L}_X.$$  As we will see later, $\Lambda = re^{-jt}/\Phi(M_k) \widetilde{L}_y$, in other words, the present value of marginal product of labor along the optimum path equals the present value of marginal product of capital($re^{-jt}$) devided by $\Phi(M_k) \widetilde{L}_y$ (change of labor migration due to imported capital).
\[ (38) \quad \frac{\partial H}{\partial \Lambda} = \Phi(M_k) L_y - L_x \quad (= -L_y) \]

\[ (43) \quad \frac{\partial H}{\partial M_k} = -r e^{-jt} + \Lambda \Phi(M_k) L_y = 0 \]

\[ (44) \quad \frac{\partial H}{\partial \Lambda} = \left( k \sigma_1 - \frac{\partial Y}{\partial L_x} \right) e^{-jt} - \Lambda \Phi(M_k) = -\Lambda \]

The first-order derivative of equation (43) with respect to \( t \) yields

\[ (45) \quad r e^{-jt} + \Lambda \Phi(M_k) L_y + \Lambda \Phi(M_k M_k) L_y M_k + \Lambda \Phi(M_k) L_y = 0 \]

or

\[ (45)' \quad -\Lambda \Phi(M_k) L_y = j r e^{-jt} + \Lambda (\Phi(M_k M_k) L_y M_k + \Phi(M_k) L_y) = 0 \]

since

\[ \Lambda = \frac{r}{\Phi(M_k) L_y} e^{-jt} \quad \text{(from eq. 43)} \]

equations (45)' and (44) yield,

\[ r \frac{\Phi(M_k M_k)}{\Phi(M_k)} \frac{\Phi}{M_k} \Phi(M_k) L_y \sigma_1 - \frac{\partial Y}{\partial L_x} - j (r + \Phi + \frac{L_y}{L_y}) \]

From equation (38),

\[ \frac{\dot{L}_y}{L_y} = -\Phi \]

Thus,

\[ (46) \quad r \frac{\Phi(M_k M_k)}{\Phi(M_k)} \Phi(M_k) L_y = k \sigma_1 \Phi(M_k) L_y - \frac{\partial Y}{\partial L_x} - jr \]

Let us show the optimum path of \( M_k \) and \( L_x \) on \( (M_k, L_x) \) space.

The appropriate canonical equations can be derived as follows;

From equation (46), \( \dot{M}_k = 0 \) if
\[ Q_1 = \kappa \phi_{M_k} \phi_{L_y} - \frac{\partial Y}{\partial L_x} - rj = 0 \]

and by equations (36) and (38),

\[ \frac{\partial L_x}{\partial x} = 0 \quad \text{if} \]

\[ Q_2 = \bar{w} - c' = 0. \]

The locus of \( Q_1 \) has negative slope on \((M_k, L_x)\) space since

\[ \left( \frac{dM_k}{dL_x} \right) Q_1 = - \left( \frac{\partial Q_1}{\partial L_x} \right) / \left( \frac{\partial Q_1}{\partial M_k} \right) \]

and

\[ \left( \frac{\partial Q_1}{\partial L_x} \right) = - \kappa \phi_{M_k} < 0 \]

\[ \left( \frac{\partial Q_1}{\partial M_k} \right) = \kappa \phi_{M_k} \Phi_{L_y} < 0 \quad (\Phi_{M_k} \Phi_{L_y} < 0) \]

The right-hand side of the locus reflects positive \( M_k (M_k > 0) \) and the left-hand side of the locus reflects negative \( M_k (M_k < 0) \).\(^{15}\) The locus of \( Q_2 \) has positive slope on \((M_k, L_x)\) space since

\[ \left( \frac{dM_k}{dL_x} \right) Q_2 = - \left( \frac{\partial Q_2}{\partial L_x} \right) / \left( \frac{\partial Q_2}{\partial M_k} \right) \]

and

\[ \left( \frac{\partial Q_2}{\partial L_x} \right) = \bar{w} / \partial L_x < 0 \quad \text{\(^{16}\)} \]

\[ \left( \frac{\partial Q_2}{\partial M_k} \right) = \bar{w} / \partial M_k - c'' \Phi_{M_k} \Phi_{L_y} > 0 \]

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15/From equation (46), if \( L_y = (L - L_x) = 0 \) or \( L = L_x \), both sides of the equation become negative, i.e., \( M_k > 0 \).

16/\( \bar{w} / \partial L_x \) is negative because when we have more labor in the industrial sector, the wage differential will become smaller due to diminishing return.
The left-hand side of the locus reflects a dualistic development and growth of the economy ($\dot{L}_x > 0$ or labor migration toward the industrial sector) and the right-hand side reflects stagnant growth of the economy ($\dot{L}_x = 0$ or no labor migration toward the more productive sector).

Figure V-3 shows the phase diagram discussed above. Since the horizontal axis measures $\bar{L}_x = L_x e^{\frac{\lambda}{\sigma_2} t}$, all points on $(M_k, \bar{L}_x)$ space move toward the right-hand side at equal and constant speed ($e^{\frac{\lambda}{\sigma_2} t}$). Consequently, the analysis with $\frac{\lambda}{\sigma_2} = 0$ (zero speed or all points stay at the same places) does not change our result.

As we see from Fig. V-3, if the initial amount of labor in the industrial sector is given, the growth path of the economy is determined by the choice of the initial amount of capital imports. For example, if the initial amount of labor in the industrial sector is given, we can figure out the time path of $M_k$ (foreign capital imports) and $\bar{L}_x$ (efficiency unit of labor in the industrial sector) with our chosen initial value of $M_k$. Then, by equations (25) and (23) (p.176), we can determine the growth path of the industrial sector and the whole economy.
Fig. V-3

Optimum Path of $M_k$ and $L_x$
Now, let us look at three possible choices for the initial amount of capital imports. If we choose an initial amount of capital imports represented by point A, dualistic development and growth (labor migration and economic growth) will proceed, but labor migration will be completed shortly and growth will depend upon only technical progress (with a considerable amount of underemployment of labor remaining in the agricultural sector).

If we choose point C as our initial amount of capital imports, the dualistic development and growth will proceed rapidly, but we have to import more and more foreign capital to attain our development and growth goals. In this case, as we see from equation (25) (p. 171) and condition 5 (p. 172), long-run growth will become uncertain.

Finally, the path originating from point B is very interesting in relation to our development and growth goals. If we choose the initial amount of capital imports represented by point B, dualistic development and growth will proceed until the economy reaches a steady-state growth path (\( \dot{L}_x = \dot{M}_k = 0 \)). But even in that steady-state growth path, the economy is operating at less than full-employment because, as long as \( w_x > w_y \) and \( w_y \) (wage rate in the agricultural
sector) is determined under the circumstance of ignoring the opportunity cost of land, the difference in productivity of labor in two sectors persists (and it may exceed the migration cost). Consequently, once the economy has reached the steady-state path, some other kind of economic policy, i.e., a policy suggested by Lapan, H.E. and Ray, E.J. might be useful for the full-employment of the economy.

In general, the problem of a current trade balance deficit is not important when the equilibrium of that balance is attainable in the future. However, if the current trade deficit is intolerably high, we cannot avoid adjusting our growth policy with respect to the trade balance deficit. In that event, we need to look at the relationship between the growth rate of the industrial sector and the

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17/Lapan, H.E. (1976) and Ray, E.J. (1977, 1979) discuss a subsidy policy to encourage labor migration toward the more productive sector.

18/For example, if the trade balance deficit is extraordinarily high, Korea's borrowing position in the international loan market would deteriorate and our open economy growth policy (growth policy with capital import) would be limited.
trade balance deficit.

By definition, \( D_m = \frac{2D}{M_k} \)
where \( D \) is the trade balance deficit and that can be rewritten as
\[
D_m = \frac{2D}{\frac{\partial X}{X} \frac{\partial M_k}}
\]

Consequently,

\[
(47) \quad \frac{2D}{\frac{\partial X}{X}} = \frac{D_m}{\frac{\partial X}{X} \frac{\partial M_k}}
\]

The time path of \( D_m \) is shown in Fig. V-2 (p. 183). If the necessary condition for feasible open economy growth policy is fulfilled (i.e., \( u_1 < 1 \)), the trade balance deficit increases for some time but at a decreasing rate. (Since \( D_m > 0 \) until \( D_m \) curve in Fig. V-2 reaches horizontal axis, the trade balance deficit \( D \) is getting larger but it increases at a decreasing rate as time passes because \( \frac{2D_m}{\partial t} < 0 \)). Let us assume that \( D_m \) be positive \( (D_m > 0) \) in the planning horizon. Then, from equation \((47)\), the trade balance deficit will become larger when we raise growth rate (since \( \frac{\partial X}{X} / \frac{\partial M_k} > 0 \)), which means that there exist trade-offs between the trade balance deficit
and the growth rate of the industrial sector during the planning horizon. Consequently, if the trade balance deficit is judged to be too high, we have to lower the growth rate of the industrial sector. This implies that we choose a time path between A and B (instead of B) in Fig. V-3. However, if we want to attain a steady-state growth path (or follow the time path B) and the economy is under serious pressure from the trade balance deficit, we must reduce income elasticity of demand for industrial goods even further. As we see from equation (31)(p.180), if \( u_1 = 1 \), the numerator of equation (47) is unity \( (D_m = 1) \), but if \( u_1 \) is less than unity, the numerator becomes less than unity. In other words, the smaller is the income elasticity, the more would the trade-off effect be crowded out.

Simulation of the Model

For the empirical application of a dual economy model, we need a set of well specified data. But in most developing countries, such sophisticated data are not available. Consequently, empirical work on dual

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19/Note that \( \frac{\partial D}{\partial (X/X)} < 0 \) when \( D_m < 0 \) or when the economy is sufficiently matured. In Fig.V-2, this is the case after \( D_m \) curve cuts the horizontal axis.
economy models has been rare. Korea is not an exceptional case. The time series data which are needed to apply our model to the Korean economy are either not suitable or sufficiently long, to allow us to perform a very complete empirical analysis of our model at the present time. Accordingly, we are going to look at the optimum foreign capital import policy (or the policy to use labor more efficiently) under several restricted sets of assumptions. In more precise terms, the purpose of this subsection is not to show a complete solution of our model but to show the growth path which the Korean economy would have had if Korea's economic policy had followed the course suggested by our model.

First of all, let us assume that capital-efficiency-unit-of-labor ratio(\(\kappa\)) to be

\[(5-1) \kappa = \frac{K_x}{L_x} = \$2,128.3 \text{ (1970 constant price)}\]

which is the average value in 1965-75\(^20\) and assume that the rate of technical progress is 8% each year.\(^21\) It is important to note that for the period 1971-1975 we assume that \(\kappa = \$2,128.3\) along the optimum growth path because of program promoting labor intensive techniques.

\(^20\)This is an arbitrary value which we assume as an optimum. But it might be an overestimate because capital imports have been heavily subsidized since the 1st 5-year economic development plan (started in 1962). Therefore, we use the ratio in 1963 (an extreme case) to illustrate a range of outcomes of growth path changes. (See Table V-1 and Table V-2).

\(^21\)Korea Production Center
Second, let us assume a simple linear labor migration function as follows:

\[ L_x = A(w) = A \cdot \bar{w} \]

where \( \bar{w} = w_x - w_y \) and \( A \) is a linear operator.

The above labor migration function is not linear from the origin \((L_x=0, \bar{w}-c'=0)\) because, as we see from eq. (36)

\[ L_x = 0 \quad \text{if} \quad \bar{w}-c' \leq 0 \]
\[ L_x > 0 \quad \text{if} \quad \bar{w}-c' > 0 \]

Thus, we simplify the above labor migration function as,

\[ (5-2) \ L_x = A \cdot (\bar{w}-c') = A \cdot \bar{w} \]

where \( A = A \ (\bar{w} / \bar{w}-c') \), \( \bar{w}-c' \neq 0 \)

which is linear from the origin.

Third, we assume that the cost of migration per worker consists of transition costs and moving costs. Let us assume that a worker needs two months transition period to change jobs, and the moving expense is equivalent to one month family expenditure in the new place. Consequently, the total cost of migration per worker is assumed to be equal to three months expenditure of that family in the new place.

The monthly expenditure of salary and wage income earners is around $91.8 (1970 US dollars) and it is very stable throughout the 1967-75 period. This means that the

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22/In fact, labor migration would depend not only on the wage differential but also social, cultural and religious backgrounds of the society. But, let us assume, for simplicity, that labor migration depends only on the economic factor (wage differential).

23/Major Statistics of Korean Economy, 1976
cost of migration per worker is $275.4(91.8 \times 3)$. 

In Table V-1, the first column shows the difference between the (annual) wage differential across the sectors and the migration cost per worker. By utilizing this information in eq.(5-2), the average value of $\bar{A}$ can be calculated:

$$\bar{A} = 0.5378$$

and thus,

$$(5-2): \bar{L}_x = 0.5398 \cdot (w-c')$$

The methodology of our experiment is as follows:

(1) The base-year is 1970, i.e., the industrial sector has attained the optimal capital-efficiency-unit-of-labor ratio in 1970.$^{24}$

(2) We are going to compare the actual growth path in the 1971-75 period with the growth path suggested by our model. Our objective is more clearly depicted in Fig. V-4. The $\bar{k}$ path is an actual capital-efficiency-unit-of-labor ratio along the time and the $k^*$ path is the optimal ratio along the time. Consequently, we are comparing the growth path which has $\bar{k}$ capital-efficiency-unit-of-labor ratio with the growth path which has $k^*$ capital-efficiency-unit-of-labor ratio.

$^{24}$Refer to footnote 20. When we use the 1963 value for optimum $k^*$, the cost to the economy(Tables V-1 and V-2) in 1971 is overestimated because we don't have to import that much capital in 1971 since the capital-efficiency-unit-of-labor ratio in 1970 would have been higher than optimum ratio.
(3) For this comparison, we are going to look at the following two questions: If the Korean economy had followed the growth path suggested by our model (the growth path with the $\tilde{k}^*$ capital-efficiency-unit-of-labor ratio), and if the Korean economy had wanted to maintain the same average annual growth rate of the industrial sector as actual (14.7%), i) how much cost would have been involved (if any)? and ii) what would have happened to the trade balance deficit?

Now, the amount of capital imports ($M_k$, which is a control variable) is determined such that all new comers
into the labor force in the industrial sector are employed.

In other words, we have to create sufficient jobs to employ all new comers by importing capital. From eq. (5-1) and by our assumption (which says that capital-efficiency-unit-of-labor ratio is constant), the principle for determination of the optimum amount of capital imports is as follows:

\[ K_x = 2,128.3 \frac{L_x}{\lambda} \]  
(from eq.5-1).

Thus,

\[ K_x = N_k = 2,128.3 \frac{\lambda t}{\psi^2} L_x \]

i) Determination of the maximum subsidy to labor migration:

The amount of maximum subsidy required to maintain the same average growth rate (an actual average growth rate or 14.7%) along the growth path suggested by our model can be determined by the following equation:

\[ \frac{d}{dt} \Phi_{M_k} \frac{\Delta y}{\Delta L_x} = r(j + \Phi_{M_k} \frac{M_k}{M_k} \frac{\Delta L_x}{\Delta t}) + \frac{\Delta y}{\Delta L_x} \]

This equation is a special form of eq.46(p.192). Eq.46 can be rewritten as

\[ \frac{d}{dt} \Phi_{M_k} = \Phi_{M_k} \frac{\Delta y}{\Delta L_x} \]

and this means that the amount of capital imports along the optimum path should be determined such that the output increase in the industrial sector due to capital imports change is sufficient to cover the marginal product of capital times the sum of social rate of time preference (j) and percentage change of labor migration speed minus marginal product of labor in the agricultural sector (which is being foregone by losing labor to the industrial sector). But in our example above, we want to maintain the growth rate of the industrial sector as actual(14.7%) and we are going to determine the amount of capital imports to attain that growth rate along the optimum capital-efficiency-unit-of-labor ratio.
illustrated as follows: The supply of labor from the agricultural sector and the demand for labor in the industrial sector can be depicted in \((L_x, w-c')\) space as in Fig.V-5. In a given year \((t=t)\), the amount of labor supplied is determined by eq.(5-2), i.e., the amount of labor supplied from the agricultural sector depends on the difference between the wage differential across the sectors and the migration cost in that year. The supply of labor from the agricultural sector is represented by \(L_x^S\) curve in Fig.V-5. However, demand for labor in the industrial sector is not determined by \((w-c')\) but by the number of jobs created by imported capital, \(M_k\) (which is a control variable). From eq.(5-3), the demand for labor function along the optimum path (the growth path with \(\tilde{k}^*\)) can be rewritten as

\[
(5-3)^* \quad L_x(\tilde{k}^*-1, M_k^*) = \tilde{k}^*-1 \quad M_k/e^{\lambda t}
\]

where \(\tilde{k}^*\) is the optimal capital-efficiency-unit-of-labor ratio.

26/If the wage rate in the industrial sector increases as the growth policy changes toward the more labor intensive industrial techniques, the total subsidy discussed above is an overestimate or a maximum amount of the subsidy required. (Refer to footnote 30 also.)
Fig. V-5

Determination of total subsidy
The above demand function is represented by a vertical line originating from $L_x$ (on the horizontal axis). But, the actual demand for labor is,

$$L_x(\kappa^a, M^a_k) = \kappa^a M_k/e^t$$

where $\kappa^a$ and $M^a_k$ are actual capital-efficiency-unit-of-labor ratio and the actual amount of capital imported ($\kappa^a > \kappa^*$ and $M^a_k > M^*_k$).

The actual demand for labor function is represented by the vertical line originating from $L_x$ (on the horizontal axis). The point $A'$ represents the current equilibrium of supply of and demand for labor, and $(\bar{w}-c^*)^a$ is the current equilibrium difference between the wage differential across the sectors and labor migration cost.

However, from our production function (eq. 41) with the constant capital-efficiency-unit-of-labor ratio along the optimum growth path, the growth rate of the industrial sector is,

$$\frac{\dot{X}}{X} = \frac{\lambda}{\sigma_2} + \frac{\dot{L}_x}{L_x}$$

Because we want to maintain a 14.7% growth rate and we assumed that the rate of technical progress ($\lambda/\sigma_2$) is 8% each year, the required labor growth rate and the required labor migration to maintain 14.7% growth rate
is easily calculated from the above equation. Once $L^*_x$ (optimum amount of labor migration to maintain 14.7% growth rate) is determined, $M^*_k$ (optimum amount of capital imports) is determined by eq. (5-3) i.e., the authorities would limit $M_k$ to $M^*_k$. The required $L^*_x = L^*_x$ which is a planners' demand for labor curve) suggests a new, higher $(w-c')$ so as to attract more migrants from the agricultural sector. Therefore, if there is no changes in the relative cost of capital, the industrial firms' own $L^*_x$ curve will remain constant and the total subsidy will be equal to the maximum (ABCD in Fig.V-5). But if the wage-rental ratio decreases due to the higher cost of capital (less capital imports and reduction of the subsidies to capital imports), the industrial firms' demand for labor curve will shift to the right and the total subsidy represented by ABCD will be the maximum (or the actual subsidy will be less than ABCD).

In Fig.V-5, the point B represents a new equilibrium of demand for and supply of labor and, to maintain labor market equilibrium at point B, we have to have wage differential across the sectors as represented by $(w-c')^\ast$. Consequently, we need subsidy as much as $(\bar{w}-c')^\ast- (w-c')^\ast$ per worker at maximum or $L^*_x \left[ (\bar{w}-c')^\ast - (\bar{w}-c')^\ast \right]$ totally. (The total maximum required subsidy
Table V-1

Required time paths of \( M_k, \dot{L}_x \) and \( \dot{X}/X \)

<table>
<thead>
<tr>
<th>Year</th>
<th>( L_x )</th>
<th>( M_k )</th>
<th>( \dot{X}/X )</th>
<th>( \dot{L}_x )</th>
<th>( M_k )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1971</td>
<td>89.5</td>
<td>664.5</td>
<td>2,520.8</td>
<td>45</td>
<td>13.9</td>
</tr>
<tr>
<td>1972</td>
<td>194.5</td>
<td>706.0</td>
<td>2,574.8</td>
<td>83</td>
<td>11.5</td>
</tr>
<tr>
<td>1973</td>
<td>270.8</td>
<td>947.8</td>
<td>2,527.2</td>
<td>168</td>
<td>24.1</td>
</tr>
<tr>
<td>1974</td>
<td>297.5</td>
<td>1,267.0</td>
<td>2,521.0</td>
<td>170</td>
<td>12.7</td>
</tr>
<tr>
<td>1975</td>
<td>297.6</td>
<td>1,205.3</td>
<td>2,570.2</td>
<td>172</td>
<td>11.2</td>
</tr>
</tbody>
</table>

Notes: (1) 1970 U.S. dollars
(2) 1,000 persons
(3) Million 1970 U.S. dollars
# Two-year moving average
** actual capital -efficiency-unit -of-labor ratio
\[ 1/k^* = $2,128.3 (1965-75 average) \]
\[ 2/k^* = $1,387.5 (1963) \]
is represented by the area of ABCD in Fig. V-5.)

The effect of the subsidy (to migration) policy is summarized in Table V-1. The purpose of the subsidy policy is to utilize the domestic factor of production (labor) more efficiently and to save imported capital. As Table V-1 shows, if the Korean economy had followed the growth path suggested by our model, it could have reduced imported capital to an average (1971-75) of 65.8% of the amount actually imported. (The total current amount of capital imports accounted for 26.2% of Korea's total imports in 1975.)\(^{27}\) This would reduce, although not eliminate, the trade balance deficit problem.

ii) The maximum total cost to the economy:

(1) The real cost of subsidy;

The whole part of total subsidy discussed above is not the real cost to the economy from the macroeconomic point of view. Because all those subsidies are paid back to employees in the industrial sector. The reason is quite simple. When the equilibrium point moves from point A' to B, the migrants' surplus increases as much

\(^{27}\)When we use the extremely low value of \(\bar{k}^*(1963)\) we could have reduced imported capital to an average of 40.2% of the amount actually imported. The net effect on the trade balance deficit will be discussed in more detail shortly (see Table V-2).
as A'DCB (in Fig.V-5). (The total migrants' surplus increases from ODA' to OCB.) Therefore, only the part represented by A'AB is the real cost of subsidy to the whole economy. This is the non-economic (non-resource) psychological (or welfare) loss of the economy. This psychological welfare loss would be related to the social and cultural background of the society (traditionally, farmers do not want to leave their farms which are held for many generations) and/or it would arise from taking risk in the new place. The real cost of the subsidy is calculated numerically as,

\[ \frac{1}{2} \left[ (\bar{w} - c')^*- (\bar{w} - c')^a \right] (L^*_x - L^*_x) \]

(2) The foregone cost in the agricultural sector;

If the speed of the labor migration is faster than otherwise, the total production of agricultural goods will be lower than the actual level. Consequently, unless consumers reduce their consumption of agricultural goods, the economy should import more agricultural goods.

One important point in the process of calculating the foregone cost is a "two months transition period". The amount of labor which is represented
by \((L_x^* - L_x^a)\) (extra amount of labor migrated by the subsidy policy), who are employed in the production activities in the industrial sector during a certain year, are not employed in the production activities in the agricultural sector for at least 1 1/6 years (or 14 months). Consequently, the foregone cost (opportunity cost) per worker is

\[
1 \frac{1}{6} \cdot w_y
\]

As a result, the increase of agricultural goods imports is calculated as,

\[
M_y = w_y \cdot (L_x^* - L_x^a) \cdot 1 \frac{1}{6}
\]

where \(M_y\) is the extra amount of agricultural goods import needed to sustain faster labor migration.\(^{28}\)

(3) The migration cost (labor relocating cost); \(^{29}\)

Since we are going to induce \((L_x^* - L_x^a)\) more labor to migrate toward the industrial sector, that labor relocating (subsidy) policy would cost the economy as much as

\[
c \cdot (L_x^* - L_x^a)
\]

---

\(^{28}\)Actually, this is over-estimated because the wage rate in the agricultural sector is larger than the marginal productivity of labor in that sector.

\(^{29}\)It is assumed that the training cost is included in the labor migration cost (see footnote 12). However, if we assume that training of labor is done at the employers' cost (i.e., the training cost does not influence the labor migration process), the labor relocating cost of the economy is slightly under evaluated.
(4) Net maximum total cost to the economy:

The sum of all costs specified above is the total cost to the economy for changing the growth path of the economy from the capital-intensive-production growth path to the labor-intensive-production growth path (from the growth path with $\bar{k}$ capital-efficiency-unit-of-labor ratio to the growth path with $\bar{k}^*$ capital-efficiency-unit-of-labor ratio in terms of Fig.V-4). However, in the process of summing up the total cost of the economy, we still ignored one more factor. Changing the growth path from the capital-intensive-production growth to the labor-intensive production growth implies less subsidy to capital use (which used to be subsidized along the current growth path).\(^{30}\) Therefore, when we take into account this reduction of subsidies to capital, the total net cost to the economy must be somewhat smaller than our initial estimate of total cost. Since the

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\(^{30}\)Reduced subsidies on imported capital will lower the domestic wage-rental ratio in the industrial sector. This will increase the demand for labor and will push the equilibrium wage rate upward. On the other hand, less capital imports implies less capital equipment per worker which will lower the labor productivity in the industrial sector. As a result, the net effect on the industrial wage rate is unclear at the present stage. Consequently, I assume, for simplicity, that the wage differential across the sectors remains the same after the growth path change(toward the more labor intensive production path).
subsidy to capital use has been indirect (subsidy in the form of low interest rates relative to the private interest rate, low foreign exchange rate and a government guarantee program for repayment), we need more information to measure it completely. The only clear information available is that the private rate on imported capital is lower than the social (optimum) rate by 3% (Table II-22 p.70). In other words, imported capital use is subsidized by at least 3% of its value. Consequently, if the economy imports less capital, the subsidy to capital use declines by as much as,

$$0.03 \cdot (M_k^a - M_k^*)$$

Therefore, the maximum total cost (the sum of non-economic cost of subsidy, labor relocating cost and foregone cost in the agricultural sector) less the reduction of subsidy to capital use (accompanied automatically by importing less capital) is the net maximum total cost to the economy to change the growth path (toward labor intensive production growth). These costs are summarized in the first four columns in Table V-2.

iii) The net economic (resource) cost and the trade balance gain;

When we change the growth path of the economy as our model suggests, the overall economy will obtain a
lot of benefits by utilizing the production factors more efficiently. For example, we can employ domestic labor more efficiently by inducing them to migrate from the less productive sector to the more productive sector, and we can use imported capital more efficiently by shifting to more labor intensive production methods. All those benefits are reflected collectively in the balance of trade deficit change. The change of the trade balance deficit is,

$$\Delta B_T = M^a_k - M^*_k - M_y$$

where $$\Delta B_T$$ is the trade balance deficit decrease.

The required resource cost to attain that trade balance deficit decrease is the labor relocating cost less the subsidy (to capital use) saved by importing less capital (the net resource cost).

The net change of the trade balance deficit is summarized in Table V-2. As seen from the table, we could have alleviated the trade balance deficit around 13.2% (or 25.3% maximum when we assume the 1963 capital-efficiency-unit-of-labor ratio as optimum) on average annually in the 1971-75 period at an average annual resource cost of 0.22% of GNP, if the Korean economy
### Table V-2

Cost and Benefit to the Economy

(million 1970 $)

<table>
<thead>
<tr>
<th>Year</th>
<th>$W_L$</th>
<th>$C^*$</th>
<th>$M_y$</th>
<th>$(-)S^k$</th>
<th>$C_n$</th>
<th>$C''/\text{GNP} (%)$</th>
<th>$\Delta B_T(1)$</th>
<th>$\Delta B_T(2)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1971</td>
<td>7.3</td>
<td>24.9</td>
<td>46.9</td>
<td>6.3</td>
<td>72.8</td>
<td>0.39</td>
<td>163.9</td>
<td>413.9</td>
</tr>
<tr>
<td>1972</td>
<td>12.4</td>
<td>35.1</td>
<td>61.3</td>
<td>5.4</td>
<td>103.4</td>
<td>0.51</td>
<td>120.3</td>
<td>301.8</td>
</tr>
<tr>
<td>1973</td>
<td>4.1</td>
<td>15.6</td>
<td>27.7</td>
<td>10.2</td>
<td>37.2</td>
<td>0.07</td>
<td>312.7</td>
<td>523.8</td>
</tr>
<tr>
<td>1974</td>
<td>5.1</td>
<td>19.2</td>
<td>35.8</td>
<td>17.0</td>
<td>43.1</td>
<td>0.02</td>
<td>532.0</td>
<td>773.0</td>
</tr>
<tr>
<td>1975</td>
<td>8.9</td>
<td>23.1</td>
<td>46.6</td>
<td>11.8</td>
<td>66.8</td>
<td>0.12</td>
<td>347.5</td>
<td>629.2</td>
</tr>
</tbody>
</table>

Average: 0.22  13.2  25.3

Notes:

- $W_L$ = psychological welfare loss of subsidy
- $C^*$ = labor relocating cost
- $M_y$ = foregone cost in the agricultural sector
- $S^k$ = subsidy reduction to capital use
- $C_n$ = net total cost ($C_n=W_L+C^*+M_y-S^k$)
- $C''$ = net resource cost ($C''=C^*-S^k$)
- $\Delta B_T(1)$ = Trade balance change with $k^*=2,128.3(1965-75)$
- $\Delta B_T(2)$ = Trade balance change with $k^*=1,387.5(1963)$
had followed the growth path suggested by our model. It will be interesting to see the total resource cost of eliminating the trade balance deficit totally. But it is not possible to meet both the trade balance equilibrium and the development strategies in the early stage of development (as summarized in Fig.V-2).\textsuperscript{31}

In conclusion, the simulation is not generated as a result of solving the maximization explicitly but rather as an approximation to indicate the sensitivity of trade balance paths to alternative rates of labor transfer and consequent alternative rates of capital imports. The basic implication is that the growth path suggested by our model fulfills better the present economic needs than the current growth policy. In the 1960s and early 1970s, the major goals of economic development and growth in Korea were to maximize growth rate and fast structural change (by expanding manufacturing sector, especially heavy industries). And the policy authority was optimistic about the trade balance deficit problem because that problem could be solved by export promotion and import substitution policies. (Expanding heavy industries were believed to be the best

\textsuperscript{31}/But we discussed the trade-offs between the growth rate and the trade balance deficit. (See eq.47, p.198 and footnote 19, 199.)
way to attain export promotion and import substitution.)\textsuperscript{32}
But now, the more important social and economic problems
are employment, income distribution and the trade balance
deficit. Especially, maintaining a high growth rate of
exports is pessimistic. The high growth rate of exports
in the past was possible because the amount of exports in
1961 was only 40.9 million dollars (i.e., there were a
lot of unexploited international markets for the goods
produced in Korea). But now the competition in the inter-
national market is very tight. Therefore, importing less
capital and specializing in labor intensive goods production
is the way to alleviate the trade balance deficit problem
in the future. (Furthermore, capital intensive production
methods implies more energy or petroleum consumption
which Korea has to import.)

Our major findings from Table V-1 and Table V-2 are,
if Korea had had more labor-intensive production policy,

\textsuperscript{32}/Actually, the amount of exports in 1975 was 122 times
that in 1961, or 34\% increase annually throughout the 1961-
1975 period. Nevertheless, the trade balance deficit in-
creased continuously during the same period (and the actual
trade balance deficit always exceeded the planned trade
balance deficit). When we look at the composition of Korea's
imports, the reason is clear. Imports of capital goods,
raw materials for exports and petroleum accounted of 74.6\% of
total imports in 1975. In other words, the export
promotion policy did not contribute greatly to the
improvement of the trade balance deficit.
(1) we would have attained very comparable growth rates of the industrial sector with reasonable amount of costs (around 0.22% of GNP),

(2) we would have induced more labor to migrate from the agricultural sector to the industrial sector,

(3) we would have imported less capital than otherwise which would alleviate trade balance deficit problem. These results are exactly what we have expected from the discussion of our model. The economic benefits of this alternative strategy are;

(1) more efficient use of domestic resource (better utilization of underemployed labor in the agricultural sector),

(2) alleviation of trade balance deficit problem (by importing less capital),

(3) reduction of domestic cost for economic growth and development (by correcting the factor market distortions, i.e., by reducing the subsidy to capital use).

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33/ The effect of labor-intensive production on Korea's exports is unclear in the short-run. But the effect in the long-run must be positive because Korea has a comparative advantage in labor-intensive-goods production.
CHAPTER VI

SUMMARY AND CONCLUSION

Necessary of a new approach for the Korean economy

The Korean economy is one of the most rapidly growing economies in the world. The average annual GNP growth rate was approximately 10% during the 1960s and 1970s. Yet, the Korean economy is characterized by duality in domestic production; An agricultural sector which is dominated by traditional production methods and an advanced industrial sector where modern techniques and skills are used. The agricultural sector supplies food and labor to the industrial sector. The industrial sector produces exportables which supply the foreign exchange necessary to import food as well as capital and raw materials for industrialization of the economy.

Previous studies of the Korean economy ignore the interplay between these two non-aggregative sectors. They emphasize the role of savings and investment in defining the limits to growth. Foreign capital inflows are often introduced as a possible solution to the savings-constraint on growth. For the most part, the "two-gap" model is used to explain the relationship between the internal gap (investment-saving) and external gap (import-export). In
virtually all of the models of the Korean economy, the role of labor is deemphasized, although labor is the only surplus factor in Korea. The result of the adoption of such models for planning purposes has been to create factor market distortions, i.e., capital is relatively less expensive than labor in a capital poor country. Consequently, production in the industrial sector has become too capital intensive.

Korea began the 4th 5-year economic development plan in 1977. The main goals of the 4th 5-year economic development plan\(^1\) are: first, the attainment of a high, self-sustained growth path by improving the industrial structure of the economy\(^2\) and by attaining equilibrium in the international balance of payments and in domestic savings and investments, second, the improvement of the social welfare system, and third, improvement in technology and promotion of economic efficiency.

\(^1\)The 4th 5-year Economic Development Plan, Government of the Republic of Korea(in Korean), 1976,p.17-20. A more detailed goals are summarized in Table II-27,p. 82.

\(^2\)The improvement of the industrial structure of the economy means increasing the weight of technology and skilled-labor intensive production industries such as machinery, electronics and ship-building, to exploit comparative international advantages.(Ibid.p.18)
The two-gap approach adopted is very useful in analyzing the equilibrium conditions of the balance of international payments, and the balance of international payments is crucial for self-sustained economic growth. However, the planning model of Korea which is based on the two-gap approach is not appropriate as a theoretical background for planning to meet the development goals. The inappropriateness of that approach can be summarized as follows:

i) A Leontief-type production function was assumed with labor surplus and a capital constraint. Consequently, the role of labor in the development process was ignored and capital formation was emphasized. Therefore, required structural changes in the traditional sector and more efficient use of labor were not analyzed by the model.

ii) The demand side is not explicitly developed. Consequently, the optimum trade volume (or the exporting ability of the economy without domestic inflation) cannot be determined. The mechanism to explain the trade-off between the economic growth rate and the long-run trade balance deficit is omitted.

We find that the Korean economy has two non-aggregative sectors, a traditional sector and a modern industrial sector. The center of gravity of the economy is moving very rapidly toward the industrial sector and labor
migration from the traditional sector to the industrial sector has contributed substantially to overall economic growth? In other words, the development and growth of the Korean economy should be approached from the dualistic point of view. Superficial observation of the Korean economy suggests that it has a normal dual economy structure. But a careful analysis shows that the Korean economy has several characteristics which are distinctly different from the standard dual economy models. For example, the role of the traditional sector in industrial development has been negative (Korea is a net food importer) except for the fact that the traditional sector has supplied labor to the industrial sector. Moreover, Korea is a natural resource poor country that must import capital goods and all basic raw materials including coal and crude oil. The main forces contributing to the rapid economic growth of the past decade were well-educated labor and foreign capital inflows (including foreign aid in the 1960s). In this context, the key policy variables for economic development and growth in Korea are the mobilization of this well-educated labor in combination with imported capital.

In our model, the two non-aggregate traditional and industrial sectors are introduced separately, and

3/Chapter IV. (4-2, p. 133)
labor plays an active role in each sector. In other words, the impact of labor migration is explained simultaneously in both sectors.

**Basic assumption in our model**

In the discussion of our dual economy model, the following assumptions were employed: First, we have a neo-classical type surplus labor (non-zero marginal productivity of labor) in the traditional sector. Second, neo-classical savings and investment functions were assumed in both sectors. Third, we have a fairly developed industrial sector as an initial condition. The center of gravity of the economy is moving very fast toward the industrial sector and the rate of technical progress in the industrial sector is higher than that in the traditional sector. Fourth, as our development strategies, we assume that we have to induce labor in the traditional sector to move into the industrial sector (for better productive employment) and stimulate the industrial sector to grow faster than the agricultural sector.

**The limit of growth of the closed dual economy**

The dual economy models introduced by Jorgenson, Fei and Ranis and others showed only the conditions for emergence of the industrial sector. But in our theoretical model, the growth path of a dual economy after the emergence of the industrial sector was developed. In Chapter IV, we discussed the growth of a closed economy. When the
economy, which has an asymmetrical labor allocation with surplus labor in the traditional sector, is closed, and when the traditional sector is assumed to have limited cultivatable farm area, its development is very limited. The necessary and sufficient condition for the development and growth of the industrial sector is

\[ (c.2) \quad \varepsilon < \frac{\alpha - (1 - \beta_1)\rho}{1 - \beta_1 - \beta_2} \]

which is an extended form of the Jorgenson's condition. But, for equilibrium growth, the rates of technical progress in two sectors must fulfill the following condition:

\[ (c.4) \quad \frac{\alpha}{\beta_2} - \frac{\lambda}{\beta_2} = \frac{1 - \beta_1 - \beta_2}{\beta_2} (\varepsilon + \rho) > 0 \]

(faster technical progress in the agricultural sector than in the industrial sector) which is unlikely in a country like Korea. But if condition (c.4) is fulfilled, the industrial sector can grow faster than the agricultural sector. In other words, our development goals can be met under highly restrictive assumption.
To break through the growth limits of the closed economy, we introduced international trade. The growth of the Korean economy is sometimes referred as an "export-led growth". Such an export policy was qualitatively included in our open economy model.

**Importance of the open economy policy**

Bardhan and Lewis (1970) point out that a major part of world trade is in intermediate products and capital goods, while traditional trade theory is mostly in terms of finished consumer goods. However, imports of intermediate goods and machinery are particularly important for most developing economies. Consequently, imported foreign capital is included in the production function of the industrial sector. The growth process of our open economy model can be summarized as follows: When we import foreign capital, it induces labor migration from the traditional sector to the industrial sector via a wage differential across sectors. This will cause less agricultural goods production and increased agricultural goods imports. In other words, foreign capital imports accelerate the growth of the industrial sector (condition 7) and increase imports of agricultural goods.

But Bardhan and Lewis (1970) analyze the steady-state growth path of a neo-classical one sector model with international trading of intermediate products and capital goods.
Imports require foreign exchange which can only be earned through exports. Therefore, the growth and industrialization of the economy and the long-run trade balance equilibrium are of concern to us in an open economy model. If foreign capital imports expand the economy's exporting capacity enough to finance capital imports, our policy of capital imports and export-led growth is feasible. In this context, there remain two questions to be answered in our open economy model. First, how much foreign capital should we import? Second, is such a growth policy feasible with respect to the long-run trade balance equilibrium? As we have shown in the discussion of the open economy model (Chapter V), capital imports and labor migration can accelerate growth and industrialization, but there is no automatic mechanism to attain trade balance equilibrium in the long-run unless the income elasticity of demand for industrial goods is less than unity (which can be achieved by collective social efforts). In other words, an income elasticity of demand for industrial goods which is less than unity is a necessary condition for the feasibility of an open economy growth policy.

As we see in Fig. V-2(p.178), if foreign capital imports are very large so that the growth of agricultural goods production is less than the
population growth rate\(^5\), the growth rate of the economy can be accelerated\(^6\) but trade balance equilibrium cannot be achieved in the near future (as represented by \(D_m(b<0)\) in Fig.V-2). Alternatively, if foreign capital imports are moderate (and thus labor migration is also moderate) so that the growth rate of agricultural production is larger than the growth rate of population \((\varepsilon)\) but less than the growth rate of agricultural goods demand \((\varepsilon+\rho)\), the growth rate of the economy will be moderate, too, but trade balance equilibrium can be more easily attained (as represented by \(D_m(b>0)\) in Fig.V-2).

When the feasibility condition for an open economy growth policy is fulfilled, our next concern is to determine the optimum amount of foreign capital imports. At the end of Chapter V (5-5, p.181), we discussed the optimal time path of capital imports \((M_k)\) and labor employment \((\widehat{L_x})\) in the industrial sector to show the optimum growth path.

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5/If we import a large amount of foreign capital in each year, labor migration would be speeded up and, as a result, the growth rate of agricultural goods production would be smaller than the population growth rate.

6/Accelerated growth rate of the economy can be generated in two ways. First, by condition(c.7), the growth rate of the industrial sector can be raised when we import more foreign capital. Second, more migration of labor from the agricultural sector to the industrial sector means better labor reallocation toward a more productive use of labor.
of the economy. Since labor in the agricultural sector is ready to migrate toward the more productive industrial sector whenever job opportunities are available and a sufficient wage differential exists (to cover migration cost)? imported capital is our crucial policy tool, because imported foreign capital can create both job opportunities and a wage differential. But, to determine the capital imports policy which is consistent with our development and growth goals, we have to pay attention to the following two phenomena: First, for the efficient use of imported capital and for exploitation of international comparative advantage, capital imports must maintain a certain capital-efficiency-unit-of-labor ratio (as specified by eq. 39 p. 184). In other words a transition to more capital intensive production is not consistent with economic circumstance in Korea. Second, rapid growth is not our only goal. If we import a lot of capital, we can attain rapid development and growth. However, increasing the rate of capital imports and the trade balance deficit during the planning period creates uncertainty about future growth prospects.

The solution of our optimization problem is summarized in Fig. V-3 (p. 190). The time path originating

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2/See footnote 33, p. 74
from point A shows that labor migration will be completed at far below the full-employment level, but the time path originating from point C requires more and more foreign capital imports to attain our development and growth goals which might make future growth uncertain. In the meantime, the time path which is originating from point B is most interesting with respect to our development and growth goals. However, we need a more careful investigation of key variables such as capital imports \( (K_k) \), the growth rate of the industrial sector \( (\dot{X}/X) \), the trade balance deficit \( (D) \) and income elasticity \( (u_1) \) to determine optimal policy.

Even if the necessary condition for feasible open economy growth policy is satisfied (or income elasticity of demand for industrial goods is less than unity and the trade balance equilibrium is attainable in the future), a current trade balance deficit that is extraordinarily large would jeopardize the economy's borrowing position and the potential open economy growth rate (growth with imported capital) would be limited. Eq.(47)(p.198) shows the trade-off between the growth rate of the industrial sector and the trade balance deficit during the planning period. If the current level of trade balance deficit is judged to be too high, we can lower the
growth rate of the industrial sector by choosing a growth path which is located between paths originating from points A and B (Fig. V-3, p. 195). In the analysis of eq. (47) (p. 198-199), we see that a low income elasticity of demand for industrial goods limits the possible trade-offs between growth rate of the industrial sector and the trade balance deficit during the planning period. Consequently, we must reduce the income elasticity of demand for industrial goods even further to attain a steady-state growth path when the economy is under serious threat of a trade balance deficit.

Conclusion

In conclusion, the economic model developed and discussed in this paper is intended as a backdrop against which we can assess the development and growth possibilities for the Korean type economy observed in Chapter II. Our basic conclusion in that chapter was that more laborers should be induced to migrate from the traditional sector to the industrial sector. As we see from Tables II-6 and II-2, 46% of the total labor force still remained in the agricultural sector and the average productivity of labor in the agricultural sector is only one-third of that in the industrial sector. Labor migration toward the industrial sector may cause a reduction in agricultural production, and consequently,
an increase of the import-export gap (since Korea would have to import agricultural goods). But that fact is unavoidable in the process of economic development in Korea for two reasons. First, Korea has little cultivable land (Table II-10) which makes it impossible to specialize in agricultural production. And, second, in the later stages of economic development the agricultural surplus deteriorates and may become negative, as Ranis (1972) pointed out. In other words, a dualistic development and growth policy is required for the Korean type economy, and our foreign capital imports policy must be consistent with that basic development and growth goal, i.e., imported capital must entail a more efficient use of labor which is the only surplus factor in the domestic economy. Our analysis indicated that the most important factors among others in the development and growth of the Korean economy were the structural changes in production, labor allocation, import substitution and export promotion. The main forces behind these changes were foreign capital imports and mobilization of well-educated labor. Consequently, appropriate policy formation for the development and growth of the Korean economy will entail an optimal combination of foreign capital imports and labor employment. However, the optimal combination was not
considered in previous work and remained an open question. Our dualistic open economy model provides the answer to that question.

Johnston, M. (1977) explains that the failure of growth to bring more widespread benefits in the form of expanded employment and improved income opportunities has been a consequence of an inappropriate pattern of growth. He claims there is a need to restructure growth by eliminating price distortions, implicit and explicit subsidies, licensing and other direct controls, which have encouraged the adoption of inappropriately capital-intensive technologies. Nugent, J. B. (1975) argues that the earliest macroeconometric models for less-developed countries were patterned rather closely to a simple Keynesian model that had been developed for the United States and other more developed countries in the 1940s and 1950s. Some of the more recent models move toward a more neo-classical formulation and emphasize the importance of different sectors. He notes that disaggregation has permitted the specification of different

8/See footnotes 29(p.67) and 37(p.86).
production and consumption functions for different sectors. By way of giving more attention to detail, the more recent models are generally better able than their predecessors to reflect the special conditions and institutions of the particular countries for which they are designed.9

Implications of our model and the use of the model in the future

The basic implications of our model are:

(1) We have to induce more labor to migrate from the agricultural sector to the industrial sector (where labor is more productive). This is the way to utilize domestic production factor better, and to enhance the efficiency of the overall domestic economy.

(2) With less imported capital but better utilization of labor, we can maintain the same growth rate that we have had in recent years.

(3) More labor intensive and less capital production processes could alleviate trade balance deficit problems.

(4) We could have better export and growth prospects by promoting labor intensive production methods since Korea

9/Nugent, J.B. (1975), p.510
has a comparative advantage in labor intensive goods production. In that context, the following three key growth policies of the Korean government should be re-evaluated:

1) Subsidy policy for capital use: As Table II-23 (p.72) and Table II-24(p.73) show, the interest rates on equipment loans are unreasonably low and in turn contributed greatly to factor market distortions and to the use of too capital-intensive production techniques in the industrial sector.

2) The government guarantee system for repayment of foreign loan: Due to this program more foreign capital than necessary has been imported for investment in less efficient projects (in terms of international comparative advantage). Furthermore, when such projects, which are heavily financed by foreign loans, appear to be unprofitable, government subsidies are accelerated. This has the effect of lowering the efficiency of the economy as a whole.

3) Export-promotion and import-substitution policies: If Korea tries to both produce and export all kinds of goods domestically without regard to its comparative advantage, the domestic economic structure will be distorted and long
run growth will be limited. In most small under-developed countries, exports are generally determined by the domestic ability of exportables producing industries and this was demonstrated to hold in the case of Korea by earlier studies.\textsuperscript{11}

As discussed in Chapter II, various policies were used in Korea to promote exports, i.e., domestic direct and indirect tax exemptions, reduced rates on public utilities, preferential interest rates on bank loans, direct export subsidies, etc. In addition, the Korean government set up KOTRA (Korea Trade Promotion Corporation) in 1964 to promote Korea's exports and to conduct international market research. Furthermore, the central government assigns to all Korean embassies in foreign countries responsibility for achieving a given level of Korean exports to the countries in which they are stationed. But, instead of such export-promoting policies, a reduction of domestic demand for industrial goods (reduction of income elasticity of demand for industrial goods) is more urgently needed (since Table All shows that the income elasticity of demand for industrial goods is around unity in recent years). Export increases without an accompanying reduction in domestic consumption

\textsuperscript{11}/Frank, Kim, Westphal (1975), p. 85
will create inflationary pressure, which will, in turn require more subsidies to exporting industries and generate more inefficiency in the economy.

Specific policy recommendations based on our model are not derived because of the present lack of data, but our model provides a theoretical background for a reevaluation of current policies.¹² First of all, our model is based on the assumption of equilibrium in both factor and consumption goods markets. As suggested by Johnston's argument, appropriate technologies for development and growth can be chosen by eliminating price distortions, implicit and explicit subsidies and other direct controls. Determination of an appropriate capital-efficiency-unit-of-labor ratio (as defined in eq. (39), p.189) for the economy is shown in Fig.IV-3 (p.144), and it is also essential for the derivation of the optimal amount of foreign capital imports. Second, the solution to our optimization problem tells us whether or not the current foreign capital inflows under the government guarantee system for repayment of foreign loans is appropriate for Korea's economic situation.

¹²With regard to the theoretical literature, our model combines those features of the Jorgenson and K-W-C models which are not applicable to the Korean type economy(see also the comparison of those two models in p.104).
Our solution of the optimization problem defines the appropriate limit for government intervention to promote capital imports (since $M_k$, the amount of imported capital, is a policy or control variable). Thirdly, the demand function for industrial goods, together with the production function of the industrial sector, indicate the export capacity of the economy. Consequently, if the income elasticity of demand for industrial goods ($u_1$) is given and the optimum growth path is determined, then the export capacity of the economy can be derived. As we see from Table All, the income elasticity of demand for industrial goods appeared to ve around unity during the 1960s and early 1970s. To promote exports, we need to reduce that elasticity rather than provide additional subsidies to the exportables producing industries.

**Future Research Areas**

The major concerns of this paper have been to observe and stylize the Korean economy, to review Korea's planning model analytically and to develop a model to apply to that stylized Korean economy to describe the potential for economic growth. But more rigorous studies are needed to develop specific policy recommendations for the development of the Korean economy. First of all, estimates of production functions would be
crucial for that purpose. Estimation of the production function of the traditional sector is expected to be difficult, since production of the traditional sector is influenced by weather conditions, and labor is not employed on a full-time basis throughout the year but employed intensively during the planting and harvesting periods. A proper treatment of such factors would yield a better sense of the impact of labor migration on both sectors. Second, an econometric analysis of international trade of Korea, which includes monetary factors, would be useful. As exports grow and as import substitution proceeds, Korea will earn more foreign exchange. This in turn could have an important impact on the domestic money supply and prices. Finally, a distributional question of who receives the benefits of the growth arises. This question is not addressed explicitly in this paper but left for later research.

In conclusion, the basic purpose of our model is to identify conditions which determine what the feasible policy goals of a Korean type economy should be and to show the optimum growth path under those conditions. Sometimes development goals conflict and sometimes they are too ambitious (infeasible). By identifying sources
of conflict, we can define consistent development and growth policies while avoiding unnecessary resource waste. Our model details conditions for growth and the characteristics of equilibrium paths for the economy. Our model could also be applied to other developing countries (such as Thailand, Egypt, etc.) where well-developed human resource is available but natural resource endowment is relatively poor.
Appendix A

Savings, Investment and Asymptotic Capital Accumulation Rate

In a classical theory, they assumed that the saving from wage income earners is negligible and all profit (P) is saved and invested. But in a post-Keynesian theory, the zero propensity to save of wage income earners is discarded, but still they neglected the commandship on capital by wage earners who have saved some parts of their income. Pasinetti (1962) argues that when any individual saves a part of his income, he must also be allowed to own it. From this Pasinetti theorem, the relationship between saving and investment can be derived as follows:

From the basic principle of national income account,

\[(A1) \quad X = P + W\]

where \(X\) is total income, \(P\) is total profit (including interest and rent), and \(W\) is total wage income.

And from the Pasinetti axiom,

\[(A2) \quad K = K_C + K_W\]
\[(A3) \quad P = P_C + P_W\]

where \(K\) is total capital stock, \(K_C\) is the share of capital stock which belongs to pure capitalists, \(K_W\) is the share of the capital stock
which belongs to the savers from wage earner class, and \( P_c \) and \( P_w \) are profits from \( K_c \) and \( K_w \), respectively.

Thus, by substituting (A3) to (A1), we obtain

(A4) \( X = (P_c + P_w) + W \)

and for the dynamic equilibrium,

(A5) \( I = S = s_c P_c + s_w P_w + s_w W \)

\[ = (s_c-s_w)P_c + s_w X \]

where \( I \) and \( S \) are total investment and saving, and \( s_c \) and \( s_w \) are propensities to save of pure capitalists and wage earners, respectively.

Consequently,

(A6) \( P_c = \frac{1}{s_c-s_w} I - \frac{s_w}{s_c-s_w} X \)

Now (A6) can be substituted in (A3) to obtain

(A7) \( P = \frac{1}{s_c-s_w} I - \frac{s_w}{s_c-s_w} X + r K_w \)

where \( r \) is a equilibrium rate of return to capital.

If we assume a linear saving function,

(A8) \( \frac{K_w}{K} = \frac{S_w}{S} = \frac{S_w (X-P_c)}{I} \)

\[ = \frac{S_w X}{I} - \frac{S_w P_c}{I} \]
Since $r = P/K$ in the long-run,

\[(A9) \quad P_w = rK_w = P_{K_w}^r = P_{swx/1} - P_{swp/1}\]

Utilizing (A6), (A9) can be rewritten as,

\[(A10) \quad P_w = P(X)(\frac{S_w}{s_c - s_w}) - P(\frac{S_w}{s_c - s_w})\]

Therefore, by (A6) and (A10),

$$P = P_c + P_w = \frac{1}{s_c - s_w} \cdot I - \frac{S_w}{s_c - s_w} \cdot X$$

$$+ P\left(\frac{X}{I}\right)(\frac{S_cSw}{s_c - s_w}) - P\frac{S_w}{s_c - s_w}$$

By rewriting this, we can obtain

$$\left\{1 - X\left(\frac{S_cSw}{s_c - s_w} + \frac{S_w}{s_c - s_w}\right)\right\}P = \frac{1}{s_c - s_w} \cdot I - \frac{S_w}{s_c - s_w} \cdot X$$

$$\left\{\frac{S_c}{s_c - s_w} \cdot (1 - SwX)\right\}P = \frac{1}{s_c - s_w} \cdot I(1 - SwX)$$

Finally,

\[(A11) \quad s_cP = I\]

And from the constant returns production function,

\[(A12) \quad P = \sigma_1X\]

Therefore,

\[(A13) \quad I = s_c\sigma_1X\]
From the production function of the industrial sector, we obtain

\[(A\ 14) \frac{\dot{X}}{X} = \lambda + \sigma_1 \frac{\dot{K}_x}{K_x} + \sigma_2 \varepsilon_x\]

Then,

\[(A\ 15) \frac{\dot{K}_x}{K_x} - \frac{\dot{X}}{X} = (1 - \sigma_1) \frac{\dot{K}_x}{K_x} - (\lambda + \sigma_2 \varepsilon_x)\]

And, from (A13)

\[(A\ 16) \frac{\dot{I}}{K_x} = \frac{\dot{K}_x}{K_x} = s_c \sigma_1 \frac{X}{K_x}\]

We can substitute (A16) in (A15) to obtain

\[
\frac{\dot{K}_x}{K_x} - \frac{\dot{X}}{X} = (\frac{\dot{K}_x}{K_x} / \frac{X}{K_x}) = (1 - \sigma_1) s_c \sigma_1 \frac{X}{K_x} - (\lambda + \sigma_2 \varepsilon_x)
\]

Thus,

\[(A17) \frac{\dot{K}_x}{X} = (1 - \sigma_1) s_c \sigma_1 - (\lambda + \sigma_2 \varepsilon_x) \frac{K_x}{X}\]

Let us rewrite (A17) as follows:

\[
\dot{x} = - cx + d
\]

where \(x = K_x / X\)

\[c = (\lambda + \sigma_2 \varepsilon_x)\]

\[d = (1 - \sigma_1) s_c \sigma_1\]

Solution of the above differential equation using the integrating factor \(e^{ct}\) yields
\[
\frac{d}{dt}(e^{ct}x) = e^{ct}d \\
x = \frac{d}{c} + ue^{-ct}
\]

where \(u\) is an initial condition, or

\[
(A18) \quad \frac{Kx}{X} = \frac{(1-\sigma_1)s_0^1}{\lambda + \sigma_2 \varepsilon x} + ue^{-(\lambda + \sigma_2 \varepsilon x)t}
\]

Since \(\lambda + \sigma_2 \varepsilon x > 0\),

\[
\lim_{t \to \infty} \frac{Kx}{X} = \frac{(1-\sigma_1)s_0^1}{\lambda + \sigma_2 \varepsilon x}
\]

or

\[
(A19) \quad \lim_{t \to \infty} \frac{X}{Kx} = \frac{\lambda + \sigma_2 \varepsilon x}{(1-\sigma_1)s_0^1}
\]

Substitution (A19) in (A16) yields

\[
(A20) \quad \lim_{t \to \infty} \frac{Kx}{Kx} = \frac{\lambda + \sigma_2 \varepsilon x}{1-\sigma_1} = \frac{\lambda}{\sigma_2} + \varepsilon x
\]

Substituting (A20) in (A14),

\[
(A21) \quad \frac{X}{X} = \frac{\lambda}{\sigma_2} + \varepsilon x
\]

Equations (A20) and (A21) show that capital-output ratio is constant asymptotically if we assume neo-classical savings and investment functions.
Appendix B

List of Raw Data
### Table A1

**INDUSTRIAL ORIGIN OF GNP**

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*In million 1970 dollars*
INDUSTRIAL ORIGIN OF GNP (Continued)

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Source: Korea Statistical Yearbook (Various Issues), EPB, and Hong, W.T. (1976) p. 208
### Table A2

#### SECTORAL NET FIXED CAPITAL STOCK

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In million 1970 dollars
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### Table A3

**LABOR FORCE**

(though thousand persons)

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Note: Capital accounts of Central and other monetary institutions are excluded.

Source: Major Statistics of Korean Economy, 1976, EPB
Table A5

SECTORAL ORIGIN (Y,X) OF GNP AND K/O RATIO

(1970 million dollars)

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<th>X</th>
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| 1957  | 3,266.1 | 1,449.3 | 827.3 | 353.6 | 2,285.9 | 0.24 |

| 1958  | 2,435.8 | 1,539.3 | 902.7 | 371.0 | 2,404.7 | 0.24 |
| 1959  | 3,568.4 | 1,521.4 | 989.6 | 392.3 | 2,519.1 | 0.26 |
| 1960  | 3,637.2 | 1,502.2 | 1,039.9 | 416.7 | 2,614.4 | 0.28 |

| 1961  | 3,813.5 | 1,681.3 | 1,047.8 | 452.2 | 2,746.9 | 0.27 |
| 1962  | 3,931.0 | 1,584.6 | 1,167.1 | 473.6 | 2,943.8 | 0.30 |
| 1963  | 4,276.6 | 1,713.0 | 1,309.0 | 515.8 | 3,197.3 | 0.30 |
| 1964  | 4,642.6 | 1,978.7 | 1,405.6 | 553.8 | 3,390.5 | 0.28 |
| 1965  | 4,925.0 | 1,940.3 | 1,518.6 | 606.8 | 3,658.1 | 0.31 |

| 1966  | 5,535.0 | 2,150.4 | 1,824.6 | 695.0 | 4,165.4 | 0.32 |
| 1967  | 5,965.9 | 2,043.7 | 2,164.7 | 783.2 | 4,821.3 | 0.37 |
| 1968  | 6,719.6 | 2,093.0 | 2,569.5 | 843.4 | 5,693.4 | 0.40 |
| 1969  | 7,728.6 | 2,355.1 | 2,995.7 | 927.6 | 6,895.6 | 0.39 |
| 1970  | 8,336.3 | 2,332.9 | 3,454.6 | 1,046.7 | 8,006.2 | 0.43 |

| 1971  | 9,101.2 | 2,409.7 | 3,930.6 | 1,166.9 | 9,094.0 | 0.48 |
| 1972  | 9,734.8 | 2,650.0 | 4,387.9 | 1,329.6 | 10,013.9 | 0.54 |
| 1973  | 11,341.7 | 2,585.1 | 5,444.2 | 1,489.7 | 11,261.2 | 0.58 |
| 1974  | 12,316.5 | 2,728.8 | 6,137.7 | 1,717.4 | 12,516.5 | 0.63 |
| 1975  | 13,294.7 | 2,875.5 | 6,828.9 | - | - | - |

Source: Table A1 and Table A2
## Table A6

### Sectoral Contribution to GNP Growth (％)

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Source: Table A1 and Table A2. *All values are in 1970 dollars.
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Source: Korea Statistical Yearbook (Various Issues), EPB
Notes: in parentheses, *mining, **fishery and ***agricultural products
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Source: Table A7 and Major Statistics of Korean Economy, EPB, 1976
Table A9

CHANGES OF INDUSTRIAL COMPOSITIONS

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Source: Economic Statistics Yearbook, BOK, 1975
Note: All values are ratios to GNP (1970 prices)
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<td>16.2</td>
<td>1.2</td>
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</tbody>
</table>

Source: Korea Statistical Yearbook, EPB, 1976
### Table All

Growth Rates of Demand for Industrial Goods and Agricultural Goods and Per Capita Income (%)

<table>
<thead>
<tr>
<th></th>
<th>Ind. Goods</th>
<th>Per Capita Demand</th>
<th>Per Capita Income</th>
</tr>
</thead>
<tbody>
<tr>
<td>1965</td>
<td>5.5</td>
<td>4.8</td>
<td>3.6</td>
</tr>
<tr>
<td>1966</td>
<td>5.8</td>
<td>7.6</td>
<td>8.2</td>
</tr>
<tr>
<td>1967</td>
<td>5.0</td>
<td>9.3</td>
<td>5.3</td>
</tr>
<tr>
<td>1968</td>
<td>2.5</td>
<td>13.5</td>
<td>10.0</td>
</tr>
<tr>
<td>1969</td>
<td>10.2</td>
<td>12.3</td>
<td>12.4</td>
</tr>
<tr>
<td>1970</td>
<td>7.4</td>
<td>7.5</td>
<td>5.6</td>
</tr>
<tr>
<td>1971</td>
<td>3.2</td>
<td>5.2</td>
<td>7.0</td>
</tr>
<tr>
<td>1972</td>
<td>2.9</td>
<td>1.3</td>
<td>4.9</td>
</tr>
<tr>
<td>1973</td>
<td>5.5</td>
<td>-8.6</td>
<td>14.5</td>
</tr>
<tr>
<td>Average</td>
<td>5.3</td>
<td>5.9</td>
<td>7.9</td>
</tr>
</tbody>
</table>

Source: Economic Statistics Yearbook, Bank Of Korea (Various Issues) and Hong(1976)

1/ Two-years moving average
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