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SOURCES OF EMPLOYMENT GROWTH

IN THE KOREAN MANUFACTURING SECTOR, 1963-1973

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ABSTRACT

The Korean manufacturing sector has achieved an annual rate of 11.3 percent employment growth over the period 1963 to 1973, which is one of the highest rates among LDC's. To explain this high growth rate, we specified the sources of employment growth on the basis of the demand for labor function derived from the CES production function. The sources of employment growth were defined as: real wage growth, returns to scale, domestic share of value added, growth of the domestic sector, export share of value added, growth of the export sector and residual. The purpose of this study was to measure how those sources contributed to employment growth, what sources were responsible for the high growth rate, and which industries made major contributions to employment growth. The analysis was conducted for nineteen 2-digit industries as well as for the total manufacturing sector. Following is a brief summary of the main conclusions.

(1) For the total manufacturing sector, the estimate of the elasticity of substitution within the framework of the ACMS approach was around 0.6. Real wage growth combined with the elasticity of substitution, therefore, has a substantial negative effect on employment growth because of a significant substitutability between capital and labor. Elasticities of substitution were estimated also at the 2-digit industrial level. Except for three industries, elasticities were less than one, though estimation equations were different.

(2) For the total manufacturing sector, the annual rate of 8.6 percent real wage growth, combined with the real wage elasticity of -0.56,

reduced employment growth by 4.8 percent per year. At the 2-digit level, the real wage variable was statistically significant in only seven industries. In general, real wage growth has a substantial negative effect on employment growth in a limited number of industries.

(3) For the total manufacturing sector, the annual rate of 23.0 percent value added growth, combined with the value added elasticity of 0.78, increased employment growth by 17.9 percent per year. If we compare the positive contribution from value added growth with the negative one from real wage growth, we can see that the positive contribution exceeds the negative one by more than three and a half times. This is the main reason why the Korean manufacturing sector could have achieved such a high growth rate of employment. At the 2-digit level, the value added variable was statistically significant in seventeen industries. Furthermore, the growth rate of value added and the value added elasticity are much higher than the counterparts of the real wage rates in all industries.

(4) Because the export expansion has played a key role in the Korean economy, we extracted the contribution of export to value added growth. For the total manufacturing sector, the annual rate of 46.2 percent export growth contributed 10.1 percentage points of the annual 23.0 percent value added growth. At the 2-digit level, the high growth rate of export, which ranges from 22 to 80 percent, contributed more than half of the value added growth in twelve industries. Based on value added growth from the export sector and the estimate of the value added elasticity, we can find that, *ceteris paribus*, the export expansion contributed 5 percentage points

of the annual rate of 11.3 percent employment growth in the total manufacturing and about half of employment growth in twelve 2-digit industries.

(5) Regarding the individual industries' contributions to employment growth, there are five leading industries: textiles, clothes, miscellaneous, electrical and food. The sum of the contributions made by these five industries is 7.1 percentage points of the annual 11.3 percent employment growth. This finding also suggests that high employment growth in the Korean manufacturing sector was made possible by the development of the labor-intensive industries which was the result of the export expansion.

(6) We found that there were increasing returns to scale in almost all industries and this has a substantial negative effect on employment growth, even though the negative contribution has already been accounted for in the net contribution of value added growth.

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CHAPTER I

INTRODUCTION

The Korean manufacturing sector has achieved an annual rate of 20.0 percent value added growth and 11.3 percent employment growth over the period 1963 to 1973 (Table 1). Regarding employment growth in the Korean economy, the development of the manufacturing sector has played a key role: during the same period, the annual rate of employment growth in the agricultural sector was 1.5 percent; that in the service sector was 5.7 percent; with the 11.3 percent in the manufacturing sector, this resulted in an overall 3.8 percent employment growth for the whole economy.[1] Considering that the annual 11.3 percent rate of employment growth in the manufacturing sector has increased its share of employment in the past by more than 7 percent annually, the expansion of the manufacturing sector in the near future could be expected to solve unemployment and underemployment problems in the Korean economy.

The economy of Korea has experienced dramatic structural change since 1962 when the First-Five-Year-Economic-Planning (First-Planning) program was launched. As Table 1 shows, the annual compound rate of GNP growth since 1963 was 10.3 percent. The high rate of GNP growth was primarily the result of expansion of exports and development of the manufacturing sector. The total exports and manufactured exports have grown annually by about 35 and 45 percent, respectively. As a result, the shares of total exports over GNP and manufactured exports over manufacturing value added increased by more than six or seven times from 1963 to 1973. Along with the export expansion followed the development of the manufacturing sector whose annual rate of value added growth was

Table 1

Major Economic Indicators of the Korean Economy, 1963-1973

(Index: 1963=100 and Share: % share of the whole economy)

Year	GNP	Export		Development of the Manufacturing Sector							Employment of Other Sectors			
				Value Added		Employment		Capital Stock		Real Wage	Agriculture		Services	
	Index	Index	Share	Index	Share	Index	Share	Index	Share	Index	Index	Share	Index	Share
1963	100.0	100.0	3.5	100.0	12.6	100.0	8.0	100.0	10.0	100.0	100.0	63.1	100.0	28.2
1964	108.6	123.6	4.0	106.5	12.3	104.4	8.2	105.4	10.2	89.6	99.8	61.9	105.8	29.3
1965	115.2	173.9	5.2	127.8	14.0	126.6	9.4	114.9	10.7	92.1	99.4	58.6	118.0	31.0
1966	129.4	264.9	7.1	149.7	14.5	136.6	9.9	136.1	11.9	97.5	100.8	57.9	122.1	31.3
1967	139.5	359.6	8.9	183.7	16.6	167.4	11.7	155.6	12.6	119.7	99.5	55.2	129.3	32.0
1968	157.1	509.2	11.3	233.4	18.7	191.8	12.8	179.7	13.2	129.0	99.3	52.4	142.4	33.6
1969	180.7	671.7	12.9	283.3	19.7	202.0	13.1	205.0	13.4	165.4	99.8	51.3	150.3	34.4
1970	194.9	825.9	14.7	335.4	21.6	210.5	13.2	228.5	13.4	192.0	101.6	50.4	159.1	35.2
1971	212.8	995.1	16.3	394.8	23.3	219.0	13.3	251.2	13.4	221.7	100.8	48.4	174.3	37.4
1972	227.6	1393.7	21.3	456.9	25.2	236.9	13.7	262.7	13.0	229.1	110.5	50.6	172.1	35.2
1973	266.1	2240.7	29.7	620.3	29.3	290.8	15.9	300.2	13.6	228.9	115.1	50.0	173.7	33.7
Annual Growth Rate	10.3	36.5	24.0	20.0	8.8	11.3	7.1	11.7	3.1	8.6	1.5	-2.3	5.7	1.8

Sources: a) GNP,Export and Value Added --- Yearbook of National Income 1974 and Monthly Economic Statistics (The Bank of Korea).

b) Employment --- Annual Report on the Economically Active Population (The Economic Planning Board).

c) Capital Stock --- Wontak Hong, "Export and Employment in Korea," (The Korea Development Institute Interim Progress Report 7410, Dec.,1974).

d) To obtain the real wage rates, the money wage rates from the Monthly Economic Statistics (The Bank of Korea) were deflated by the implicit price deflators for the manufacturing sector which were calculated on the basis of the data of current and constant value added from Yearbook of National Income 1974 (The Bank of Korea).

Notes: a) Export share is the export share of GNP.

b) Employment of the mining sector was excluded from the table: its share of total employment is, on the average, 0.9% and the annual rate of employment growth is -1.9%.

c) All data except employment are expressed at the 1970 constant prices.

20.0 percent and whose share of GNP increased from 12.6 percent in 1963 to 29.3 percent in 1973.

The rapid development of the Korean manufacturing sector, accelerated by an industrialization policy, has accompanied high rates of capital formation and employment growth. Over the period 1963 to 1973, the rates of capital formation and employment growth were 11.7 and 11.3 percent, respectively. The comparison between employment growth and capital formation is quite impressive because the capital-labor ratio has been stable. Furthermore, the 11.3 percent employment growth in the Korean manufacturing sector was the most successful among less developed countries (LDC's).[2] During the 1950's and 1960's, the rate of employment growth in the manufacturing sector of most LDC's was slow and less than half of the rate of output growth. Industrialization policies in most LDC's have usually failed in absorbing the labor surplus into the growing industrial sector. The Korean experience, however, shows that the manufacturing sector has played the role of an engine of growth for employment as well as output. Considering that in only eleven years the manufacturing sector's employment share of the entire economy has doubled, the maintenance of this historical trend of development would soon bring about a labor shortage in Korea.

The purpose of this study is to specify and analyze the sources of employment growth in the Korean manufacturing sector. Even though the unemployment problem is serious in most LDC's, studies of the sources of employment growth are rarely found.

1. Sources of Output Growth in the Korean Economy

Before we specify the sources of employment growth, we will first present the sources of output growth in the Korean economy by utilizing traditional growth accounting.[3] Traditional growth accounting is useful in this study because it is one methodology available for the investigation of sources of growth and it facilitates the display of contributions made by various factors to growth.

Tables 2.a and 2.b break down the 10.3 percent GNP and 20.0 percent manufacturing value added growth among their sources. The results are rough estimates and their derivations are based on the strong assumptions because we are using the Cobb-Douglas production function, especially the unitary elasticity of substitution, and unadjusted factor inputs.[4] However, the tables distinguish broadly between the contributions of increases in factor inputs, increases in output per unit of input and export increases. Here, the contribution of export increases to output growth was measured by

$$V = D + X$$ [5]

where V = GNP or manufacturing value added, D = domestic component and X = export. Differentiating the above equation with respect to time and dividing it by V results in

$$\frac{\dot{V}}{V} = \frac{D}{V} \cdot \frac{\dot{D}}{D} + \frac{X}{V} \cdot \frac{\dot{X}}{X}$$

where $\dot{V}/V$ = growth rate of GNP, D/V = share of domestic sector of GNP, $\dot{D}/D$ = growth rate of domestic sector, X/V = export share of GNP and $\dot{X}/X$ = growth rate of export.

According to Table 2.a, for the whole economy, the annual rate of capital formation was 8.2 percent and its contribution to GNP growth was 52.4 percent. The rate of employment growth, which was 3.8 percent per year, made only a 13.6 percent contribution to GNP growth. For the

Table 2.a

Sources of GNP Growth in the Korean Economy, 1963-1973

Sources of Growth	Average Share (%)		Growth Rate (% per year)		Contribution (% per year)	
	Whole	Manufacturing	Whole	Manufacturing	Whole	Manufacturing
1. GNP	100.0	100.0	10.3	20.0	10.3(100.0)	20.0(100.0)
2. Labor	35.5	26.7	3.8	11.3	1.4(13.6)	3.0(15.0)
3. Capital	64.5	73.3	8.2	11.7	5.4(52.4)	8.6(43.0)
4. Increase in output per unit of input	---	---	3.5	8.4	3.5(34.0)	8.4(42.0)

Sources: Same as Table 1.

Note: The equation for growth accounting above is derived from the Cobb-Douglas production function as

$$\frac{\dot{Y}}{Y} = \frac{\dot{A}}{A} + \alpha\frac{\dot{K}}{K} + (1-\alpha)\frac{\dot{L}}{L}$$

Table 2.b

Contributions of the Domestic and Export Sectors to GNP Growth in the Korean Economy, 1963-1973

Sector	Average Share (%)		Growth Rate (% per year)		Contribution (% per year)	
	Whole	Manufacturing	Whole	Manufacturing	Whole	Manufacturing
GNP	100.0	100.0	10.3	20.0	10.3(100.0)	20.0(100.0)
Domestic	87.7	79.2	6.6	13.4	5.8(56.3)	10.6(53.0)
Export	12.3	20.8	36.5	45.0	4.5(43.7)	9.4(47.0)

Sources: a) For the whole economy, same as Table 1.
b) For the manufacturing sector, the average export share of value added and growth rate of export were derived from the <u>Input-Output Tables</u> for 1963, 1966, 1968, 1970 and 1973 (The Bank of Korea).

manufacturing sector, the evidences are fairly similar to those of the whole economy. Especially, the low contribution of increases in labor input to GNP and manufacturing value added growth was caused by the low estimated elasticity of output with respect to labor,[6] which is 35.5 percent for the whole economy and 26.7 percent for the manufacturing sector. The low share of labor might be a result of the wage policy in which the Korean government has allowed the wage rates to be set by competitive forces.[7] In total, the contribution of increases in factor inputs to GNP growth for the whole and manufacturing sector was about 60 percent and the residual is the contribution of increases in GNP per unit of factor input, which might represent productivity increases due to technological progress. The 40 percent contribution of residual to GNP growth in the Korean economy is not unusual, compared to the evidence with respect to the U.S. and other LDC's.[8]

According to Table 2.b, the contributions of export to GNP growth for the whole and manufacturing sector were 44 and 47 percent, respectively, if we divide the total into domestic and export sectors. Although the export share was relatively low, the high contribution of export to GNP growth in the Korean economy was caused by the high growth rate of export. Without export growth, the GNP and manufacturing value added growth would have been only about 5.8 and 10.6 percent per year.

Broadly speaking, the sources of GNP growth in the Korean economy have some important implications for employment growth. The high contribution of export growth to GNP growth suggests that a substantial portion of the 11.3 percent manufacturing employment growth seems to be induced by the export expansion. Also the low wage share suggests that high employment growth was aided by the wage policy whereby Korea has never had a minimum wage law or strong labor unions. A low wage share implies a low wage rate with the level of employment given. Considering that the source of comparative advantage in the Korean economy is cheap labor, a low wage would be one of the main sources of high export and employment growth. Finally, the 40 percent contribution of residual to GNP growth suggests that technological progress would have a significant negative effect on employment growth.

Within the framework of traditional growth accounting, we will analyze the sources of employment growth in the Korean manufacturing sector. The traditional growth accounting, however, involves two theoretical defects: first, it is untested theory and second, it is based on an arbitrary specification of the production function which makes the elasticity of substitution equal to unity. Therefore, in measuring the sources of employment growth, we will utilize the constant elasticity of substitution (CES) production function to estimate the elasticity of substitution and the theory will be tested.

2. Specifications of the Sources of Employment Growth in the Korean Manufacturing Sector

To analyze the sources of the 11.3 percent employment growth in the Korean manufacturing sector, we will briefly specify the sources of employment growth, with special reference to the development of the Korean manufacturing sector and the causes of slow employment growth in LDC's.

According to the theory of production, the demand for factor inputs is determined by the level of output and their own prices: the former is called the output effect and the latter the substitution effect. We can easily specify output growth as a positive source of employment growth and increase in factor price as a negative source.

Regarding the output effect, the 20.0 percent manufacturing value added growth per year in the Korean economy seems to be one of the main sources of employment growth because, ceteris paribus, employment growth would be induced by as much as value added growth. The 20.0 percent value added growth, however, is unusual, considering that the market size in the Korean economy is small. As we showed previously, the manufacturing value added growth from the domestic sector, without export growth, would have been about 10.6 percent. Therefore, we can propose that export growth would explain about half of the contribution of value added growth to employment growth. Furthermore, if the manufactured export is more labor-intensive than the domestic component, the contribution of export growth to employment growth could be greater than that of growth of the domestic component. Many economists, after studying the low employment growth in LDC's, have suggested that the problem of labor absorption in LDC's could help solve by exporting labor-intensive manufactured products. The leading ideas appear to advocate "outward-looking policies" to help solve employment problems. The 45 percent annual growth rate of manufactured export in Korea has sustained high growth of employment and absorbed a larger portion of the labor force. In this sense, export growth can be specified as the most important source of employment growth in the Korean manufacturing sector.

The outward-looking policy induces direct and indirect gains from export expansion. The indirect gains in adaptation of the latest technology, improvement of human resources and increasing returns associated with economies of scale and market size may be as important as the direct gains in income, foreign exchange and employment. In this study, we are especially concerned with increasing returns to scale and technological progress. As the market size expands due to the increase in foreign demand, we expect that the small scale of production such as in Korea would experience a substantial amount of increasing returns to scale. At the same time, technological progress whose rough estimation we already showed, would become an important factor for the change in the production structure. Even though increasing returns to scale and technological progress are usually interrelated over time, they would be a negative source of employment growth because a given level of output would require less factor inputs.[9]

Regarding factor prices as negative source of employment growth, many development economists have paid attention to the differential growth of the user cost of capital and wage rate, which is known as factor price distortion. Factor price distortion has been widely recognized as a significant source of slow employment growth in LDC's. As some studies have already suggested,[10] factor price distortion is induced by government industrialization policy as well as wage policies such as minimum wage law and fringe benefits. To achieve rapid industrial growth, a government frequently gives several types of investment incentives: direct financial subsidies, low interest rates, tax exemptions, low tax rates, differential rates of protection and domestic currency overvaluation. These investment incentives usually result in lowering the user cost of capital and encouraging capital-intensive methods of production. On the other hand, wage policies tend to raise the real wage in line with labor productivity increases or in some instances, in excess of labor productivity increases.[11] Thus a relatively low increase in the user cost of capital and relatively high increase in wage rate resulted in factor price distortion. Hence, employment growth is retarded, even with output growth relatively high--especially in the manufacturing sector.

To specify the wage increase as a negative source of employment growth and measure the contribution of wage increase to employment growth, one method is to estimate the elasticity of substitution.[12] The elasticity of factor substitution measures the percentage change in factor proportion with respect to the percentage change in the wage-rental ratio. If the estimate of the elasticity of substitution is greater than zero, we can say that for example, a given increase in the wage rate will retard employment growth over time. However, in estimating the elasticity of substitution, the change in output is not taken into account. The other method, therefore, is to estimate the demand for labor function which distinguishes the output effect and the substitution effect.

In the Korean economy, disregarding the user cost of capital,[13] the real wage increased annually by 8.6 percent, even though the rate of increase shows fluctuations. For the manufacturing sector as a whole, however, the rate of real wage increase was less than that of labor productivity increase. Again, the wage policy in Korea has resulted in a relatively low increase in real wage, compared to the increase in labor productivity. However, the effect of wage increase on employment growth in the Korean manufacturing sector will be analyzed after we estimate the elasticity of substitution and the demand for labor function.

Sources of employment growth in the Korean manufacturing sector are: value added growth, paying special attention to export growth; increasing returns to scale associated with economies of scale and expansion of market size; technological progress; factor substitution, depending on the elasticity of substitution and wage increase. The following chapter will present the theoretical framework for the analysis.

This paper is organized as follows: following this chapter, Chapter II specifies the theoretical framework based on the CES production function; Chapter III presents the empirical findings; Chapter IV illustrates the sources of employment growth and their contributions in the Korean manufacturing sector; and the conclusion and policy implications are contained in Chapter V.

Footnotes

Chapter I

[1]Economic Planning Board, Korea, Annual Report on the Economically Active Population (Seoul: 1973), pp. 54-55.

[2]D. Morawetz, "Employment Implications of Industrialization in Developing Countries: A Survey, "Economic Journal, 84 (Sept., 1974), pp. 492-495.

[3]By traditional growth accounting, I mean a Solow-Kendrick-Denison-Jorgenson type approach. Recently Nelson criticized this approach:

> I suggest that while recent research has increased our knowledge, studies of this sort have run into sharply diminishing returns and soon will arrive at a dead end leaving many essential open questions.

For references, see R. Solow, "Technical Change and the Aggregate Production Function," Review of Economics and Statistics, XXXIX (Aug., 1957), pp. 312-20; J. W. Kendrick, Productivity Trends in the United States (Princeton, 1961); E. F. Denison, The Sources of Economic Growth in the United States and the Alternatives Before Us (New York: Committee for Economic Development, 1962); D. W. Jorgenson and Z. Griliches, "The Explanation of Productivity Change," Review of Economic Studies, XXXIV (July, 1967), pp. 249-283; R. Nelson, "Recent Exercises in Growth Accounting: New Understanding or Dead End?" American Economic Review, LXIII (June, 1973), p. 462.

[4]Jorgenson and Griliches strongly argue and show the evidence that "if quantities of output and input are measured accurately, growth in total output may be largely explained by growth in total input." Jorgenson and Griliches, "The Explanation..." p. 271.

[5]The assumption here is that outputs of the domestic and export sectors are independent and exogeneous.

[6]The Cobb-Douglas production function assumes that the share of labor can be used as a proxy for the elasticity of output with respect to labor.

[7]This point is not conclusive. However, the comparison of the wage share in the Korean manufacturing sector with that in the Argentine manufacturing sector, where there has been a minimum wage law and the average wage share was 35 percent, may shed a light on the relationship between wage share and wage policy. For the wage share in the Korean manufacturing sector, see Appendix V, and for the Argentine case, see J. M. Katz, Production Functions, Foreign Investment and Growth (Amsterdam: North-Holland Publishing Company, 1969), p. 24.

[8]For the U.S., the recent study is E. F. Denison, Accounting for United States Economic Growth 1929-1969 (Brookings, 1974) and for Latin American countries, H. Bruton, "Productivity Growth in Latin America," American Economic Review, LVII (Dec., 1967), pp. 1099-1116.

[9]It is assumed here and elsewhere that output is constrained by demand.

[10]A. D. Witte, "Employment in the Manufacturing Sector of Developing Countries: A Study of Mexico, Peru and Venezuela," (Ph.D. thesis submitted to North Carolina State University, Raleigh, 1971), p. 64; J. G. Williamson, "Capital Accumulation, Labor Saving and Labor Absorption Once More," Quarterly Journal of Economics, LXXXV (Feb., 1971), p. 59 and p. 62; T. Ruprecht, "Output Stimulation and Employment Stagnation--Policy By-Product in the Philippines," Economic Development and Cultural Change, 17 (Oct., 1968), pp. 77-89.

[11]H. A. Turner and D. A. S. Jackson, "On the Determination of the General Wage Level--A World Analysis: Or Unlimited Labor Forever, LXXX" Economic Journal (Dec., 1970), p. 845.

[12]The original Hicks-Allen version of the elasticity of substitution can be estimated by,

$$\log K/L = a + \sigma \log w/r + u$$

where K/L: capital-labor ratio, a: constant, σ: elasticity of substitution, w/r: wage-rental ratio, u: disturbance term. Later, Arrow-Chenery-Minhas-Solow developed a different approach, which is,

$$\log V/L = b + \sigma \log w + v$$

where V/L: value added per worker, b: constant, σ: elasticity of substitution, w: wage rate, v: disturbance term. Theoretically, σ's from both equations are identical. See J. R. Hicks, The Theory of Wages (London: Macmillan, 1932), pp. 241-46; R. G. D. Allen, Mathematical Analysis for Economists (London: Macmillan, 1938), pp. 340-45, 369-74, 503-9; K. J. Arrow, H. B. Chenery, B. S. Minhas, and R. M. Solow, "Capital-Labor Substitution and Economic Efficiency," Review of Economics and Statistics, XLIII (Aug., 1961), pp. 225-50.
For more complete discussion of the CES production function, see M. Brown (ed.), The Theory and Empirical Analysis of Production, Studies in Income and Wealth, vol. 32 (New York: Columbia University Press, 1967).

[13]Based on the Jorgenson model, the user cost of capital with respect to the Korean manufacturing sector was measured and reported in Appendix VI.

CHAPTER II

THEORETICAL FRAMEWORK

This chapter presents the theoretical framework for the measurement of the sources of employment growth in the Korean manufacturing sector. The chapter is divided into three parts: the CES production function, estimation forms and measures of the contribution to employment growth.

1. The CES Production Function

It is necessary to start from the production function to analyze the sources of employment growth. Production functions can be classified into three broad groups: fixed-proportion production functions; Cobb-Douglas production functions; CES production functions. Each of these production functions has a limiting assumption: zero elasticity of substitution for the first group; unit elasticity for the second group; any positive, but constant elasticity for the third group.[1] It is well known that the elasticity of substitution plays an important role in the analyses of production and income distribution.[2] Therefore, there is no *a priori* reason to assume that the elasticity of substitution is zero or unity.

Following Arrow-Chenery-Minhas-Slow (ACMS),[3] one of the most flexible production functions is the following CES function:

$$(1.1) \qquad V = \gamma \left(\delta K^{-\rho} + (1-\delta)L^{-\rho}\right)^{-\frac{1}{\rho}}$$

where V: value added

K: capital

L: capital

γ, δ, ρ: efficiency, distribution and substitution parameters.

Each of the above parameters describes a distinct aspect of the productive structure: γ is an index of the efficiency with which capital and labor are utilized under a given technology, and increases in γ describe disembodied Hicks-neutral improvements in technological efficiency. δ describes the capital intensiveness of production in the presence of a given state of technology. ρ is a unique transformation of the elasticity of substitution between capital and labor by which

$$\sigma \text{ (elasticity of substitution)} = \frac{1}{(1+\rho)}$$

First, note that there are constant returns to scale in this production function. This may be a restrictive assumption. Following Brown and Cani,[4] the production function with non-constant returns to scale becomes:

$$\text{(1.2)} \qquad V = \gamma\left[\delta K^{-\rho} + (1-\delta)L^{-\rho}\right]^{-\frac{h}{\rho}}$$

where h: scale parameter.

This production function is homogeneous of degree h in K and L; there will be decreasing, constant or increasing returns to scale depending on h, i.e., $h \lesseqgtr 1$.

Second, the production function (1.2) does not assume the existence of technological progress. It is more reasonable to assume technological progress when time-series analysis is utilized as this study does. The most common assumption with regard to technological progress is that of neutrality by which the production function is affected but not the marginal rate of technical substitution.[5] By replacing γ by $\gamma_0 e^{\lambda t}$, where γ_0 is an initial index of efficiency which is arbitrarily 1, and λ is a constant rate of technological progress, the production function with neutral technological progress and non-constant returns to scale becomes:

$$(1.3) \qquad V = \left[\delta K^{-\rho} + (1-\delta)L^{-\rho}\right]^{-\frac{h}{\rho}} e^{\lambda t}$$

However, the assumption that technological progress affects labor and capital at the same rate may also be limiting. Therefore, we assume that technological progress affects labor and capital at the different rate m and k.[6] Then the production function with non-neutral technological progress and non-constant returns to scale becomes:

$$(1.4) \qquad V = \left[\delta (e^{kt} K^{-\rho}) + (1-\delta)(e^{mt} L^{-\rho})\right]^{-\frac{h}{\rho}}$$

where k, m: rates of capital- and labor-augmenting technological progress and hence e^{kt}, e^{mt}: efficiency units of capital and labor.

The production function (1.4) can be used to measure the degree of bias in technological progress. For example, the degree of bias in regard to labor can be expressed in terms of the difference in the effects of technological progress on the marginal productivities of labor and capital. There is, however, no agreement on the precise definition of bias in technological progress: the Hicksian definition measures the bias along a constant capital-labor ratio; the Harrodian definition measures the bias along a constant capital-output ratio; and the Solow's definition measures the bias along a constant labor-output ratio.[7]

Following the Hicksian definition, the production function (1.4) details the degree of bias for labor:

$$B_L = \frac{d\log(F_L/F_K)}{dt} \qquad K/L = \text{constant}$$

$$= -\rho m + \rho k = \rho(k-m) = \frac{(1-\sigma)}{\sigma}(k-m)$$

where B_L: degree of bias for labor

F_L, F_K: marginal productivites of labor and capital.

The bias in technological progress depends on the elasticity of substitution, σ , and the differential rates of growth of labor and capital embodiment, m and k. Assuming that $\sigma < 1$, which many time-series studies have shown, the Hicksian definition results in neutral technological progress if $m = k$ ($B_L = 0$), labor-saving (or capital-using) technological progress if $m > k$ ($B_L < 0$), and labor-using (or capital-saving) technological progress if $m < k$ ($B_L > 0$).

What is interesting in relation to the labor-saving technological progress is the increasing K/L ratio. If technological progress affects the F_L/F_K ratio with the relative factor prices (W/C) ratio constant, the firm will attempt to change the K/L ratio in order to keep the ratio $F_L/F_K = W/C$. Suppose the ratio W/C remains constant:

$$\frac{d\log\ (F_L/F_K)}{dt} = d\log\ (W/C) = 0$$

If we relax the assumption of a constant K/L ratio, then

$$\frac{d\log\ (F_L/F_K)}{dt} = (k-m) + (1+\rho)\ \frac{d\log\ (K/L)}{dt} = 0$$

Therefore,

$$\frac{d\log\ (K/L)}{dt} = \frac{-\rho}{(1+\rho)}(k - m) = (1 - \sigma)(m - k)$$

Thus, change in the K/L ratio is induced by the bias in technological progress. Assuming that $\delta < 1$, the K/L ratio will increase if $m > k$, which is a labor-saving technological progress.

In the following, we will utilize the production function (1.4) based on the assumption of constant or non-constant returns to scale.

2. Estimation Forms

Suppose the CES production function and production models are given as follows:

$$(2.a) \qquad V = \left[\delta(e^{kt} K^{-\rho}) + (1 - \delta)(e^{mt} L^{-\rho})\right]^{-1/\rho}$$

$$(2.b) \qquad V = f(P) \qquad f' \leq 0 \qquad (P: \text{ product price})$$

$$(2.c) \qquad K = g_K(C) \qquad g'_K \geq 0 \qquad (C: \text{ price of capital service})$$

$$L = g_L(W) \qquad g'_L \geq 0 \qquad (W: \text{ wage rate})$$

$$(2.d) \qquad R = PV - CK - WL \qquad (R: \text{ profit})$$

$$(2.e) \qquad \frac{\partial R}{\partial K} = \frac{\partial R}{\partial L} = 0$$

(2.a) is the production function with constant returns to scale and factor augmenting technological progress; (2.b) is the product demand function in which $f' \leq 0$, depending on the assumption of imperfect or perfect competition in the product market; (2.c) includes factor supply functions in which g'_K, $g'_L \geq 0$, depending on the assumption of imperfect or perfect competion in the factor market; (2.d) is the profit equation; and (2.e) is the first-order condition for profit maximization if we assume perfect competition in the product and factor markets to simplify the model.[8]

In the above production models, we are explicitly assuming that the Korean firms attempt to maximize profits. In this model, once the factor prices are given to the firms and factors are paid up to their marginal products, the firms would try to find the relevant output level. Therefore, the output level is a constraint. This assumption seems to be reasonable for the behavior of the Korean firms because the market size in the Korean economy is very small. When the market size expands due to the increase in foreign demand, the firms would attempt to attain another output level for the profit maximization condition.

The following marginal productivity conditions of the profit maximization assumption will result:

(2.f) $$\frac{\partial V}{\partial K} = \delta\, e^{-\rho kt}\, K^{-(1+\rho)}\, V^{(1+\rho)} = \frac{C}{P} \quad \text{and}$$

(2.g) $$\frac{\partial V}{\partial L} = (1-\delta) e^{-\rho mt}\, L^{-(1+\rho)}\, V^{(1+\rho)} = \frac{W}{P}$$

From (2.g), we can derive

(2.1) $$\frac{V}{L} = (1-\delta)^{-\sigma}\, w^{\sigma}\, e^{(1-\sigma)mt}$$

where w: real wage rate.

The wage coefficient, σ, in (2.1) is the elasticity of substitution, which is the so-called ACMS approach. In this equation, σ will show the degree of factor substitution between capital and labor with respect to the change in the wage-rental ratio, assuming that the output level is constant.

In (2.1), we assumed that there are constant returns to scale in the productive structure. If non-constant returns to scale are assumed, that is $h \neq 1$, the sum of factor payments does not exhaust the value of output and there must be a residual. The conventional method then cannot be used to estimate σ. However, once the production function with non-constant returns to scale is specified, following Brown and Cani, the non-constant returns to scale assumption may be more useful for the estimation of the true elasticity of substitution. Specifically, the estimation of the elasticity of substitution based on the ACMS approach is to regress the average labor productivity on the wage rate. When there are increasing returns to scale, the increase in output will lead to a division of labor and hence higher labor productivity because there are economies of scale associated with the expansion of output. The elasticity of substitution estimated from the ACMS approach suggests the marginal adjustment of factor proportions due to the change in factor prices and brings into the model the effect of the increase in the capital-labor ratio on the observed increase in labor productivity. Therefore, the marginal adjustment in the capital-labor ratio will partly account for the observed changes in labor productivity if there are increasing returns to scale.[9]

If we assume the CES production function with non-constant returns to scale instead of constant returns to scale as (2.a), the result will be

$$(2.2) \qquad \frac{V}{L} = \left[h^{(1-\sigma)} \; (1-\delta)^{-\sigma}\right] \; w^{\sigma} \; e^{(1-\sigma)mt} \;\; V^{(1-\sigma)(h-1)/h}$$

If $\sigma < 1$ and there are increasing returns to scale, the value added coefficient will be positive, which means that there will be a net increase in labor productivity due to increasing returns to scale and vice versa. From the value added coefficient, we may compute the returns to scale parameter.

The estimate of the elasticity of substitution will be a part of the picture for the sources of the employment growth because we are assuming that the output level remains constant. Therefore, it is necessary to derive a demand for labor function. From the marginal productivity conditions of the previous models, we can derive the demand for labor function.[10] Assuming that the profit maximization assumption is relevant for the behavior of the Korean firms and there are constant returns to scale, (2.g) results

$$(2.3) \qquad L = (1-\delta)^{\sigma}\ w^{-\sigma}\ e^{(\sigma-1)mt}\ V$$

In this equation, the wage coefficient, $-\sigma$, will be a relationship between demand for labor and wage rate, which is a substitution effect as in an ordinary demand function. The value added coefficient is an output effect. Therefore, the demand for labor will be determined by the wage rate and value added. In this case, technological progress will also play an important role in determining the demand for labor, depending on $\sigma \gtreqless 1$.

The constant returns to scale assumption may also be limiting in the demand for labor function. If there are increasing returns to scale, a given increase in output would require less factor inputs, compared to the constant returns to scale case. Substituting a non-constant returns to scale production function in (2.a), the result will be:

$$(2.4) \qquad L = \left[h(1-\delta)\right]^{\sigma}\ w^{-\sigma}\ e^{(\sigma-1)mt}\ V^{(\sigma + \frac{1-\sigma}{h})}$$

If there are increasing returns to scale, a given increase in value added would have less effect on the demand for labor by $(1-\sigma)(h-1)/h$,[11] compared to the constant returns to scale assumption. The other coefficients are, however, exactly the same as the constant returns to scale case.

Based on these estimation forms, we will show more precise measures of the sources of employment growth in the following section.

3. Measures of Sources of Employment Growth

Based on the estimation forms for the elasticity of substitution and demand for labor function, we will show how to measure the contribution of changes in various factors to employment growth.

Taking logarithms for (2.1) in which constant returns to scale are assumed and differentiating it with respect to time, the result will be

$$\text{(3.a)} \qquad \frac{(\dot{\frac{V}{L}})}{(\frac{V}{L})} = \sigma(\frac{\dot{w}}{w}) + (1-\sigma)m$$

Rearranging (3.a) gives

$$\text{(3.b)} \qquad \frac{\dot{L}}{L} = -\sigma(\frac{\dot{w}}{w}) - (1-\sigma)m + \frac{\dot{V}}{V}$$

If we assume $\dot{V}/V = 0$ for the movement along the given isoquant to estimate the time-series elasticity of substitution, (3.b) becomes

$$\text{(3.1)} \qquad \frac{\dot{L}}{L} = -\sigma(\frac{\dot{w}}{w}) - (1-\sigma)m$$

In this equation, the elasticity of substitution, σ , clearly shows the relationship between real wage growth and employment growth. The negative sign suggests that the elasticity of substitution is a negative source of employment growth because less labor input will be used to produce a given level of output if real wage increases. Technological progress, if $\sigma < 1$, will also be a negative source of employment growth. Technological progress will always induce a net increase in labor productivity. Therefore, less labor input will be used for a given level of output if technological progress affects the production function.

If we assume non-constant returns to scale, (2.2) will be

$$\text{(3.2)} \qquad \frac{\dot{L}}{L} = -\sigma\left(\frac{\dot{w}}{w}\right) - (1-\sigma)m - \left[\frac{(1-\sigma)(h-1)}{h}\right] \frac{\dot{V}}{V}$$

Interpretation of the elasticity of substitution and technological progress is the same as the previous case. If there are increasing returns to scale, i.e., $h > 1$ and $\sigma < 1$, a given use of factor inputs will induce more output, compared to constant returns to scale, and hence a given level of output will require less labor by $\left[\frac{(1-\sigma)(h-1)}{h}\right] \frac{\dot{V}}{V}$. Therefore, increasing returns to scale will always have a negative effect on employment growth if $\sigma < 1$, and vice versa.

So far we have assumed that output is constant to estimate the elasticity of substitution. By so doing, we can analyze the relationship between real wage growth and employment growth only. By estimating the demand for labor function, we can analyze the relationships between both employment growth and real wage and output growth at the same time.

Taking logarithms and differentiating with respect to time, (2.3) in which constant returns to scale are assumed, results

$$\text{(3.3)} \qquad \frac{\dot{L}}{L} = -\sigma\left(\frac{\dot{w}}{w}\right) + (\sigma-1)m + \frac{\dot{V}}{V}$$

In this equation, the real wage coefficient, σ , can be an elasticity of substitution, but a more correct interpretation is that it is a real wage elasticity of employment growth. When we assume non-constant returns to scale, the estimate of the elasticity of substitution is identical to the real wage elasticity of employment growth. The negative sign of σ suggests that increase in real wage has a substitution effect. Technological progress, if $\sigma < 1$, has a negative effect on employment growth. The output growth, however, is an output effect and is a positive source of employment growth. Therefore, the total effect on employment growth will be determined by the substitution effect, technological progress and output effect.

If we assume non-constant returns to scale, (2.4) will result

$$(3.4) \qquad \frac{\dot{L}}{L} = -\sigma\left(\frac{\dot{w}}{w}\right) + (\sigma-1)m + \left\{1 - \frac{(1-\sigma)(h-1)}{h}\right\} \frac{\dot{V}}{V}$$

Interpretation of the σ and technological progress is the same as the previous case. The only difference is the value added coefficient, that is, if there are increasing returns to scale, the output effect will be $1 - \frac{(1-\sigma)(h-1)}{h}$ rather than 1 of the constant returns to scale case.

So far we have utilized the CES production function to analyze the sources of employment growth. As we showed in the Introduction, the export growth explained about half of the manufacturing value added growth in the Korean manufacturing sector. This evidence suggests that export growth is one of the most important sources of employment growth through output effect in the Korean economy. By decomposing the output growth into the domestic and export components, we can write output growth as

$$\frac{\dot{V}}{V} = \left(\frac{D}{V}\right) \frac{\dot{D}}{D} + \left(\frac{X}{V}\right) \frac{\dot{X}}{X}$$

where $\quad D/V + X/V = 1.$

Substituting the above identity in (3.4), we have

$$(3.5) \qquad \frac{\dot{L}}{L} = -\sigma\left(\frac{\dot{w}}{w}\right) + (\sigma-1)m + \left\{1 - \frac{(1-\sigma)(h-1)}{h}\right\}\left\{\left(\frac{D}{V}\right)\frac{\dot{D}}{D} + \left(\frac{X}{V}\right)\frac{\dot{X}}{X}\right\}$$

From this equation, we can quantify how domestic output and export growth contributed to employment growth in the Korean manufacturing sector.[12]

Finally, we can summarize the sources of employment growth as the following:

(1) real wage growth as a negative source via the elasticity of substitution.

(2) technological progress as a negative source if $\sigma < 1$.

(3) increasing returns to scale as a negative source if $\sigma < 1$.

(4) domestic output growth as a positive source.

(5) export growth as a positive source.

(6) domestic share of value added.

(7) export share of value added.

Footnotes

Chapter II

[1]Any advanced microeconomic textbook contains the theory of production. For example, see C. E. Ferguson, The Neoclassical Theory of Production and Distribution (Cambridge: Cambridge University Press, 1969).

[2]J. R. Hicks, The Theory of Wages (London: Macmillan and Co., Ltd., second ed., 1963), pp. 115, 122. Also see C. E. Ferguson and J. R. Moroney, "The Sources of Change in Labor's Relative Share: A Neoclassical Analysis," Southern Economic Journal, XXXV (April, 1969), pp. 308-22.

[3]K. J. Arrow, H. B. Chenery, B. S. Minhas, and R. M. Solow, "Capital-Labor Substitution and Economic Efficiency," Review of Economics and Statistics, XLIII (Aug., 1961), pp. 225-250.

[4]M. Brown and J. Cani, "Technological Change and the Distribution of Income," International Economic Review, 4 (Sept., 1963), pp. 289-309.

[5]R. M. Solow, "Technical Change and the Aggregate Production Function," Review of Economics and Statistics, XXXIV (July, 1957), pp. 312-20.

[6]Y. Kotowitz, "Technical Progress, Factor Substitution and Income Distribution in Canadian Manufacturing 1926-1939 and 1946-1961," Canadian Journal of Economics, II (Feb., 1969), pp. 106-14.

[7]M. I. Nadiri, "Some Approaches to the Theory and Measurement of Total Factor Productivity: A Survey," Journal of Economic Literature, VIII (Dec., 1970), p. 1142.

If we use change in relative shares of inputs, three types of technical change can be defined as follows:

$$\left(\frac{\partial (F_k K)/(F_l L)}{\partial t}\right) K/L \text{ const.} \gtreqless 0 \quad \text{Hicks} \quad \begin{matrix}\text{labor-saving}\\ \text{neutral}\\ \text{capital-saving}\end{matrix}$$

$$\left(\frac{\partial (F_k K)/(F_l L)}{\partial t}\right) K/O \text{ const.} \gtreqless 0 \quad \text{Harrod} \quad \begin{matrix}\text{labor-saving}\\ \text{neutral}\\ \text{capital-saving}\end{matrix}$$

$$\left(\frac{\partial (F_k K)/(F_l L)}{\partial t}\right) L/O \text{ const.} \gtreqless 0 \quad \text{Solow} \quad \begin{matrix}\text{labor-saving}\\ \text{neutral}\\ \text{capital-saving}\end{matrix}$$

[8]If imperfect competition is assumed in the product and factor market, the marginal productivity conditions result:

$$f_L = \frac{W(1 + \frac{1}{e_L})}{P(1 + \frac{1}{e})} \quad \text{and} \quad f_K = \frac{C(1 + \frac{1}{e_K})}{P(1 + \frac{1}{e})}$$

where,

f_L, f_K: marginal productivity of labor, capital;
e_L, e_K: supply elasticity of labor, capital;
e : elasticity of product supply.

[9]Katz shows an excellent discussion regarding the topic of the non-constant returns to scale. See J. M. Katz, Production Function, Foreign Investment and Growth (North Holland: Amsterdam, 1969), pp. 130-138.

[10]This demand for labor function derived from the CES production function was originally suggested by Brown. See M. Brown, On the Theory and Measurement of Technological Change (Cambridge, 1966), p. 170.

[11] $(\sigma + \frac{1-\sigma}{h}) + \frac{(1-\sigma)(h-1)}{h} = 1$

[12]By quantifying the contribution of export growth to employment growth based on this method, we are measuring the direct effect only.

CHAPTER III

EMPIRICAL FINDINGS

This chapter discusses the empirical findings based on the estimated results of the elasticity of substitution and demand for labor function. Before we discuss the empirical findings, however, we will briefly touch the estimation problems because there are several reasons why the estimates may be biased. The empirical findings from this chapter will be used for the measurement of the contributions of the sources of employment growth in the following chapter.

1. Estimation Problems

By taking logarithms for the estimation forms of the previous chapter, we can estimate the elasticity of substitution and demand for labor function. If all variables are measured without errors and if real wage rates and value added are determined exogenously, the application of least squares will yield a consistent estimate of the parameters. However, there are several problems in estimation, some of which will be discussed below.

First, even though the money wage rates are given exogenously to the industry at the 2-digit level, the price level may not be given exogenously. In a rapidly growing economy such as the Korean economy, the fluctuations of industry value added due to the short run shift in demand might cause a change in the price level. Then the wage data deflated by the specific industry's 1970 constant price may result in estimates biased to an unknown extent. Over the period 1963 to 1966 or 1967, the real wage rates were highly correlated negatively with price levels. However, we did not correct this problem.

Second, also in a rapidly growing economy, changes in value added might have caused simultaneous variations in labor productivity and real wage rates, and hence the estimates may be biased to an unknown extent. To investigate this problem, a simultaneous equations model for the total manufacturing sector was developed, but the simultaneous bias problem was not serious (we do not report the results).

Third, a more difficult problem may be the short run measurement errors in factor inputs. Over the period 1963 to 1966, the growth rates of employment were slow, but since then, rapid. During a recession or boom, the variations in capacity utilization and changes in quality of labor services are expected to be serious.[1] In addition to that, when we use the production function (1.4), we have to use the efficiency units of capital and labor.[2] However, no attempts were made to correct this problem.

Fourth, especially for the demand for labor function, the speed of adjustment may be slow. This being the case, a distributed lag model may be more appropriate. The model and results are reported in Appendix II.E. The results suggest that the distributed lag model is not appropriate with respect to the Korean manufacturing industries.

Finally, the rate of technological progress and returns to scale parameter may be computed as,

$$m = \text{trend coefficient}/(1-\sigma) \quad \text{and}$$

$$h = (1-\sigma)/\{(1-\sigma) - \text{value added coefficient}\}.$$

Especially for the rate of technological progress, if the trend coefficient is positive and the estimated $\sigma > 1$, the computed $m < 0$. If the estimated σ approaches 1, from above or below, the computed m approaches minus or plus infinity. This is a deficiency in estimating the rate of technological progress from the CES production function. Many empirical studies have shown that the rate of technological progress is negative in many cases.[3] Regarding this problem, Moroney writes, "This deficiency in the calculation of technological progress is basically intractable; and it surely accounts in large measure for the very unreliable estimates frequently obtained."[4] The size of σ raises a similar problem in computing h.[5]

Although there are some other estimation problems such as multicollinearity and serial correlation,[6] we will use the estimated results for the discussion of the empirical findings.

2. Empirical Findings

To measure the contributions of sources of employment growth in the Korean manufacturing industries, we will discuss in this chapter the empirical findings based on the estimated results of the elasticity of substitution and demand for labor function.

A. Elasticity of Substitution

The estimates of the elasticity of substitution from three different equations are shown in columns (1) - (3) of Table 3, and another set of estimates derived from columns (1) - (3) are shown in column (4). The estimates in column (4) will be used primarily as one of the sources of employment growth. Therefore, we will discuss the different estimates of the elasticity of substitution and the relevant topics in the following.

Column (1) represents the results from a production function with technological progress and constant returns to scale (equation (2.1) in Chapter II). Our basic assumption here is that technological progress

Table 3

Time-Series Elasticity of Substitution:
2-Digit Korean Manufacturing Industries, 1963-1973

(Three Different Estimates)

Industry	(1)	(2)	(3)	(4)
Total Manufacturing	0.62	0.56	-	0.62
Food	1.15	0.45*	0.74	0.74
Beverage	0.74	0.65	-	0.74
Textiles	0.66	0.38*	-	0.66
Clothes	0.54	0.47	-	0.54
Wood	0.12*	-0.42*	0.97	0.97
Furniture	0.80	0.64	-	0.80
Paper	-0.09*	-0.11*	0.64	0.64
Printing	1.02	-0.08*	-	1.02
Leather	-0.36*	0.23*	0.80	0.80
Rubber	0.99	0.76	-	0.99
Chemical	0.65	0.27	-	0.65
Petroleum-Coal	0.60*	-0.32*	1.90	1.90
Nonmetallic Minerals	0.74	0.79	-	0.74
Basic Metal	-0.16*	-0.40*	1.19	1.19
Metallic	0.55*	-0.04*	0.87	0.87
Machine	0.50	0.43	-	0.50
Electrical	0.77*	0.01*	0.79	0.79
Transportation	0.15*	0.09*	1.35	1.35
Miscellaneous	0.69*	0.36*	0.79	0.79

* indicates estimate not significant at $P \leq 0.05$.

Sources: Appendix II.A, II.C, and II.D.

Notes: a) - indicates estimate not shown.
b) The estimation form for each column is as follows:

(1) $\log \frac{V}{L} = a + \sigma \log w + (1-\sigma)m + u$

(2) $\log \frac{V}{L} = a + \sigma \log w + \left(\frac{(1-\sigma)(h-1)}{h}\right) \log V + u$

(3) $\log \frac{V}{L} = a + \sigma \log w + u$

(4) Same as columns (1) and (3), but the estimates that are significant at the 5% level were chosen from column (1).

as well as the increase in the capital-labor ratio via the elasticity of substitution is a significant source of labor productivity growth within the framework of the ACMS approach. According to the results of growth accounting for the Korean economy, we already found that technological progress contributed a net increase in GNP or manufacturing value added by about 40 percent per annum. This being the case, we would expect that technological progress also induced a net increase in labor productivity. Therefore, the inclusion of technological progress as one of the explanatory variables for the changes in observed labor productivity, would result in an estimate closer to the true elasticity of substitution.

For the total manufacturing sector, all the coefficients are significant at the 1 percent level (one-tail, see Appendix II.A). The estimate of the elasticity of substitution is 0.62 and the trend coefficient is 0.4, which results in the computed annual rate of technological progress of 10.5 percent. Before we discuss the estimated result of the elasticity of substitution, it is better to discuss the computed rate of technological progress.

The annual 10.5 percent rate of technological progress from the CES production function contributed about 43 percent to manufacturing value added growth, which is virtually the same as the 42 percent[7] derived from growth accounting of the Cobb-Douglas production function. As Nelson has pointed out in his recent criticism of traditional growth accounting, if the elasticity of substitution is less than unity, the contribution of technological progress to value added growth would be greater than the unity case.[8] According to our results, however, no serious discrepancies are expected. The annual 10.5 percent rate of technological progress that contributed to value added growth actually induced a net increase in labor productivity by 4 percent per annum. This result shows that technological progress is a significant source of labor productivity growth in the total Korean manufacturing sector.

Now going back to the elasticity of substitution, the estimate of 0.62 suggests that a 10 percent increase in real wage rates will increase labor productivity by 6.2 percent via the increase in capital-labor ratio and hence employment will decrease for a given output by 6.2 percent. The elasticity of substitution combined with real wage growth has then a significantly negative effect on labor absorption. This finding with respect to the Korean manufacturing sector is quite comparable to other LDC's: Reynolds and Gregory obtained an estimated value around 1 for the Puerto Rican economy;[9] Katz's study for the Argentine manufacturing sector showed 0.48;[10] Todaro and Harris' result for Kenya was 0.8;[11] and Chetty's estimation for some LDC's, 0.8.[12] This set of empirical results on the elasticity of substitution supports the conclusion that employment growth would be retarded by wage increases because of the significant substitutability between capital and labor in the manufacturing sector. The Korean case is not exceptional.

For the 2-digit industrial levels, however, the estimates of the elasticity of substitution are significant at the 5 percent level in ten out of nineteen industries (food, beverage, textile, clothes, furniture, printing, rubber, chemical, nonmetallic and machine) and the trend coefficients are significant at the 5 percent level in only six industries (food, beverage, paper, leather, machine and transportation). Among those industries, the estimates of the elasticity of substitution range from 0.50 to 1.15. According to these results, we can find that the elasticity of substitution and technological progress are significant sources of labor productivity growth and hence negative sources of employment growth in limited industries at the 2-digit levels. In the remaining industries, however, it is difficult to find the source of labor productivity growth whether it is the elasticity of substitution or technological progress. This is why we turn to a different equation.

Column (2) represents the results from a production function with non-constant returns to scale. Although previously we assumed constant returns to scale, we would expect that the economies of scale associated with rapid expansion of market size or rapid increase in output such as in Korea, are the significant factors of the productive structure. This being the case, the non-constant returns to scale assumption may result in another significant source of labor productivity growth along with the elasticity of substitution. Based on this assumption, we estimated the equation (2.2) in which technological progress and non-constant returns to scale are included as explanatory variables, but the trend coefficients were insignificant at the 5 percent level in fifteen industries and unexpected signs were resulted in four industries (see Appendix II.B.) This may be statistical evidence that technological progress and returns to scale are interrelated with each other over time. By dropping the trend variable from equation (2.2), we reestimated the equation and the results are shown in column (2).

For the total manufacturing sector, all the coefficients are significant at the 1 percent level (see Appendix II.c). The estimate of the elasticity of substitution is 0.56 and the value added coefficient is 0.22, which results in the computed returns to scale parameter of 2.0.[13] From these results, we can determine that there were increasing returns to scale in the total Korean manufacturing sector, and increasing returns to scale are another significant source of labor productivity growth along with real wage growth and the elasticity of substitution.

The value added coefficient of 0.22 suggests that the 10.0 percent increase in value added would induce the 2.2 percent increase in labor productivity because of increasing returns to scale. Considering that the annual growth rate of value added in the total manufacturing sector was 23.0 percent in the past, we can easily find how increasing returns to scale played a significant role in labor productivity growth in the Korean manufacturing sector.

The elasticity of substitution of 0.56 from the above equation is almost the same as that from the previous equation. If we accept that technological progress and increasing returns to scale are interrelated, we may claim that the true elasticity of substitution with respect to the Korean manufacturing sector is around 0.60. Again we can conclude that a 10 percent increase in real wage rates, because of the elasticity of substitution, will increase labor productivity by about 6.0 percent via the increase in capital-labor ratio and hence employment will decrease by about 6.0 percent.

For the 2-digit industries, however, it is more difficult to obtain estimates of the elasticity of substitution. The estimates are significant at the 5 percent level in seven industries (beverage, clothes, furniture, rubber, chemical, nonmetallic and machine). Among those industries, the estimates range from 0.27 to 0.76 and, in general, are lower than those of the constant returns to scale case. This may suggest that increasing returns to scale is a more important source of labor productivity growth in some industries than technological progress.

The evidence can be strongly justified by the value added coefficents, significant at the 1 percent or 5 percent levels in fifteen industries, and by the computed returns to scale parameters, which all show increasing returns to scale (in Appendix II.C, the computed returns to scale parameters are separately reported). According to these results, then, the elasticity of substitution and increasing returns to scale are also significant sources of labor productivity growth, and hence, negative sources of employment growth, in limited industries.

The main purpose in this section is to analyze the relationship between the elasticity of substitution and employment growth. According to the results from the previous two kinds of estimates, our analysis is confined to half of the nineteen industries. We already found out that the increases in labor productivity in the Korean manufacturing industries were significantly caused by real wage growth and technological progress or increasing returns to scale. Then the increase in labor productivity, regardless of which source it is caused by, will have a negative effect on employment growth along the given isoquant. Therefore, we simplified the equation in which the elasticity of substitution is the only source of labor productivity growth and reestimated the equation. Some of the results are shown in column (3). (see Appendix II.D)

The results in column (3) are suspected to be overestimates because we assumed that the elasticity of substitution is the main source of labor productivity growth. The estimates in the reported industries range from 0.64 to 1.90, which are much higher than those of other industries in columns (1) and (2). These estimates, even though they are overestimates, can shed light on the relationship between the elasticity of substitution and employment growth.

Finally, from the three different estimates, we chose one representative estimate for each industry, which is shown in column (4). Simply, we chose all the estimates from column (1) that are significant at the 5 percent level, because there are more significant estimates in column (1) than in column (2). With only a few exceptions, there are no serious differences in the size of estimates between column (1) and (2). For the industries whose elasticities of substitution were difficult to estimate, we chose the estimates from column (3). These estimates will be used to measure the contribution of the elasticity of substitution to employment growth in the past.

As a source of employment growth, the elasticity of substitution within the framework of the ACMS approach can show the effect on employment growth with the given real wage growth. According to our results the elasticity of substitution combined with real wage growth, has a substantial negative effect on employment growth in the Korean manufacturing industries. However, the analysis is partial because value added is assumed to remain constant. By discussing the estimate of the demand for labor function, this analysis will be complete.

B. Demand for Labor Function

The estimations of the demand for labor function based on the equations (2.3) and (2.4) are shown in Table 4. As we already discussed, there were increasing returns to scale in almost all the Korean manufacturing industries. In this sense, equation (2.4) is a more appropriate model than equation (2.3). The estimations of equation

Table 4

Demand for Labor Function: 2-Digit Korean Manufacturing Industries, 1963-1973

Industry	const.	w	V	R^2
Total	-0.77* (-1.03)	-0.56 (-2.86)	0.78 (7.57)	0.98
Food	-3.10* (-1.83)	-0.45* (-1.28)	0.80 (3.47)	0.94
Beverage	-0.31* (-0.32)	-0.65 (-4.66)	0.75 (7.40)	0.93
Textile	0.27* (0.30)	-0.38* (-1.56)	0.66 (4.90)	0.95
Clothes	-3.71 (-2.51)	-0.47 (-2.72)	0.85 (16.44)	0.98
Wood	-3.04 (-1.99)	0.42* (1.00)	0.35 (1.88)	0.90
Furniture	-2.10* (-0.55)	-0.64 (-2.79)	0.87 (5.51)	0.79
Paper	-0.62* (-0.52)	0.11* (0.71)	0.39 (3.39)	0.92
Printing	-1.67* (-0.74)	0.08* (0.24)	0.47 (1.93)	0.78
Leather	-2.64* (-1.50)	-0.23* (-1.24)	0.64 (9.47)	0.92
Rubber	0.06* (0.07)	-0.76 (-2.79)	0.83 (5.72)	0.93
Chemical	0.65* (0.72)	-0.27* (-1.859)	0.54 (5.39)	0.95
Petroleum and Coal	9.37 (28.59)	0.32 (3.03)	-0.15 (-2.86)	0.42
Nonmetallic	-1.31* (-0.85)	-0.79 (-2.99)	0.89 (5.20)	0.85
Basic Metal	0.29* (0.85)	0.40* (0.92)	0.21* (1.07)	0.77
Metallic	-1.05* (-1.27)	0.04* (0.17)	0.47 (3.47)	0.95
Machine	0.43* (0.43)	-0.43 (-3.05)	0.64 (8.87)	0.93
Electrical	-5.12 (-3.73)	-0.01* (-0.02)	0.66 (4.45)	0.96
Transportation	1.84* (1.76)	-0.09* (-0.43)	0.41 (4.36)	0.91
Miscellaneous	-3.27 (-2.98)	-0.36* (-0.91)	0.78 (3.40)	0.94

Numbers in the parenthesis are t-ratios.

Sources: a) Annual value added and employment data for 1963, 1966 and 1968-73 were obtained from Report on Mining and Manufacturing Survey (EPB). For missing years, data from Report on Sample Survey for Mining and Manufacturing Establishments for 1964-1965 (KRB) and Report on Mining and Manufacturing Census 1967 (EPB and KRB) were used.
b) Annual money wage rates and price deflators were calculated on the bases of the data from Economic Statistics Yearbook and Yearbook of National Income 1974 (BOK), respectively.

Notes: a) * indicates estimates not significant at $P \leq 0.05$.
b) The estimation equation is:

$$\log L = a - \sigma \log w + (\sigma + \frac{1-\sigma}{h}) \log V + u$$

(2.4), however, showed that technological progress did not significantly decrease employment growth in any of the nineteen industries or in the manufacturing sector as a whole. By dropping the trend variable from equation (2.4), we reestimated the equation whose results are shown in table 4.

For the total manufacturing sector, all the coefficients are significant at the 1 percent level. The estimate of the real wage elasticity of employment growth is -0.56 and that of the value added elasticity is 0.78. According to the results, *ceteris paribus*, a 10 percent increase in real wage would decrease employment by 5.6 percent. The negative effect on employment of the real wage increase in terms of the real wage elasticity is also substantial. By the same token, the 10.0 percent increase in value added would increase employment by 7.8 percent. The positive effect of the value added increase is much higher than the negative effect of the real wage increase. Here the 2.2 percent (in relation to the value added elasticity) can be interpreted as the percentage decrease in employment due to increasing returns to scale when value added increases by 10 percent. Considering that the increasing returns to scale parameter with respect to the total Korean manufacturing sector was 2.0, the above interpretation seems to be quite reasonable because increasing returns to scale always require less of factor inputs for a given level of output. As we specified returns to scale as one of the sources of employment growth, we would expect that economies of scale would have been associated with the annual 23.0 percent value added growth and hence increasing returns to scale are one of the significant negative sources of employment growth in the Korean manufacturing sector.

For the 2-digit industrial levels, the estimates of the real wage elasticity are significant at the 5 percent level only in seven industries (beverage, clothes, furniture, rubber, chemical, nonmetallic and machine). Among those industries, the estimates range from -0.43 to -0.79. According to these results, the effects on employment of the given increases in real wage are also substantial. However, the analyses on these effects are confined to only seven industries because the results are not significantly different from zero at the 5 percent significance level in the remaining industries.

The value added elasticities, however, are significant at either the 1 percent level, as in most cases, or the 5 percent level, except in the petroleum-coal and basic metal industries. The estimates in seventeen industries range from 0.35 to 0.89. According to these results, we can find that only the increase in value added is a significant variable in explaining the demand for labor in more than half of the industries. In the remaining industries, the increase in real wage is also a significant variable, but the magnitude of the value added elasticity are greater than those of the real wage elasticity in all industries. Considering that the annual growth rates of value added exceed those of real wage by from one and a half to ten times in all the industries, the comparison of the estimates of the real wage and value added elasticities tentatively suggest which source was mainly responsible for the high growth rate of employment in the Korean manufacturing industries.

Based on the estimates of the value added elasticity, we can also analyze the effects of increasing returns to scale on employment. Depending on the industry, the negative effect seems to be extremely high.

This result is found especially in the industries whose estimates of the real wage elasticity are insignificant. We may explain these extreme cases with the statistical reason that in those industries the low estimate of the value added elasticity could be because value added is the only significant explanatory variable. Therefore, the analyses on the effects of increasing returns to scale on employment are also confined to the limited industries.

Regarding the relationship between the real wage and employment increases, we need some explanation why the real wage elasticities were difficult to estimate in many industries. One reason may be found in the trends of the real wage data. As we see in Appendix I, the real wage rates in almost all industries generally decreased from 1963 to 1966 or 1967, increased sharply thereafter up to 1971, and again decreased or increased slowly after 1972. During the period 1963 to 1966 or 1967, the money wage rates increased continuously, but the price levels (implicit price deflators) generally increased faster than the money wage rates. This can be explained by the effect of rapid economic development after the First-Planning period started in 1962; the rapid GNP growth was followed by inflation. During the period 1967 or 1968 to 1971, money wage rates increased sharply. The maintenance of high GNP growth during the Second-Planning period caused rapid increases in labor absorption, and hence money wage rates increased sharply. Considering that the Korean government has been willing to allow wage rates to be set by competitive forces, the rate of unemployment reflects the trends of the wage increase. The average rate of unemployment in the non-farm sector was 13.6 percent over the period 1963 to 1967, and 7.8 percent over the period 1968 to 1971.[14] After 1971, however, the slow increases in money wage rates seem to be the main factor for decreases or slow increases in real wage. The slow increase in the money wage during this period seems to be caused by the recession in 1972, in which the average rate of unemployment in the non-farm sector was 7.2 percent. As a result, fluctuations of the real wage rates might have failed to explain the variations in observed labor productivity (for the case of the elasticity of substitution) and in employment (for the case of the demand for labor function).

Second, the above explanation, however, is not complete because it does not address itself to the relationship between real wage and employment. For the more comprehensive explanation, we can utilize the growth terms. From the CES production function, the relationship between labor productivity growth and real wage growth can be derived as,

$$\frac{(\dot{\frac{V}{L}})}{(\frac{V}{L})} = \sigma \left(\frac{\dot{w}}{w}\right)$$

where σ is the elasticity of substitution under the assumptions of constant return to scale and non-technological progress.[15] If we use the annual growth rates of value added per worker and real wage (see Appendix I), labor productivity growth is greater than real wage growth in fifteen out of the total twenty cases (nineteen industries and manufacturing sector as a whole). Even if we apply the Cobb-Douglas relation, the results remain unchanged. This is different from the finding of Jackson and Turner, where the average real wage tends to rise at a pace equal to that of the average productivity growth during the 1950's and 1960's in many LDC's.[16]

Third, an interesting question is why the increase in real wage rates in general could not catch up with the increase in labor productivity. This does not mean that the increase in real wage rate was slow; on the average, real wage rate has increased annually by 8.6 percent. To answer this question, we have to turn to the wage policy in Korea.

The Korean government has never allowed a minimum wage law or a powerful labor union in its history. This is one way to control the wage increase in the Korean economy.[17] In the countries where the minimum wage law has been adopted or strong labor unions exist, the average labor productivity growth is a general guide to the real wage growth. Without a minimum wage law, the wage rate will be determined by the demand and supply curves of manufacturing employment. As long as the supply of labor curve remains relatively elastic, the increase in wage rate will be determined by the shift of the demand for labor curve which is affected by an increase in the capital-labor ratio, technological improvement and an increase in sale of output. According to Y. Lim, "This experience in South Korea appears to be rather different from that in Puerto Rico, where the regulation of a minimum wage law jacked up wage rates with small employment effect."[18] The generally insignificant estimates of the real wage elasticity, therefore, might be a result of the wage policy in the Korean economy.

The purpose of this chapter was to estimate the elasticity of substitution and demand for labor function by testing the relationship between employment and other sources. We have discussed five sources: elasticity of substitution, real wage growth, technological progress, value added growth and returns to scale. The estimates regarding these sources will be used to measure the contributions to employment growth in the past. The main findings about these sources can be summarized in the following manner: (1) The elasticity of substitution would retard employment growth because of the significant substitutability between capital and labor; (2) Although in more than half of the total industries, the real wage variable failed to play a significant role in labor demand decisions, the rise in real wage must have had a serious effect on employment growth in other industries; (3) The value added variable played a most significant role in the labor demand decision in all industries, and its positive effect was greater than the negative effect of real wage; (4) Although the interpretation needs qualification, increasing returns to scale showed a substantial negative effect on labor absorption in many industries.

Footnotes

Chapter III

[1]C. Ferguson, "Time Series Production Functions and the Rate of Technical Progress in American Manufacturing Industry," *Journal of Political Economy*, LXXIII (April, 1965), p. 142.

[2]Y. Kotowitz, "On the Estimation of a Non-Neutral CES Production Function," *Canadian Journal of Economics*, I (May, 1968), p. 431.

[3]J. R. Moroney, *The Structure of Production in American Manufacturing* (Chap Hill, 1972, p. 84.)

[4]Moroney, *op. cit.*, p. 74.

[5]With given value added coefficient, $h < 1$, if $\sigma > 1$ and vice versa.

[6]In some industries, there seemed to be multicollinearity problems because the simple correlation between dependent and independent variables was extremely high. However, the serial correlation problem in general was not serious. Although the number of observations is very small, I tried to correct the serial correlation problem for some industries, but improvement was not found.

[7]Caution is required for the comparison of the 43 percent contribution of technological progress from the CES production function with the 42 percent from growth accounting. The former is the result based on the Survey Data and the latter, on the BOK data.

[8]R. Nelson, "Recent Exercises in Growth Accounting: New Understanding or Dead End?" *American Economic Review*, LXIII (June, 1973), p. 463.

[9]I. G. Reynolds and P. Gregory, *Wages, Productivity and Industrialization in Puerto Rico* (Illinois, 1965), Ch. 3, pp. 82-103.

[10]J. M. Katz, *Production Function, Foreign Investment and Growth* (North Holland, Amsterdam, 1969), p. 59.

[11]J. R. Harris and M. P. Todaro, "Wages, Industrial Employment and Labor Productivity: The Kenyan Experience," *Eastern African Economic Review*, I (June, 1969), p. 36.

[12]Cited in A. C. Kelley, J. G. Williamson, and R. J. Cheetham, *Dualistic Economic Development: Theory and History* (University of Chicago Press, 1972), p. 228.

[13] Katz discusses the problem of computation of the non-constant returns to scale parameter. See J. M. Katz, *Production Function, Foreign Investment and Growth* (North Holland: Amsterdam, 1969), pp. 79-80.

[14] Economic Planning Board, Korea, *Annual Report on the Economically Active Population* (Seoul: 1973), p. 43.

[15] According to the CES production function, the elasticity of substitution estimated on the assumptions of constant returns to scale and non-technological progress can be used for the relationship between labor productivity growth and real wage growth. If the Cobb-Douglas production function is assumed, the elasticity of substitution simply becomes unity.

[16] H. A. Turner and D. A. S. Jackson, "On the Determination of the General Wage Level--A World Analysis; Or Unlimited Labor Forever," *Economic Journal*, LXXX (Dec., 1970), p. 845.

[17] *The Dong-A Il Bo*, April 6, 1976, p. 2, Editorial.

[18] Y. Lim,"Industrialization, Trade, and Employment in South Korea" (TDI Papers Series 1974 No. 2, mimeographed), p. 70.

CHAPTER IV

SOURCES OF EMPLOYMENT GROWTH AND THEIR CONTRIBUTIONS

The level of employment in the Korean manufacturing sector was about three times as high in 1973 as in 1963. During the eleven-year period the manufacturing employment grew at an annual rate of 11.3 percent. To explain this high growth rate, previously we specified the sources of employment growth and estimated the elasticity of substitution and demand for labor function. The purpose of this chapter is to measure how those sources contributed to the growth rate, what sources were responsible for the high growth rate and which industries made major contributions to the annual 11.3 percent employment growth within this eleven-year time span.

1. Measures of Contribution of Individual Sources

In Chapter II, we presented the measures of contribution of various sources to employment growth by utilizing the CES production function, which is repeated as a reference:

$$\frac{\dot{L}}{L} = -\sigma\left(\frac{\dot{w}}{w}\right) + (\sigma-1)m + \left(1 - \frac{(1-\sigma)(h-1)}{h}\right)\left\{\left(\frac{D}{V}\right)\frac{\dot{D}}{D} + \left(\frac{X}{V}\right)\frac{\dot{X}}{X}\right\}$$

There are seven (negative or positive) sources of employment growth in this growth equation: real wage growth, technological progress, returns to scale, domestic share of value added, growth of domestic sector, export share of value added and export growth. Here, $1 - \frac{(1-\sigma)(h-1)}{h} = \sigma + \frac{1-\sigma}{h}$, which is a value added elasticity when non-constant returns to scale is assumed. Therefore, the second term in the left side of the equation measures the effect of returns to scale on employment growth via value added growth. In the actual estimation in Chapter III, however, we used only three sources: real wage growth, trend variable and value added growth. To measure the contributions of the seven sources we will now combine all sources by using the estimates and actual growth rates. The complete measures of contributions of the seven sources are shown in Tables 5.a, 5.b and 5.c.

The sources of employment growth in Table 5 are broadly divided into three groups: real wage growth (lines 3-6), value added growth (lines 7-21) and residual (lines 22-23). We already found out that technological progress did not significantly affect employment growth in any of the industries except transportation. Therefore, we omitted the term (σ-1)m from the growth equation and instead added a residual term, which is expected to capture the effect of technological progress. More correctly, the residual will reflect the statistical errors as well as the effect of technological progress. Under these three broad groups all other sources are listed according to relevant group. Especially, returns to scale is enclosed by the dotted lines because it is not a direct source of employment growth. The measures of contributions are expressed by the computed annual growth rates and index numbers in the parentheses. These index numbers are convenient for comparison of contribution of individual source to the 100 percent employment growth which is converted from the annual growth rate (lines 1-2).

A. Real Wage Growth

The real wage elasticity is a measure of the percentage change in employment with respect to the percentage change in real wage when the time rate of change in value added is assumed to be constant. Therefore,

Table 5.a

Sources of Employment Growth and their Contributions in the Korean Manufacturing Industries, 1963-1973

(All numbers are percentage annual growth rates or index numbers except estimates)

Line	Sources	Total	Food	Beverage	Textiles	Clothes	Wood
1	EMPLOYMENT GROWTH						
2	Annual rate (index)	11.3 (100)	10.5 (100)	5.2 (100)	10.0 (100)	19.4 (100)	13.7 (100)
3	REAL WAGE GROWTH						
4	Annual rate	8.6	11.2	13.1	8.1	2.4	8.3
5	Real wage elasticity	-0.56	--	-0.65	--	-0.47	--
6	Effect (index)	-4.8 (-43)	--	-8.5(-164)	--	-1.1 (-6)	--
7	VALUE ADDED GROWTH						
8	Annual rate	23.0	16.8	20.0	21.0	24.5	25.5
9	Domestic	12.9	14.4	19.2	3.9	8.9	0.0
10	Domestic share	0.79	0.91	0.98	0.61	0.68	0.08
11	Domestic growth	15.1	14.4	18.8	5.1	11.8	0.0
12	Export	10.1	2.4	0.8	17.1	15.6	25.5
13	Export share	0.21	0.09	0.02	0.39	0.32	0.92
14	Export growth	46.2	27.9	40.0	44.2	48.6	27.7
15	Value added elasticity	0.78	0.80	0.75	0.66	0.85	0.35
16	Effect	17.9	13.4	15.0	13.9	20.8	8.9
17	Domestic (index)	10.1 (89)	11.5 (110)	14.4 (276)	2.6 (26)	7.6 (39)	0.0 (0)
18	Export (index)	7.8 (69)	1.9 (18)	0.6 (12)	11.3 (113)	13.2 (68)	8.9 (65)
19	Returns to scale						
20	Elasticity	0.22	0.20	0.25	0.34	0.25	0.65
21	Effect	-5.1	-3.4	-5.0	-7.1	-6.1	-16.7
22	RESIDUAL						
23	Effect (index)	-1.8 (-15)	-2.9 (-28)	-1.3 (-25)	-3.9 (-39)	-0.3 (-2)	4.8 (35)

Sources: a) Employment, real wage and value added --- Same as Table 4.
b) Estimates --- Table 4.
c) Domestic share, domestic growth, export share, and export growth --- Input-Output Tables for 1963, 1966, 1968, 1970, and 1973 (BOK).

Notes: a) -- indicates estimates not significant at $P \leq 0.05$.
b) The multiplication of domestic share by domestic growth is not equal to value added growth(line9) from the domestic sector because they were derived from the Input-Output tables and same for the export case. I adjusted value added growth from the domestic and export sectors on the basis of the Survey data. See footnote 3 of Chapter IV.
c) The equation for this measure is:

$$\frac{\dot{L}}{L} = -\sigma\left(\frac{\dot{w}}{w}\right) + \left\{1 - \frac{(1-\sigma)(h-1)}{h}\right\}\left\{\left(\frac{D}{V}\right)\frac{\dot{D}}{D} + \left(\frac{X}{V}\right)\frac{\dot{X}}{X}\right\} + \text{Residual}$$

Table 5.b

Sources of Employment Growth and their Contributions in the Korean Manufacturing Industries, 1963-1973

(All numbers are percentage annual growth rates or index numbers except estimates)

Line	Sources	Furniture	Paper	Printing	Leather	Rubber	Chemical	Petroleum -Coal
1	EMPLOYMENT GROWTH							
2	Annual rate (index)	4.3 (100)	8.9 (100)	6.7 (100)	17.4 (100)	9.7 (100)	8.7 (100)	0.2 (100)
3	REAL WAGE GROWTH							
4	Annual rate	3.1	11.4	6.3	4.0	7.4	15.9	15.1
5	Real wage elasticity	-0.64	--	--	--	-0.76	-0.27	--
6	Effect (index)	-2.0 (-46)	--	--	--	-5.6 (-49)	-4.3 (-49)	--
7	VALUE ADDED GROWTH							
8	Annual rate	6.3	20.0	9.1	30.0	19.7	23.0	36.5
9	Domestic	0.0	6.2	6.2	17.7	4.2	17.9	32.6
10	Domestic share	0.73	0.74	0.92	0.85	0.63	0.92	0.89
11	Domestic growth	0.0	6.0	8.7	20.8	6.4	16.2	12.3
12	Export	6.3	13.8	2.9	12.3	15.5	5.1	3.9
13	Export share	0.27	0.26	0.08	0.15	0.37	0.08	0.11
14	Export growth	34.8	53.9	40.3	82.0	41.7	67.1	35.4
15	Value added elasticity	0.87	0.39	0.47	0.64	0.83	0.54	--
16	Effect	5.5	7.8	4.3	19.2	16.6	12.4	--
17	Domestic (index)	0.0 (0)	2.4 (27)	2.9 (44)	11.3 (65)	3.5 (36)	9.7 (111)	--
18	Export (index)	5.5 (128)	5.4 (61)	1.4 (20)	7.9 (45)	13.1 (135)	2.7 (32)	--
19	Returns to scale							
20	Elasticity	0.13	0.61	0.53	0.36	0.17	0.46	--
21	Effect	-0.8	-12.2	-4.8	-10.8	-3.3	-10.6	--
22	RESIDUAL							
23	Effect (index)	0.8 (17)	1.1 (12)	2.4 (36)	-1.8 (-10)	-1.3 (-13)	0.6 (6)	--

Table 5.c

Sources of Employment Growth and their Contributions in the Korean Manufacturing Industries, 1963-1973

(All numbers are percentage annual growth rates or index numbers except estimates)

Line	Sources	Nonmetallic Minerals	Basic Metal	Metal Product	Machine	Electrical	Transportation	Miscellaneous
1	EMPLOYMENT GROWTH							
2	Annual rate (index)	8.3 (100)	10.9 (100)	11.3 (100)	9.4 (100)	25.0 (100)	8.0 (100)	22.0 (100)
3	REAL WAGE GROWTH							
4	Annual rate	10.7	12.2	10.5	6.9	11.5	8.0	16.3
5	Real wage elasticity	-0.79	--	--	-0.43	--	--	--
6	Effect (index)	-8.5(-102)	--	--	-3.0 (-32)	--	--	--
7	VALUE ADDED GROWTH							
8	Annual rate	22.0	31.5	23.0	22.0	39.0	28.0	39.0
9	Domestic	-0.8	-0.5	-1.2	20.8	20.0	27.0	15.9
10	Domestic share	0.45	0.15	0.69	0.95	0.75	0.97	0.58
11	Domestic growth	-1.7	-2.6	-1.8	30.0	26.6	31.0	24.0
12	Export	22.8	32.0	24.2	1.2	19.0	1.0	23.1
13	Export share	0.55	0.85	0.31	0.05	0.25	0.03	0.42
14	Export growth	42.8	37.9	78.3	21.8	76.7	35.0	54.7
15	Value added elasticity	0.89	--	0.47	0.64	0.66	0.41	0.78
16	Effect	19.6	--	10.8	14.1	25.7	11.5	30.4
17	Domestic (index)	-0.7 (-9)	--	-0.6 (-5)	13.3 (142)	13.2 (53)	11.1 (139)	12.4 (56)
18	Export (index)	20.3 (245)	--	11.4 (101)	0.8 (8)	12.5 (50)	0.4 (5)	18.0 (82)
19	Returns to scale							
20	Elasticity	0.11	--	0.53	0.36	0.34	-0.59	0.22
21	Effect	-2.4	--	-12.2	-7.9	-13.3	-16.5	-8.6
22	RESIDUAL							
23	Effect (index)	-2.8	--	0.5 (4)	-1.7 (-18)	-0.7 (-3)	-3.5 (-44)	-8.4 (-38)

the real wage elasticity directly measures the percentage reduction in employment growth with the given real wage growth. The estimates of the real wage elasticity (line 5) are the same as the real wage coefficients in Table 4. Here we assume that the estimates are not significantly different from zero when they were not significant at the 5 percent level. The effects of the real wage growth in terms of the real wage elasticity are shown in line 6.

For the total manufacturing sector, the real wage elasticity of -0.56 and the annual 8.6 percent real wage growth resulted in the annual 4.8 percent reduction in employment growth. Ceteris paribus, real wage growth had a substantial negative effect on employment growth. The contribution of real wage growth to the annual 11.3 percent employment growth is -43 percent (index number). Therefore, at least a 143 percent positive contribution should be sought from the other sources.

Of the 2-digit industries, the negative contributions exceed 100 percent of the annual rate of employment growth in beverage and non-metallic minerals industries, and in the industries such as clothes, furniture, rubber, chemical, and machine, the negative contributions are less than 60 percent. In the remaining industries, the real wage growth might not have affected employment growth.

According to the results, the negative contributions of real wage growth combined with the real wage elasticity are substantial in only a few industries.

B. Value Added Growth

The contribution of real wage growth to employment growth was about -43 percent of the annual rate of 11.3 percent employment growth in the total manufacturing sector. Seeking the compensating positive 143 percent contribution, we now turn to value added growth, a positive source of employment growth. In the following, we will first divide value added growth into the contributions from the domestic and export sectors, and next measure the contribution of value added growth to employment growth. Finally, we will discuss the contribution of returns to scale.

(1) Value Added Growth: The level of value added in the Korean manufacturing sector was more than six times as high, at the 1970 constant price, in 1973 as in 1963. During the eleven-year period, the annual growth rate of value added was 23.0 percent (line 8).[1] Except for furniture and printing, all industries show that the annual growth rates of value added exceed 20.0 percent. At a glance, these high growth rates are enough to have induced high employment growth in individual industries. Considering that the market size in the Korean economy is extremely small, we have to first analyze how such high growth rates of value added were made possible within only an eleven-year time span. In Chapter I, we briefly discussed that the contribution of export to value added growth in the Korean manufacturing sector was about 47 percent. Within this framework, we will discuss the contributions of the domestic and export sectors to value added growth at the 2-digit industrial level.

Value Added Growth from Domestic Sector: To measure the contribution of the domestic sector to value added growth, the average domestic share of value added[2] and the annual growth rate of the domestic sector[3] are shown in line 10 and line 11, respectively.

The average domestic share of value added in the manufacturing sector is 79 percent, which suggests that the manufacturing sector is an export industry. The domestic share, however, decreased from 95.8 percent in 1963 to 57.9 percent in 1973 (see Appendix III), which is a by-product of trade policies that the Korean government has adopted since the First-Planning.[4] Considering that the domestic share has been rapidly decreasing, the average domestic share may be overestimated. At the 2-digit level, the domestic share exceeds 90 percent in the industries such as food, beverage, printing, petroleum-coal, chemical, machine and transportation. The other industries such as textiles, clothes, furniture, paper, leather and rubber show that the domestic share is from 60 to 90 percent. In wood and basic metal industries the domestic share is less than 15 percent.

The annual growth rates of the domestic sector show large variations. For the total manufacturing sector, the annual growth rate is 15.1 percent. At the 2-digit level, the growth rates range from -2.6 to 31 percent. In the industries such as textiles, furniture, wood, paper, rubber, nonmetallic minerals, basic metal and metal product, however, the annual growth rates of domestic sector are negligible.

According to value added growth from the domestic sector only (line 9), the annual growth is 12.9 percent for the total manufacturing sector. Without export growth, therefore, the annual growth rate of the manufacturing value added would have been only 12.9 percent rather than 23.0 percent. At the 2-digit level, the development of the domestic sector was the main factor for the high growth rate of value added in chemical, petroleum-coal, machine and transportation industries. In the remaining industries, growth of the export sector played more important role than that of the domestic sector.

<u>Value Added Growth from Export Sector</u>: Value added growth from the export sector is simply the difference between value added growth and growth from the domestic sector. However, we separately reported the export share of value added and export growth rate in lines 13 and 14, respectively. The export share of value added was directly derived from the domestic share of value added.[5]

The annual growth rate of export for the total manufacturing sector is 46.2 percent. At the 2-digit level, the export growth rates range from 22 to 80 percent.[6] The growth rates of export are extremely high because the amounts of export at the base year were very small. Although the export share is small in many industries, the high growth rate of export has played a key role for the high contribution of the export sector to value added growth.

According to line 12, the annual growth rate of value added from the export sector is 10.1 percent in the total manufacturing sector. In other words, without growth of the domestic sector, the annual growth rate of value added in the manufacturing sector would be about 10.1 percent. In the industries such as textiles, clothes, wood, furniture, paper, rubber, nonmetallic minerals, basic metal, metal product, electrical and miscellaneous, the contribution of the export sector to value added growth is much higher than that of the domestic sector.

The rapid growth of exports has obviously had an important effect on the rate of growth and structure of the Korean economy. The export orientation of economic development in Korea has encouraged the use of excess factor of production, labor, and economized on use of scarce capital. Considering that the industries above are relatively labor-intensive ones, the effect of export expansion on employment growth would be more important.

(2) Contribution of Value Added Growth to Employment Growth: Based on the estimates of the value added elasticity of employment growth (line 15) and the annual growth rates of value added (line 8), we will now measure the contributions of value added growth to employment growth. We will also measure the contributions of the domestic and export sectors to employment growth.

The estimates of the value added elasticity are the same as the value added coefficients in Table 4. The effects on employment growth of value added growth combined with the value added elasticity are shown in line 16 (the figure is for the annual growth rate).

The value added elasticity of 0.78 implies that a 10 percent increase in value added will induce a 7.8 percent increase in employment in the manufacturing sector. Therefore, the annual 23.0 percent value added growth in the past, _ceteris paribus_, resulted in an annual 17.9 percent employment growth and its contribution to the annual 11.3 percent employment growth is 158 percent (index number). If we compare -43 percent contribution from real wage growth with this 158 percent, we can easily see that the positive contribution exceeds the negative one by more than three and a half times in absolute value. This is the main reason why the Korean manufacturing sector could have achieved such a high growth rate of employment during the eleven-year time period. Here the high value added elasticity and also high value added growth determines the extremely high contribution of value added growth to employment growth.

At the 2-digit industrial level, the annual growth rates of employment included by value added growth range from 4.3 to 30.4 percent. In the industries such as beverage, clothes, furniture, rubber, chemical, nonmetallic minerals and machine, the positive contributions from value added growth are greater than the negative ones from real wage growth by more than double. In the remaining industries, the positive contributions fully explain the actual employment growth. Only the petroleum-coal and basic metal industries are excluded because, the value added variable was not statistically significant.

From these results, we can conclude that the high growth rates of employment in the Korean manufacturing industries could be made possible because the positive contributions of value added growth exceeds the negative ones of real wage growth by from about twice (beverage) to eighteen (clothes) times in absolute avlue.

Contribution from Domestic Sector: Previously we measured how much the domestic and export sectors contributed to value added growth. Now, based on the value added elasticity and value added growth from the domestic sector, we are ready to measure the contribution of the domestic sector to employment growth (line 17).

For the total manufacturing sector, the annual 12.9 percent value added growth from the domestic sector induced an annual 10.1 percent employment growth, which is a 89 percent of the total 158 percent contribution of value added growth to employment growth. Disregarding the real wage growth, the growth of the domestic sector only in the Korean manufacturing sector would have resulted in about an annual 6.3 percent employment growth instead of the annual 11.3 percent.

The growth of the domestic sector made a zero or negative contribution to employment growth in the 2-digit industries such as wood, furniture, nonmetallic minerals, basic metal and metal product. As we see from line 9, the domestic sector did not contribute anything to value added growth in these industries. These industries are all export industries. However, domestic industries such as food, beverage, chemical, machine and transportation, show that the contribution of the domestic sector was dominant. For the discussion of the remaining industries, we turn to the contribution of the export sector.

Contribution from Export Sector: We discussed that the high growth rate of value added was mainly responsible for the high growth rate of employment in all industries. By comparing the contribution of the domestic sector with that of the export sector (line 18), we can now find out why the export growth has played a key role for employment growth in the Korean manufacturing industries.

We already found that the annual growth rate of employment, without export growth, would have been only about 6.3 percent in the total manufacturing sector. Therefore, the annual 10.1 percent value added growth from the export sector contributed about 5.0 percentage points to the 11.3 percent annual employment growth in the Korean manufacturing sector. If Korea did not follow the export-oriented development policy from the beginning of industrialization, she could not have achieved such a high growth rate of employment during this eleven-year time span.

At the 2-digit level, in the industries such as wood, furniture, nonmetallic minerals, basic metal and metal product, the export growth made the entire contribution to the annual employment growth, which ranged from 4.3 to 13.7 percent. The contribution of export growth is almost the same or exceeds that of domestic growth in textiles, clothes, paper, leather, rubber, electrical and miscellaneous industries. In the remaining six industries, the domestic contribution is dominant. In general, about two-thirds of the nineteen industries made major contributions to employment growth by exporting their manufactured products.

(3) Returns to Scale: In Chapter III, it was found that there were increasing returns to scale in the productive structures in the Korean manufacturing industries. Increasing returns to scales are associated with the expansion of the market size and the adoptation of advanced foreign technology. Our findings of increasing returns to scale with respect to the Korean manufacturing industries seem to be reasonable because, in a rapidly growing economy such as we find in Korea, the high growth rate of value added would bring about a change in the productive structure. Increasing returns to scale always result in net increases in value added and labor productivity. However, they have negative effects on employment growth because a given level of production would require less of factor inputs.

The estimates of the returns to scale elasticity of employment growth were indirectly derived from the value added elasticity. The returns to scale elasticity would show how much employment growth would be lost if there are increasing returns to scale. Actually, returns to scale is an indirect source of employment growth because the value added elasticity already accounted for employment growth lost due to increasing returns to scale. Our concern here is to measure how much increasing returns to scale affected employment growth in the Korean manufacturing industries. The estimates and effects are shown in lines 20 and 21, respectively.

For the total manufacturing sector, the annual growth rate of employment might have been decreased by 5.1 percent because of increasing returns to scale. At the 2-digit industry level, one qualification is needed in interpreting the indirect estimates of the increasing returns to scale elasticity. In the industries in which the real wage coefficients were not significantly different from zero (line 5), the estimates of the value added elasticity could be relatively lower (line 15) because value added is the only explanatory variable. Regarding the effects of increasing returns to scale, therefore, our discussion may be confined to the industries such as beverage, clothes, furniture, rubber, chemical, nonmetallic minerals and machine. In those industries, the annual growth rates of employment lost from 0.8 to 10.6 percent due to increasing returns to scale. In the remaining industries, the negative effects are fairly high as we expected.

C. Residual

Residual is defined as the difference between the actual growth rate and the computed growth rate of employment from our explanatory variables. If the residual is positive, the actual growth rate is greater than the computed rate, and vice versa if the residual is negative. By adding the residual instead of the trend variable, we may interpret the residual as the effect of technological progress. This interpretation, however, should be made cautiously because statistical errors are expected in computing the annual compound growth rates of real wage, employment and value added.

According to line 23, the total manufacturing sector shows that the residual is -1.8 percentage points of the annual 11.3 percent employment growth and its contribution is -16 percent (index number). Actually, this amount of residual may be negligible. At the 2-digit level, the contributions of residual are around 30 percent in the industries such as food, beverage, textiles, wood, printing, nonmetallic minerals, transportation and miscellaneous. In the remaining industries, they are negligible.

A discussion of the main findings from this section will be shown after the following section.

2. Contributions to Employment Growth by Individual Industries

So far, we have analyzed the contributions to employment growth of the individual sources within each industry. These findings, however, cannot show which industry has made a higher contribution to the annual 11.3 percent employment growth than another. To compare contributions by individual industries, we can write total employment in the manufacturing sector as,

$$L = \Sigma L_i$$

where i = industry index. Taking growth terms, the above equation can be rewritten as,

$$\frac{\dot{L}}{L} = \Sigma \left(\frac{L_i}{L}\right)\left(\frac{\dot{L}_i}{L_i}\right)$$

The term on the left side of the equation is the growth rate of employment in the total manufacturing sector; the first term on the right side is the industry i's share of total employment; and the second term is the growth rate of employment in the industry i.

Within this framework, the individual industry's contribution to the annual 11.3 percent employment growth in the manufacturing sector over the period 1963 to 1973 is shown in Table 6. To compare the relationship between the contribution to value added growth and employment growth, the individual industry's contribution to the annual

Table 6

Contributions to Employment Growth by

Individual Industries in Korean Manufacturing, 1963-1973

Industry	(1) Share of Total L	(V)	(2) Growth Rate L	(V)	(3) Contribution to Total L	(V)	(4) Ranking of Contribution L	(V)	(5) Ratio of Contribution to L to V
Total	100%	(100%)	11.3%	(23.0%)	100%	(100%)	-		1.00
Food	8.96	(8.92)	10.5	(16.8)	8.86	(6.30)	5	(7)	1.41
Beverage	3.57	(9.02)	5.2	(20.0)	1.63	(7.61)	16	(4)	0.21
Textiles	25.27	(16.35)	10.0	(21.0)	22.17	(14.41)	1	(1)	1.54
Clothes	7.00	(4.35)	19.4	(24.5)	11.91	(4.50)	2	(11)	2.65
Wood	3.65	(3.65)	13.7	(25.5)	4.42	(3.91)	6	(12)	1.12
Furniture	1.31	(0.72)	4.3	(6.3)	0.49	(0.20)	18	(19)	2.45
Paper	2.52	(3.07)	8.9	(20.0)	1.96	(2.56)	15	(13)	0.77
Printing	3.73	(3.96)	6.7	(9.1)	2.19	(1.51)	14	(17)	1.45
Leather	0.46	(0.29)	17.4	(30.0)	0.70	(0.37)	17	(18)	1.89
Rubber	3.98	(2.48)	9.7	(19.7)	3.39	(2.06)	10	(16)	1.65
Chemical	5.77	(9.99)	8.7	(23.0)	4.40	(9.66)	8	(3)	0.46
Petroleu-Coal	2.19	(7.35)	0.2	(36.5)	0.04	(11.26)	19	(2)	0.004
Nonmetallic	6.03	(6.79)	8.3	(22.0)	4.42	(6.26)	7	(8)	0.70
Basic Metal	3.45	(4.88)	10.9	(31.5)	3.30	(6.47)	12	(6)	0.51
Metal Product	4.05	(2.57)	11.3	(23.0)	4.02	(2.48)	9	(15)	1.62
Machine	3.36	(2.71)	9.4	(22.0)	2.77	(2.52)	13	(14)	1.10
Electrical	4.35	(4.28)	25.0	(39.0)	9.54	(7.02)	4	(5)	1.36
Transportation	4.79	(4.93)	8.0	(28.0)	3.36	(5.80)	11	(9)	0.58
Miscellaneous	5.47	(3.15)	22.0	(39.0)	10.55	(5.17)	3	(10)	2.04

Sources: Appendix I and IV.

Note: L = Employment and V = Value added.

23.0 percent value added growth is also shown in parenthesis in Table 6. Column (1) is the average share from 1963 to 1973. No serious error is expected in using the average for the share of total employment and value added because the shares have been fairly stable for employment and value added in all industries (see Appendix IV). Column (2) is the annual growth rate. Column (3) is the contribution to the growth rate. Column (4) is the ranking of the contribution and column (5) is the ratio of the contribution to employment to value added.

Column (4) directly shows which industries were responsible for the annual 11.3 percent employment growth in the Korean manufacturing sector over the period 1963 to 1973. Among nineteen industries, the five leading industries in making contributions are: textile (22 percent), clothes (12 percent), miscellaneous (11 percent), electrical (10 percent) and food (9 percent). The high contribution is determined by the industry's share of employment and annual growth rate of employment. The high contributions in textiles and food industries were in part the result of the high employment shares even though the annual growth rates were less than the average. However, in the industries such as clothes, miscellaneous and electrical, the high contributions were mainly the result of their extremely high annual growth rates of employment. Except for these five leading industries, the contributions were less than 4.5 percent and may be considered negligible for the interindustrial comparison.

What is interesting is that the sum of the contributions of the five leading industries is amazingly 63 percent of the total employment growth. Without these industries' contributions, the annual growth rate of employment in the Korean manufacturing sector would have been only 4.2

percent instead of 11.3 percent. Now another interesting question is how those five leading industries could make such high contributions. Let us first look at the individual industries' contributions to the annual 23.0 percent value added growth.

According to the index numbers in the parentheses of column (4), most industries made relatively equal contributions to value added growth except textiles and petroleum-coal, which are actually the leading industries, along with chemical, in contributions to the high value added growth. The textiles industry ranks first for contributions to value added growth as well as to employment growth; its shares of total value added and employment are the highest. The petroleum-coal industry ranks second for contributions to value added growth even though it contributed almost nothing to employment growth. This industry is highly capital-intensive; hence, the annual 36.5 percent value added growth induced only 0.2 percent annual employment growth. Now the sum of the contributions to value added growth made by textiles, clothes, miscellaneous, electrical and food industries is 37 percent. If we compare this 37 percent contribution to value added growth with the 63 percent contribution to employment growth made by the five leading industries, we can discover one aspect of the pattern of employment growth in the Korean manufacturing sector.

One way to define the degree of labor-intensiveness may be with a ratio of the industry's contribution to employment growth to its contribution to value added growth. This ratio for the manufacturing sector as a whole is 1. If the ratio is greater than 1, we can say that the industry in question is labor-intensive because that industry's contribution to employment growth is higher realtive to its contribution to value added growth. Column (5) shows this ratio for each industry. For the five leading industries in employment growth the ratio exceeds 1.36. Therefore, the development of these labor-intensive industries has been another source of employment growth in the Korean manufacturing sector.

As far as these five leading industries' contributions to employment growth are concerned, one observation deserves to be mentioned. As we see in Table 5 (lines 8 and 12), the contributions of export to the annual value added growth in these industries, except food (which is a domestic industry), are greater than 50 percent. Especially in the textiles and clothes industries, whose contribution to the annual 11.3 percent employment growth is 34 percent, the export growth contributed more than 64 percent to value added growth. These findings suggest that the high employment growth in the Korean manufacturing sector was made possible by the contributions of the labor-intensive industries whose high value added growth was the result of export expansion.

In the first part of this chapter, we measured the contributions of various sources to employment growth and in the second part, we compared the individual industry's contribution to the annual 11.3 percent employment growth in the Korean manufacturing sector. Our main purpose was to explain how those sources contributed to employment growth, what sources were responsible for the high growth rate and what industries made high contributions to employment. Based on our findings, we will briefly compare the Korean experience with that of other LDC's as the concluding remarks of this chapter.

After about two decades of industrialization, much evidence of pessimistic employment growth in LDC's began to appear. Many economists have tried to explain this problem. Baer and Herve,[7] for example, explained this phenomenon in terms of the capital-intensive production techniques which dominated many LDC's during the 1950's. Later on, other economists tried to explain what determined the choice of capital-intensive production techniques. Reynolds showed an impressive body of evidence on this point based on the Puerto Rican economy, where producers "responded with productivity-raising improvements which were sufficient to offset most of the higher wage costs."[8] The increasing wage costs are held to be caused by the wage policy which many LDC's have adopted, such as a minimum wage law or fringe benefits. These wage policies are known to have induced wage increases to catch up with labor productivity increases. Jackson and Turner summarized worldwide evidence of this point during the 1950's and 1960's: "Average real wages tend to rise at a pace equal to that of average productivity growth in the manufacturing sector for LDC's."[9] Most studies regarding slow employment growth in LDC's have been conducted for the relationship between wage increases and employment growth. The results suggest that the wage increases are the main reason for slow employment growth, even with output growth acceptably high.

Studies on the relationship between output and employment in LDC's are rarely found, even though they are available for developed countries.[10] Williamson's findings on the Philippines, however, may be generalized for the relationship between both output and wage rate and employment:

> In the very short run, of course, rates of manufacturing output growth between 5 and 6 percent annually will produce even "more disappointing" rates of labor absorption between 1.0 and 1.2 per cent per annum. Although we can generalize from Philippine experience only with caution, it is of some interest

> to note that these discrepancies between output growth rates and labor absorption rates are roughly the range that Baer and Herve find for Asia and Latin America and for which they have such difficulty finding explanations. . . . Adjustment lags are not, of course, the whole explanation of the low rates of labor absorption to manufacturing . . . . For manufacturing as a whole, this rise in real wages must have had a serious impact on employment growth. It has been commonly recognized that the upward pressure of minimum wage legislation is partly responsible for the relatively high capital intensity of manufacturing activities in the developing economies. . . . Philippine evidence illustrates their very large impact on labor absorption. In the short run, the 1 per cent annual increase in real wage would result in a reduction of employment growth by 0.5 per cent.[11]

The Korean experience, however, is quite different from the Philippine experience. First of all, the 10 percent increase in value added instantaneously[12] resulted in the 7.8 percent increase in employment. In addition to that, the annual growth rate of value added was amazingly 23 percent. This high growth rate of value added, and also high value added elasticity of employment growth, resulted in the annual 11.3 percent employment growth after accounting for the annual 4.8 percent reduction in employment growth due to the 8.6 percent real wage growth and the real wage elasticity of -0.56. The annual real wage growth and the real wage elasticity are seemingly high, but their negative contribution to employment growth in the past was less than one-third of the positive contribution from value added growth in absolute value. This is the answer to the question that we raised in the beginning: how did the sources contribute to employment growth, and what sources were responsible for the high rate of growth?

Regarding the extremely high growth rate of value added, we found that the export sector contributed 10.1 percentage points of the annual 23.0 percent value added growth. Without export growth, therefore, the annual growth rate of manufacturing value added would have been only 12.9 percent instead of 23.0 percent and ceteris paribus, the annual growth rate of manufacturing employment would have been only 6.3 percent instead of 11.3 percent. Some economists have explained that the high rate of export growth could have been made possible by the low wage rate in the Korean manufacturing sector.[13] Although the real wage has increased annually by 8.6 percent, the total wage share (or wage cost per unit of output) has declined (see Appendix V) and the monthly money wage per production worker in 1973 was about $60 U.S. This low wage cost has been a main source of high export growth. The annual 46.2 percent export growth also has drastically changed the structure of the Korean economy: the export share of value added increased from 4.2 percent in 1963 to 42.1 percent in 1973. What is more important, the major contribution to high export growth was made by the development of the labor-intensive industries such as textiles, clothes, miscellaneous and electrical. Adding food, these five industries contributed 7.1 percentage points of the annual 11.3 percent employment growth. This was a pattern of employment growth in the Korean manufacturing sector and also an answer to the question: which industries made major contributions to the 11.3 percent employment growth?

Finally, two industrialization policies should be mentioned regarding the high growth rate of employment in the Korean manufacturing sector: wage policy, the Korean government has never allowed a minimum wage law or powerful labor unions; and outward-looking policy, emphasis on the exports of labor-intensive manufactured goods. The former policy has actually controlled the wage increase and the latter one has resulted in rapid increases in export, and the expansion of exports in turn has led to an acceleration of economic growth and employment growth.[14] These two policies have played an important role in achieving high employment growth in the Korean manufacturing sector.

Footnotes

Chapter IV

[1]The Bank of Korea data resulted in the annual 20.0 percent growth rate of value added, but in this study, we are using the EPB Survey data.

[2]Because of the data problem, the domestic and export shares of value added were obtained from the Input-Output tables 1963, 1966, 1968, 1970 and 1973, published by the Bank of Korea, and the average shares were calculated on the basis of these figures. The sectoral export over value added ratios are attached in Appendix III as a reference.

[3]Also because of the data problem, the sectoral compound annual growth rates of domestic and export sectors were obtained from the Input-Output tables of 1963 and 1973, after the figures were deflated by the sectoral 1970 constant prices. One problem was the discrepancy between the sectoral annual growth rates of value added in the BOK data and in the Survey data (which we used for this study). The former data resulted in the annual 20 percent value added growth and the latter, the annual 23 percent growth, for the total manufacturing sector. This discrepancy, even though it was minor, was found in almost all industries. The sectoral contributions of the domestic and export sectors to the sectoral value added growth, therefore, were adjusted by using the value added growth figures from the Survey data rather than the BOK data, and the same was done for sectoral contribution figures of domestic and export sectors originally obtained from the Input-Output tables.

[4]G. T. Brown, *Korean Pricing Policies & Economic Development in the 1960s* (The Johns Hopkins University Press, 1973), Ch. 6.

[5]See footnote 2 above and Appendix III.

[6]When the figure was extremely small in the base year and extremely large in the terminal year, the growth rate of export was calculated as,

$$\frac{\dot{X}}{X} = \left\{ \left(\frac{\dot{V}}{V}\right) - \left(\frac{D}{V}\right)\left(\frac{\dot{D}}{D}\right) \right\} \Big/ \left(\frac{X}{V}\right)$$

This method was applied for rubber and petroleum-coal industries. Therefore, the growth rates of export in these two industries may not be reliable.

[7]W. Baer and M. E. A. Herve, "Employment and Industrialization in Developing Countries," *Quarterly Journal of Economics*, LXXX (Feb., 1966), pp. 88-107.

[8]L. G. Reynolds, "Wages and Employment in a Labor-Surplus Economy," *American Economic Review*, LV (March, 1965), p. 31.

[9]H. A. Turner and D. A. S. Jackson, "On the Determination of the General Wage Level--A World Analysis; Or Unlimited Labor Forever," Economic Journal, LXXX (Dec., 1970), p. 845.

[10]Some of the interesting studies with respect to developed countries are: F. Brechling, "The Relationship Between Output and Employment in British Manufacturing Industries," Review of Economic Studies, XXXII (July, 1965), pp. 187-216; F. Brechling and P. O'Brien, "Short-Run Employment in British Manufacturing Industries: An International Comparison," Review of Economics and Statistics, XLIX (Aug., 1967), pp. 227-87; R. J. Ball and E. B. A. St. Cry, "Short Term Employment Functions in British Manufacturing Industries," Review of Economic Studies, XXXIII (July, 1966), pp. 179-207; N. J. Ireland and D. J. Smyth, "Specification of Short-Run Employment Models," Review of Economic Studies, XXXVII (April, 1970), pp. 281-5; T. Hazledine, "Employment and Output Functions For New Zealand Manufacturing Industries," Journal of Industrial Economics, XXII (March, 1974), pp. 161-198.

[11]J. G. Williamson, "Capital Accumulation, Labor Saving and Labor Absorption Once More," Quarterly Journal of Economics, LXXXV (Feb., 1971), p. 57.

[12]Lagged adjustment model was not appropriate with respect to the Korean manufacturing industries except textile, nonmetallic minerals, basic metal and metal product industries. See Appendix II.E.

[13]Y. Lim,"Industrialization, Trade, and Employment in South Korea" (TDI Papers Series 1974 No. 2, mimeographed), Ch. V. S. Watanabe, "Constraints on Labor-Intensive Export Industries in Mexico," International Labor Review, 109 (Jan., 1974) and "Export and Employment: The Case of the Republic of Korea," International Labor Review, 106 (Dec., 1972). G. Ranis, "Industrial Sector Labor Absorption," Economic Development and Cultural Change, 21 (April, 1973).

[14]B. Balassa, "Industrial Policies in Taiwan and Korea," Weltwirtschaftliches Archiv (Band 106, 1971), pp. 55-77.

CHAPTER V

SUMMARY AND CONCLUSION

In this chapter we will summarize our main findings and suggest their policy implications.

1. Summary of Findings

To explain the annual rate of 11.3 percent employment growth in the Korean manufacturing sector over the period 1963 to 1973, we first specified the sources of employment growth by utilizing the CES production function (in Chapter II). The sources of employment growth were defined as: real wage growth, technological progress, returns to scale, domestic share of value added, growth of domestic sector, export share of value added and export growth. Next, in Chapter III, we estimated the elasticity of substitution and demand for labor function to find out what kind of relationships there were between employment and other sources. Finally, in Chapter IV, based on the estimates of the elasticity of substitution and demand for labor function, and the actual growth rates in the past, we measured how those sources contributed to employment growth, what sources were responsible for the high growth rate, and which industries made high contributions to the annual rate of 11.3 percent employment growth in the Korean manufacturing sector. The analysis was conducted for the total manufacturing sector and nineteen 2-digit industries except for the tobacco industry which has been run by the government monopoly. The basic data on employment, wage rates and value added are those published by the Economic Planning Board in Korea since 1963. Brief summaries of our findings are as follows:

(1) The elasticity of substitution was estimated within the framework

of the ACMS approach. The three modified equations were estimated; first, by including the trend variable under the constant returns to scale assumption; second, by including value added under the non-constant returns to scale assumption; and third, by excluding the trend variable or value added. Therefore, caution is required for the interpretation. For the total manufacturing sector, the "true" elasticity seems to be around 0.60, which is quite comparable to other studies with respect to LDC's.[1] The elasticity of substitution of 0.62 from one model and the annual rate of 8.6 percent real wage growth, with value added constant, reduced employment growth by 5.3 percent. This negative effect is substantial. For the 2-digit industrial level, it was difficult to estimate a consistent elasticity of substitution in half of the nineteen industries. The estimates from the three modified equations suggest, however, that the negative effects on employment growth were substantial. Overall, real wage growth combined with the elasticity of substitution has a substantial negative effect on employment growth because of a significant substitutability between capital and labor.

(2) By estimating the demand for labor function, we could directly test the relationship between employment growth and real wage growth. For the total manufacturing sector, the real wage elasticity of employment growth of -0.56 suggests that a 10 percent increase in real wage growth results in a 5.6 percent reduction in employment growth. The annual rate of 8.6 percent real wage growth, therefore, reduced employment growth by 4.8 percent per year. The negative effect of real wage growth was substantial, amounting to 43 percent of the annual 11.3 percent employment growth. Considering that at least a 143 percent positive contribution should be sought from the other sources, the

negative contribution is about one-third of the positive contribution in absolute value. For the 2-digit industrial level, the real wage variable was statistically significant in only seven industries. The estimates of the real wage elasticity in those industries ranged from -0.43 to -0.79. The annual real wage growth, combined with the real wage elasticity, therefore, reduced employment growth by from -1.1 to -8.5 percent per year. Regarding the statistical result that the real wage variable was insignificant in about two-third of the whole industries, one possible explanation can be found in wage policy--Korean government has never allowed a minimum wage law or powerful labor union; so in the Korean economy, wages have been determined by competitive forces, Hence, real wage growth was behind labor productivity growth in three-fourths of all industries. Had real wage growth increased at least at a pace equal to labor productivity growth, the negative effect would have been more substantial.

(3) To find the positive contribution we turned to value added growth. First of all, unlike the real wage variable, the value added variable played the dominant role in labor demand in eighteen industries, including the total manufacturing sector. The estimate of the value added elasticity ranged from 0.35 to 0.89 and exceeded the real wage elasticity in all industries. Therefore, given equal rates of growth in real wages and value added, employment will increase. Furthermore, the annual rate of value added growth was higher than that of real wage growth by from one and a half times to ten times. This is the main explanation why the high employment growth could be achieved in the Korean manufacturing sector. For example, other factors being constant, the annual rate of 23.0 percent value added growth and the value added

elasticity of 0.78 caused annual employment growth of 17.9 percent in the Korean manufacturing sector. If we compare the annual -4.8 percent from real wage growth with this 17.9 percent from value added, we can easily conclude that value added growth as a positive source made a major contribution to high employment growth in the Korean manufacturing sector.

(4) Considering that the market size of the Korean economy is small, the annual rate of 23.0 percent value added growth was extremely high. To find the source of this value added growth, we divided it into the contributions of the domestic and the export sectors. According to the result, without export growth, the annual growth rate of value added would have been only 12.9 percent instead of 23.0 percent. Actually, the high growth rate of export, whose annual rate ranged from 22 to 80 percent, contributed more than half of the value added growth in twelve industries. Based on the value added growth from the domestic and export sectors, and the estimate of the value added elasticity, we also measured the contributions of the domestic and export sectors to employment growth. For the total manufacturing sector, <u>ceteris paribus</u>, the growth of the domestic sector induced an annual rate of 10.1 percent employment growth, and the export sector, an annual 7.8 percent growth. For the 2-digit industrial level, in the wood, furniture, nonmetallic, basic metal and machine industries, growth of exports comprised the entire contribution to employment growth. In the industries such as textiles, clothes, paper, rubber, electrical and miscellaneous, the growth of exports was about half of the contribution to employment growth. In the remaining industries, growth of the domestic sector made a major contribution. Therefore, without export growth, the annual growth

rate of employment in the total Korean manufacturing sector would have been only 6.3 percent instead of 11.3 percent. Export growth as a source of employment growth played a most important role in achieving a high rate of employment growth in the past.

(5) We also measured the contribution to the annual rate of 11.3 percent employment growth by individual industries to find out which industries made the higher contributions. This measure has important implications for the policy for, and the pattern of, employment growth in the Korean manufacturing sector. Referring to our results, we found the five leading industries in contributions to annual employment growth: textile (22 percent), clothes (12 percent), miscellaneous (11 percent), electrical (10 percent), and food (9 percent). The sum of these industries' contributions was 64 percent of the annual rate of 11.3 percent employment growth. Therefore, without these industries' contributions, the annual growth rate of employment in the Korean manufacturing sector would have been only 4.2 percent. These industries are all labor-intensive in terms of the ratio of contribution to employment growth to the contribution to value added growth. With the exception of the food industry, these four industries contributed more than half of the value added growth by exporting their manufactured products. This is evidence that the high growth rate of employment in the Korean manufacturing sector was made possible by export of manufactured products.

(6) While measuring the contributions of various sources of employment growth, indirectly we found that increasing returns to scale substantially reduced employment growth in the Korean manufacturing industries. However, this negative contribution has already been

accounted for in the net contribution of value added growth.

2. Policy Implications

The development of the Korean manufacturing sector since the First-Planning was launched in 1962 implies that the expansion of the manufacturing sector could be expected to solve the unemployment and underemployment problems in the Korean economy if the service sector would maintain the historical trend of employment growth of 5.7 percent per year. The method of numerical illustration is simple: A manufacturing sector employing 25 percent of the total labor force would need to increase employment by 10 percent per year to absorb the incremental increase from labor force growth at an annual rate of 2.5 percent; if increases in labor productivity of 10 percent per year are taken into account, then the required rate of value added growth should be greater than 20 percent per year.

The development of the Korean manufacturing sector over the period 1963 to 1973 almost matches the range of this numerical illustration. First, the manufacturing employment share of whole economy increased from 8.0 percent in 1963 to 15.9 percent in 1973 and its annual growth rate is 7.1 percent. If this growth rate could be maintained, the manufacturing employment share would be 25 percent in 1980.[2] Second, the Korean manufacturing sector has already achieved an annual rate of 11.3 percent employment growth. Third, the 2.5 percent growth rate of labor force per year is reasonable if the annual rate of 5.7 percent employment growth in the service sector is maintained. Finally, the annual rates of 23.0 percent value added growth and 10.6 percent labor productivity growth are enough to account for the annual rate of 10 percent employment growth. Therefore, if Korea can and will maintain the historical trend, the development of the manufacturing sector could be expected to solve the unemployment problem in the near future. Future policy implications are suggested on the basis of the findings of this study.

(1) The current wage policy that has not allowed a minimum wage law or powerful labor unions might be maintained in the near future. We have already learned that a 10 percent increase in real wages would reduce employment growth by 5.6 percent. In the past, the annual rate of 8.6 percent real wage growth combined with the real wage elasticity of -0.56 reduced employment growth by 4.8 percent per year. If a minimum wage law is adopted and real wages increase at a pace at least equal to labor productivity growth, the negative effect on employment growth would be more substantial. It has been argued that the low wage rates make the income distribution in Korea worse. Low wage rates, however, could help increase employment by encouraging manufacturers to adopt labor-intensive production techniques. The opposite evidence has been widely recognized with respect to many LDC's. Furthermore, considering that the source of comparative advantage in international competition for Korea is cheap labor, wage determination by competitive forces rather than minimum wage law would help maintain this advantage. To explain the constraints on labor-intensive export industries in Mexico, Watanabe makes an interesting comparison between wage rates of Korea and Mexico (where there is a minimum wage law):

> On the average, Mexican manufacturers spend about three times more for each worker than their Korean counterparts, what with wages and salaries and expenditure on social security and other welfare schemes, while the productivity of Mexican labor . . . is about double.[3]

Therefore, wage policy that does not allow a minimum wage law would have a favorable effect on employment growth by encouraging the choice of labor-intensive production techniques and by making production internationally competitive. This is one way to maintain the annual rate of 10 percent employment growth in the Korean manufacturing sector in the future.

(2) The most important policy should focus on the maintenance of the annual rate of 20.0 percent value added growth. In the past, the annual rate of 23.0 percent value added growth and the value added elasticity of employment growth of 0.78 induced the annual rate of 17.9 percent employment growth. However, the domestic sector contributed 10.1 percentage points of this 17.9 percent and the remaining contribution was made by the export sector. Furthermore, more than half of the employment growth was contributed by the growth of export sector in twelve industries. Because the market size in the Korean economy is rather small, this suggests that the growth of the export sector played a key role in the high employment growth in the Korean manufacturing sector. Without export growth, the annual growth rate of manufacturing value added would have been only 12.9 percent instead of 23.0 percent. The Korean government has made every effort to promote exports: policy measures included exemptions from custom duties on imported machines and capital equipment, tax reductions, credit and loans, low interest rates, and financial subsidies.[4] It is well known that these policy measures have helped the high growth rate of export. As a result, the annual export growth rates in all industries ranged from 22 to 80 percent. Therefore, policy measures should be focused on the maintenance of the export expansion to achieve the annual rate of 20 percent value added

growth and, at the same time, the annual rate of 10 percent employment growth.[5]

(3) If the negative effect of real wage growth could be minimized, and the positive effect of value added growth, maximized, some leading industries should be selected to attain the highest employment growth and also to increase the manufacturing employment share up to 25 percent. The leading industries could be selected on the basis of their contributions to employment growth in the past. According to our study, there were five leading industries in employment growth: textiles, clothes, miscellaneous, electrical and food. Without the contributions of these five industries, the annual rate of employment growth in the Korean manufacturing sector would have been only 4.2 percent instead of 11.3 percent. These five industries are labor-intensive; hence, a given growth rate of value added can induce a high growth rate of employment. Among these, food industry is a domestic industry, and as GNP increases, the improvement of living standards is expected to bring about the further development of the food industry. The other four industries are all export industries. More than half of employment growth in these industries were contributed by export growth. Therefore, the policy measures to promote exports should not ignore these four industries because these industries have proven their favorable effect on employment growth in terms of employment share and degree of labor-intensiveness.

Footnotes

Chapter V

[1]See text p. 33.

[2]See any compound interest rate tables.

[3]S. Watanabe, "Constraints on Labour-Intensive Export Industries in Mexico," International Labor Review, 109 (Jan., 1974), p. 32.

[4]B. Balassa, "Industrial Policies in Taiwan and Korea," Weltwirtschaftliches Archiv (Band 106, 1971), pp. 55-77. An excellent description of the evidences on the Korean government's industrialization policies including trade policies during the 1960's are shown by Brown. See G. T. Brown, Korean Pricing Policies & Economic Development in the 1960's (The Johns Hopkins University Press, 1973).

[5]This proposition is not easy to justify because, if the export promotion requires a lot of subsidies, it may not represent the most efficient allocation of resources. Regarding this point, more research should be conducted, especially, with respect to the Korean economy.

APPENDIX I

DATA

This Appendix describes the data utilized in this study.

1. Employment Data

The main source of the sectoral time-series employment data is the annual _Report on the Mining and Manufacturing Survey_ published by the Economic Planning Board (EPB) since 1963. However, the EPB surveys were not conducted for the years 1964, 1965 and 1967. For the missing years, we utilized the annual _Report on the Sample Survey for Mining and Manufacturing Establishments_ published by the Korean Development Bank (KDB) since 1960. The survey methods of these two sources of data are quite consistent and the figures are consistent for comparable years.

2. Wage Data

The wage data presents a problem because the KDB survey did not cover the wage data for the missing years of the EPB survey. Therefore, we used a different source for the wage data.

The Bank of Korea (BOK) has published monthly earnings of the production workers in the mining and manufacturing sectors since 1954. The BOK's wage data are related to the EPB survey in terms of the weighting method and levels since 1963.

To check the consistencies between the BOK's wage data and the EPB's wage data (except for three missing years), we calculated the annual total wage shares based on the BOK's wage and EPB's wage data and compared these two figures, which are attached in Appendix V. Generally speaking, there are no serious discrepancies between these two results.

To get the annual real wage rate per worker, we converted the BOK's monthly money wage rate per worker into the annual rate and deflated by the sectoral implicit price deflator.

3. Value Added Data

There are two sources of data on the sectoral value added: the BOK's data developed for the national income accounting and the EPB survey. Again the KDB data can be used for the missing years of the EPB data.

The main difference between the BOK and EPB data is that the former gives higher estimates relative to the latter. This might be caused by the fact that the EPB survey data is related to production workers only. We chose the EPB survey data for the analyses because the main source of employment data in this study is the EPB survey and we are interested in the production structure.

4. Implicit Price Deflators

Based on the BOK's sectoral annual data on the current and constant value added, we obtained the sectoral implicit price deflators.

Some of the basic data is reported on the following pages.

Value Added

2-Digit Korean Manufacturing Industries, 1963-1973

(Unit: one million won at 1970 price)

Sector	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	Compound Growth Rate(%)
Food	13598	10098	13189	18603	22012	26148	31399	47034	54441	65594	64126	16.8
Beverage	11121	13042	17240	19067	19867	25641	33020	44394	53388	60544	69148	20.0
Textile	24017	19218	24731	28266	40267	48409	66310	76035	89337	117359	168908	21.0
Clothes	5167	3751	5365	8548	15436	15607	16510	16624	24056	32374	47018	24.5
Wood	2652	3397	3514	6607	7791	14180	14303	17474	27323	29461	42267	25.5
Furniture	1124	1448	1448	1650	2092	2917	2743	2014	2176	2611	2069	6.3
Paper	4579	4120	4858	7495	6882	9546	10882	12726	15363	18638	28897	20.0
Printing	7471	8508	5940	9401	7979	11254	13939	15093	21439	19265	17842	9.1
Leather	400	460	610	733	670	840	760	1092	1272	1472	5436	30.0
Rubber	3720	3897	4843	4167	5351	7858	8018	10689	13613	15238	22443	19.7
Chemical	12381	7123	12135	13937	18587	39191	53610	59102	71614	75172	101486	23.0
Petroleum-Coal	3316	8673	9011	11100	22542	20334	37496	46174	57266	51445	73947	36.5
Nonmetallic	7798	9323	11499	13986	17630	21270	28139	32694	41308	42205	60166	22.0
Basic Metal	5318	3900	8007	9337	10830	14516	21001	21978	25386	33255	79910	31.5
Metal Product	3328	2305	4130	5452	6313	8441	10346	12867	14499	16087	26419	23.0
Machine	3706	3994	4958	6683	8373	8067	9270	9723	9239	13003	26767	22.0
Electrical	3303	3243	4942	7204	5380	11113	15740	21844	27109	42373	89042	39.0
Transportation	4092	3142	6652	11338	10943	17622	31852	29566	27944	30090	48926	28.0
Miscellaneous	1797	1186	2604	4212	4191	8804	13931	22964	22726	34042	47678	39.0
Total	123192	117737	148766	189603	235612	316172	420243	500086	598470	696326	979395	23.0

Sources: a) For 1964, 1965 and 1967, Report on Sample Survey for Mining and Manufacturing Establishment, annual, Korean Development.

b) For other years, Report on Mining and Manufacturing Survey, annual, Economic Planning Board.

Employment Data

2-Digit Korean Manufacturing Industries, 1963-1973

Unit: one

Sector	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	Compound Growth Rate(%)
Food	35814	34903	44460	52377	53271	61805	63887	76179	72578	97287	97643	10.5
Beverage	16122	16531	20235	21407	23512	25689	26004	30193	27889	26916	26875	5.2
Textile	109456	96974	125136	134063	158203	186352	210507	207191	202660	226577	280646	10.0
Clothes	17185	18180	21629	37870	54264	52674	61080	56906	69078	87043	101642	19.4
Wood	12089	11806	12399	19017	22282	31373	34328	36211	32931	35211	43406	13.7
Furniture	5359	5225	6542	9020	10252	11724	11976	9019	8729	9995	8164	4.3
Paper	11135	12319	10456	14502	15492	18504	17672	19109	20403	24396	26155	8.9
Printing	16252	17556	19574	22584	22317	26075	28067	30251	31058	32574	31178	6.7
Leather	1829	2116	2456	3209	2025	2508	2429	3382	2996	3851	9105	17.4
Rubber	18951	17876	22870	23508	23265	25953	23686	27269	31757	36453	47811	9.7
Chemical	25775	23044	25412	29264	34172	46514	53588	49637	49223	45759	59731	8.7
Petroleum-Coal	14784	13963	15293	15614	13283	14994	13858	15696	14351	15583	15116	0.2
Nonmetallic	23651	22292	31537	33141	46504	50569	49924	50366	48406	45241	52078	8.3
Basic Metal	13170	12413	15561	18622	26213	28817	29066	31528	25872	27628	37134	10.9
Metal Product	15008	15336	18125	24395	24791	28575	30728	35243	38167	38165	43782	11.3
Machine	14453	15651	15369	22005	25834	24182	24545	26504	21004	25557	35557	9.4
Electrical	10270	10477	13041	18354	21323	27774	37996	39417	42172	62333	95515	25.0
Transportation	20045	15909	21129	30394	33187	36753	44331	43143	37769	39264	43143	8.0
Miscellaneous	12011	10177	12198	27675	30193	38701	55113	62842	56812	80983	85284	22.0
Total	393359	372748	453422	557026	640383	739536	818848	850086	833855	960689	1139865	11.2

Sources: a) For 1964, 1965 and 1967, Report on Sample Survey for Mining and Manufacturing Establishment, annual, Korean Development Bank.
b) For other years, Report on Mining and Manufacturing Survey, annual, Economic Planning Board.

Annual Real Wage Rates

2-Digit Korean Manufacturing Industries, 1963-1973

(Unit: one thousand won at 1970 price)

Sector	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	Compound Growth Rate(%)
Food	72.8	67.0	75.0	86.6	98.4	97.3	137.2	166.3	204.0	199.2	211.4	11.2
Beverage	81.6	74.7	86.1	88.1	90.9	93.8	129.9	154.6	193.3	220.6	278.8	13.1
Textile	74.6	62.2	61.8	66.2	78.3	89.4	113.3	139.6	151.5	155.6	163.1	8.1
Clothes	125.4	87.1	88.9	82.3	93.2	83.7	116.5	124.0	136.2	146.3	158.4	2.4
Wood	88.8	72.0	89.8	88.9	104.8	139.4	181.6	172.1	191.6	203.8	197.7	8.3
Furniture	95.1	62.9	80.1	78.8	84.8	94.8	113.5	128.6	144.3	138.9	129.4	3.1
Paper	77.3	84.5	76.9	76.0	91.6	123.3	162.4	187.4	216.4	224.4	227.7	11.4
Printing	156.1	129.8	131.1	152.6	143.1	153.5	193.8	228.6	260.1	270.4	288.4	6.3
Leather	87.9	72.5	75.0	73.9	81.7	100.1	120.8	139.7	144.7	156.3	160.7	4.0
Rubber	78.8	72.5	75.0	73.9	81.7	100.1	120.8	139.7	144.7	156.3	160.7	7.4
Chemical	83.2	73.0	71.7	81.2	94.9	122.8	199.4	221.6	290.9	326.2	363.9	15.9
Petroleum-Coal	77.7	82.3	102.3	119.4	130.9	166.8	193.4	240.8	259.6	264.7	312.1	15.1
Nonmetallic	94.6	96.9	87.8	91.3	98.2	123.9	161.3	194.8	235.2	243.3	261.0	10.7
Basic Metal	111.2	119.6	120.5	128.2	164.0	209.4	226.2	224.5	275.1	307.6	351.7	12.2
Metal Product	77.8	70.6	74.4	81.6	101.6	119.3	131.6	150.2	185.3	204.8	210.7	10.5
Machine	134.1	121.7	115.7	110.8	121.2	125.4	148.4	161.9	188.8	226.6	261.3	6.9
Electrical	79.2	82.5	77.8	86.5	92.8	102.5	144.7	174.2	211.7	217.5	235.8	11.5
Transportation	118.5	112.7	114.6	120.7	149.8	201.5	244.9	256.0	275.9	288.9	254.2	8.0
Miscellaneous	45.7	45.7	47.3	50.6	63.3	80.4	113.3	140.9	186.3	193.3	205.9	16.3
Total	88.4	79.3	81.5	86.2	99.0	114.0	146.3	169.8	196.1	202.6	202.4	8.6

Sources: a) Monthly money wage rates are obtained from Economic Statistics Yearbook, annual, Bank of Korea.
b) Monthly money wage rates are converted into the annual rates and deflated by the sectoral implicit price deflators.
c) Sectoral price deflators are calculated from the data Yearbook of National Income 1974 and Monthly Economic Statistics (Sept., 1974), Bank of Korea.

Value Added Per Worker

2-Digit Korean Manufacturing Industries, 1963-1973

(Unit: one thousand won at 1970 price)

Sector	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	Compound Growth Rate(%)
Food	379.7	289.3	295.5	355.2	413.2	423.1	491.5	617.4	750.1	684.5	656.7	5.6
Beverage	689.8	788.9	852.0	890.7	845.0	998.1	1269.8	1470.3	1914.4	2249.4	2572.9	14.0
Textile	219.4	198.2	197.6	210.8	254.5	259.8	315.0	367.0	440.8	518.0	601.9	10.6
Clothes	300.7	206.3	248.0	225.7	284.5	296.3	270.3	292.1	348.2	371.9	462.6	4.4
Wood	362.8	287.7	283.4	347.4	349.7	452.0	416.7	482.6	829.7	836.7	973.8	10.4
Furniture	209.7	107.6	221.3	182.9	204.1	248.8	229.0	223.3	249.3	261.2	253.4	1.9
Paper	411.2	334.4	464.6	516.8	444.2	515.9	615.8	666.0	753.0	764.0	1104.8	10.4
Printing	460.0	484.6	303.4	416.3	357.5	431.6	496.6	498.9	690.3	591.4	572.3	2.2
Leather	218.7	114.4	248.4	228.4	330.9	334.9	305.0	322.9	424.6	382.2	597.0	10.8
Rubber	196.3	218.0	211.8	177.3	230.0	302.8	338.5	392.0	428.7	418.0	469.4	9.1
Chemical	480.3	309.1	477.5	476.3	543.9	842.6	1000.4	1190.7	1454.9	1642.8	1699.1	13.5
Petroleum-Coal	224.3	621.1	589.2	710.9	1697.1	1356.1	2705.7	2941.8	3990.4	3301.4	4892.0	36.0
Nonmetallic	329.7	418.2	364.6	422.0	379.1	420.6	563.6	649.1	853.4	932.9	1155.3	13.4
Basic Metal	403.8	314.2	514.6	501.3	413.2	503.7	722.5	697.1	911.6	1203.7	2151.9	18.2
Metal Product	221.7	150.3	227.9	223.5	254.6	295.4	336.9	365.1	379.9	421.5	603.4	10.5
Machine	256.4	255.2	322.6	303.7	324.1	333.6	377.7	366.9	439.9	508.8	752.8	11.4
Electrical	321.6	309.5	379.0	392.5	352.3	400.1	414.3	554.2	642.8	679.8	932.2	11.2
Transportation	204.1	197.5	314.8	373.0	329.7	479.5	718.5	685.3	739.9	766.4	1134.0	18.6
Miscellaneous	149.6	116.5	213.5	152.2	138.8	227.5	252.8	365.4	400.0	420.4	559.1	14.1
Total	313.2	315.9	328.1	340.4	367.9	427.5	513.2	588.3	717.7	724.8	859.2	10.6

Source: Same as Employment and Value Added data.

APPENDIX II

STATISTICAL RESULTS

This Appendix presents statistical results on the estimations of the elasticity of substitution and demand for labor function which were not shown in the text. The estimated equation is shown at the bottom of each table.

APPENDIX II.A

Elasticity of Substitution:
2-Digit Korean Manufacturing Industries, 1963-1973

Industry	const.	w	t	R^2
Total	5.59 (3.27)	0.62 (3.98)	0.04 (2.31)	0.99
Food	-0.02* (-0.01)	1.15 (5.33)	-0.06 (-1.95)	0.95
Beverage	5.14 (3.56)	0.74 (5.59)	0.04 (2.00)	0.98
Textile	4.82 (2.06)	0.66 (3.04)	0.04* (1.67)	0.95
Clothes	6.16 (2.56)	0.54 (2.54)	0.03* (1.76)	0.74
Wood	11.01 (1.96)	0.12* (0.23)	0.11* (1.79)	0.78
Furniture	3.09* (0.72)	0.80 (2.07)	-0.01* (-0.24)	0.53
Paper	13.62 (4.34)	-0.09* (-0.30)	0.11 (2.65)	0.85
Printing	0.92* (0.22)	1.02 (2.91)	-0.04* (1.23)	0.66
Leather	16.17 (5.25)	-0.36* (-1.31)	0.11 (5.11)	0.84
Rubber	1.11* (0.41)	0.99 (4.06)	0.01* (0.34)	0.95
Chemical	5.53 (2.16)	0.65 (2.75)	0.05* (1.10)	0.95
Petroleum & Coal	5.79* (0.33)	0.60* (0.38)	0.19* (0.82)	0.90
Nonmetallic	4.28* (1.47)	0.74 (2.82)	0.03* (0.83)	0.92
Basic Metal	14.25* (1.10)	-0.16* (-0.14)	0.17* (1.21)	0.77
Metallic	5.97* (1.09)	0.55* (1.09)	0.04* (0.66)	0.87
Machine	6.60 (2.33)	0.50 (2.01)	0.05 (2.33)	0.87
Electrical	3.97* (0.77)	0.77* (1.63)	0.003* (0.05)	0.77
Transportation	10.37 (2.53)	0.15* (0.41)	0.15 (3.59)	0.93
Miscellaneous	4.39* (0.95)	0.69* (1.54)	0.02* (0.23)	0.85

Numbers in the parenthesis are t-ratios.

Sources: Same as Table 4 or Appendix I.

Notes: a) * indicates estimates not significant at $P \leq 0.05$.
b) The estimation equation is:

$$\log \frac{V}{L} = a + \sigma \log w + (1-\sigma)mt + u$$

APPENDIX II.B

Elasticity of Substitution:
2-Digit Korean Manufacturing Industries, 1963-1973

Industry	const.	w	t	V	R^2
Total	5.42*	0.61	0.04*	0.01*	0.98
	(0.87)	(2.87)	(0.76)	(0.03)	
Food	-6.13	0.65	-0.09	0.50	0.98
	(-2.51)	(3.11)	(-4.12)	(3.28)	
Beverage	-1.89*	0.64	-0.02*	0.35*	0.98
	(-0.31)	(4.23)	(-0.36)	(1.17)	
Textile	-2.21*	0.36*	-0.02*	0.44*	0.96
	(-0.46)	(1.36)	(-0.41)	(1.64)	
Clothes	-1.24*	0.53	-0.05*	0.35	0.85
	(-0.37)	(3.27)	(-1.63)	(2.65)	
Wood	1.36*	-0.40*	-0.02*	0.71	0.86
	(0.23)	(-0.87)	(-0.29)	(2.37)	
Furniture	-3.63*	0.90	-0.03*	0.27*	0.52
	(-0.44)	(2.44)	(-0.79)	(-0.96)	
Paper	-3.25*	-0.23*	-0.04*	0.74	0.93
	(-0.58)	(-0.15)	(-0.71)	(3.25)	
Printing	-8.82	0.33*	-0.07	0.79	0.94
	(-3.64)	(1.70)	(-4.93)	(5.96)	
Leather	9.58*	-0.11*	0.06*	0.20*	0.86
	(1.79)	(-0.36)	(1.36)	(1.46)	
Rubber	-2.43*	0.79	-0.02*	0.26*	0.95
	(-0.63)	(2.75)	(-0.63)	(1.22)	
Chemical	-1.01*	0.28*	-0.01*	0.47	0.98
	(-0.44)	(1.64)	(-0.17)	(3.85)	
Petroleum	-9.66	-0.31*	-0.00*	1.15	0.99
	(-3.60)	(-1.32)	(-0.07)	(19.45)	
Nonmetallic	16.59*	0.75	0.14*	-0.55*	0.92
	(0.97)	(2.77)	(0.89)	(-0.73)	
Basic Metal	-2.82	-0.25*	-0.03*	0.83	0.89
	(-2.67)	(-0.32)	(-0.24)	(3.13)	
Metal	-6.77*	0.29*	-0.09	0.73	0.97
	(-1.78)	(1.13)	(-2.09)	(4.92)	
Machine	-1.81*	0.46	-0.01*	0.40	0.94
	(-0.55)	(2.76)	(-0.45)	(3.20)	
Electrical	-5.59*	0.34*	-0.16	0.67	0.94
	(-1.65)	(1.28)	(-3.29)	(4.70)	
Transportation	3.70*	-0.12*	0.07	0.45	0.98
	(1.34)	(-0.58)	(2.11)	(4.31)	
Miscellaneous	-1.01*	0.50*	-0.08*	0.36*	0.86
	(-0.16)	(1.11)	(-0.71)	(1.28)	

Numbers in the parenthesis are t-ratios.

Sources: Same as Table 4 or Appendix I.

Notes: a) * indicates estimates not significant at $P \leq 0.05$.
b) The estimation equation is:

$$\log \frac{V}{L} = a + \sigma \log + (1-\sigma)mt + \left[\frac{(1-\sigma)(h-1)}{h}\right] \log V + u$$

APPENDIX II.C

Elasticity of Substitution:
2-Digit Korean Manufacturing Industries, 1963-1973

Industry	const.	w	V	R^2	h
Total	0.77*	0.56	0.22	0.98	2.00
	(1.03)	(2.86)	(2.09)		
Food	3.07*	0.45*	0.20*	0.94	1.57
	(1.81)	(1.27)	(0.85)		
Beverage	0.31*	0.65	0.25	0.99	3.50
	(0.32)	(4.66)	(2.47)		
Textile	-0.27*	0.38*	0.34	0.96	2.21
	(-0.30)	(1.56)	(2.56)		
Clothes	3.71	0.47	0.15	0.82	1.39
	(2.51)	(2.71)	(2.86)		
Wood	3.04	-0.42*	0.65	0.88	-
	(1.99)	(-1.00)	(3.46)		
Furniture	2.10*	0.64	0.13*	0.55	1.57
	(0.55)	(2.79)	(0.61)		
Paper	0.62*	-0.11*	0.61	0.94	-
	(0.52)	(-0.71)	(5.21)		
Printing	1.67*	-0.08*	0.54	0.75	-
	(0.74)	(-0.24)	(2.22)		
Leather	2.64*	0.23*	0.36	0.84	2.79
	(1.50)	(1.24)	(5.21)		
Rubber	-0.06*	0.76	0.17*	0.96	3.43
	(-0.07)	(2.79)	(1.15)		
Chemical	-0.65*	0.27*	0.46	0.98	2.70
	(-0.72)	(1.86)	(4.54)		
Petroleum & Coal	-9.37	-0.32	1.15	0.99	-
	(-28.59)	(-3.03)	(21.67)		
Nonmetallic	1.31*	0.79	0.11*	0.92	1.91
	(0.85)	(2.99)	(0.63)		
Basic Metal	-0.29*	-0.40*	0.79	0.90	-
	(-0.18)	(-0.92)	(3.81)		
Metal Product	1.05*	-0.04*	0.53	0.95	-
	(1.27)	(-0.17)	(3.89)		
Machine	-0.43*	0.43	0.36	0.95	2.71
	(-0.43)	(3.05)	(4.92)		
Electrical	5.12	0.01*	0.34	0.86	1.52
	(3.73)	(0.02)	(2.25)		
Transportation	-1.84*	0.09*	0.59	0.97	2.94
	(-1.76)	(0.43)	(6.22)		
Miscellaneous	3.27	0.36*	0.22*	0.87	1.52
	(2.98)	(0.91)	(1.13)		

Numbers in the parenthesis are t-ratios.

Source: Same as Table 4 or Appendix I.

Notes: a) * indicates estimates not significant at $P \leq 0.05$.
b) The estimation equation is:
$$\log \frac{V}{L} = a + \sigma \log w + \left\{\frac{(1-\sigma)(h-1)}{h}\right\} \log V + u$$

APPENDIX II.D

Elasticity of Substitution:
2-Digit Korean Manufacturing Industries, 1963-1973

Industry	const.	w	R^2
Total	1.82 (2.82)	0.96 (17.39)	0.97
Food	4.40 (6.38)	0.74 (12.57)	0.94
Beverage	2.42 (4.27)	0.99 (20.44)	0.98
Textile	1.18* (1.27)	1.00 (12.30)	0.94
Clothes	3.30* (1.68)	0.80 (4.72)	0.68
Wood	1.59* (0.73)	0.97 (5.23)	0.73
Furniture	3.96 (1.83)	0.72 (3.84)	0.58
Paper	5.77 (4.31)	0.64 (5.59)	0.75
Printing	5.46 (3.08)	0.63 (4.30)	0.64
Leather	3.32* (0.96)	0.80 (2.70)	0.39
Rubber	0.24* (0.29)	1.07 (14.67)	0.96
Chemical	2.86 (3.50)	0.90 (13.14)	0.95
Petroleum and Coal	-8.55 (-3.61)	1.90 (9.60)	0.90
Nonmetellic	2.02 (2.01)	0.94 (11.11)	0.92
Basic Metal	-1.13* (-0.45)	1.19 (5.73)	0.76
Metallic	2.42 (2.03)	0.87 (8.55)	0.88
Machine	0.97* (0.53)	0.99 (6.53)	0.81
Electrical	3.73 (2.52)	0.79 (6.27)	0.79
Transportation	-3.29* (-1.42)	1.35 (7.04)	0.83
Miscellaneous	3.37 (3.03)	0.79 (8.12)	0.87

Numbers in the parenthesis are t-ratios.

Source: Same as Table 4 or Appendix I.

Notes: a) * indicates estimates not significant at $P \doteq 0.05$.
b) The estimation equation is:
$$\log \frac{V}{L} = a + \sigma \log w + u$$

APPENDIX II.E

Demand for Labor Function:
2-Digit Korean Manufacturing Industries, 1963-1973

Industry	const.	w	t	V	Lt-1	R^2
Total	-5.60*	-0.65	-0.04*	0.81	0.40*	0.97
	(-1.02)	(-3.42)	(-0.85)	(2.89)	(1.73)	
Food	10.42	-0.61	0.13	0.43	-0.32*	0.98
	(2.72)	(-3.12)	(3.65)	(2.88)	(-1.41)	
Beverage	-0.27*	-0.59	0.003*	0.59	0.29*	0.93
	(-0.04)	(-3.81)	(0.06)	(2.02)	(1.23)	
Textile	-3.16*	-0.75	-0.02*	0.66	0.65	0.96
	(-0.67)	(-2.59)	(-0.41)	(2.91)	(2.05)	
Clothes	1.10*	-0.52	0.05*	0.64	0.04*	0.98
	(0.30)	(-2.88)	(1.21)	(3.96)	(0.23)	
Wood	-2.29*	-0.16*	-0.02*	0.37*	0.59*	0.90
	(-0.40)	(-0.28)	(-0.32)	(1.28)	(1.40)	
Furniture	-10.69*	0.05*	-0.03*	0.77	0.30*	0.78
	(-1.54)	(0.16)	(-0.83)	(2.56)	(1.02)	
Paper	4.38*	0.08*	0.05*	0.25*	-0.17*	0.90
	(0.67)	(0.33)	(0.77)	(1.03)	(-0.43)	
Printing	2.90*	-0.24*	0.02*	0.17*	0.61*	0.95
	(0.56)	(-1.25)	(0.51)	(1.27)	(1.26)	
Leather	-6.49*	0.01*	-0.04*	0.82	-0.30*	0.93
	(-1.08)	(0.02)	(-0.81)	(6.17)	(-1.09)	
Rubber	-1.86*	-0.65*	-0.01*	0.73	0.29*	0.92
	(-0.25)	(-1.82)	(-0.20)	(3.26)	(0.68)	
Chemical	-0.52*	-0.33	-0.05*	0.51	0.26*	0.95
	(-0.21)	(-1.98)	(-0.19)	(4.39)	(1.38)	
Petroleum and Coal	14.27	0.18*	0.02*	-0.14	-0.37*	0.43
	(3.47)	(0.77)	(0.52)	(-2.52)	(-1.44)	
Nonmetallic	-9.60*	-0.70	-0.08*	1.00*	0.49	0.91
	(-0.72)	(-3.36)	(-0.66)	(1.61)	(2.46)	
Basic Metal	0.90*	-0.61*	0.001*	0.37*	0.79	0.85
	(0.11)	(-0.85)	(0.02)	(1.66)	(2.42)	
Metal	0.22*	-0.33*	0.01*	0.36	0.56	0.98
	(0.05)	(-1.62)	(0.13)	(2.96)	(2.29)	
Machine	-0.61*	-0.38*	-0.01*	0.60	0.14*	0.91
	(-0.11)	(-1.73)	(-0.16)	(4.60)	(0.63)	
Electrical	2.45*	-0.52	0.07*	0.36	0.51*	0.98
	(0.65)	(-1.91)	(0.93)	(2.70)	(1.51)	
Transportation	-3.78*	-0.09*	-0.07	0.53	0.32*	0.96
	(-1.60)	(-0.44)	(-2.65)	(5.95)	(1.88)	
Miscellaneous	-1.22*	-0.85*	0.000*	0.71	0.50*	0.95
	(-0.22)	(-1.86)	(0.00)	(2.83)	(1.66)	

Numbers in the parenthesis are t-ratios.

Source: Same as Table 4 or Appendix I.

Notes: a) * indicates estimate not significant at $P \leq 0.05$.
b) The estimation equation is:
$$\log L = a - \lambda\sigma \log w + \lambda(\sigma - 1)mt + \lambda\left(\sigma + \frac{1-\sigma}{h}\right) \log V + (1-\lambda) \log Lt\text{-}1 + u$$
where λ: speed adjustment which is assumed to be $1 \geq \lambda \geq 0$ and t-1: previous time period.

APPENDIX III

Export/Value added Ratio

Industry	1960	1963	1966	1968	1970	1973	% Average
Total	4.19	7.13	15.48	17.05	22.10	42.12	20.8
Food	3.20	5.15	8.94	9.24	7.38	12.08	8.6
Beverage	1.14	0.33	3.05	1.71	1.17	4.24	2.1
Textiles	5.80	9.70	31.46	27.59	49.87	74.76	38.7
Clothes	2.55	4.29	20.40	35.28	38.70	61.90	32.1
Wood	18.87	75.70	87.93	93.51	99.70	103.05	92.0
Furniture	13.50	5.53	7.47	7.73	19.89	70.78	22.3
Paper	4.29	0.75	12.97	22.73	28.08	63.45	25.6
Printing	1.96	1.07	1.87	8.11	2.64	25.36	7.8
Leather	2.19	0.26	6.45	11.10	9.26	47.56	14.9
Rubber	8.55	5.17	28.60	39.60	45.23	67.33	37.2
Chemical	4.54	1.76	2.12	2.95	8.48	23.67	7.8
Petroleum-Coal	0.00	0.00	10.00	7.24	19.82	16.64	10.7
Nonmetallic Minerals	12.66	11.01	44.03	75.01	59.66	98.60	53.3
Basic Metal	19.60	89.46	67.98	120.11	57.03	86.80	84.2
Metal Product	1.96	6.66	23.02	27.03	29.82	67.79	30.9
Machine	1.90	6.68	3.41	1.21	8.89	7.47	5.5
Electrical	14.06	7.23	13.29	19.30	24.39	59.67	24.8
Transportation	9.77	2.18	1.18	5.25	1.82	5.04	3.1
Miscellaneous	7.68	17.78	37.73	38.42	55.03	62.06	42.2

Sources: Input-Output Tables for 1960, 1963, 1966, 1968, 1970 and 1973 (BOK).

Note: Because ISIC was changed in 1968, the data from the Input-Output tables were adjusted on the basis of the old ISIC.

APPENDIX IV

Sectoral Shares of Employment and Value Added

Sector		1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973
Food	Employment	9.1	9.4	9.8	9.4	8.3	8.4	7.8	9.0	8.7	10.1	8.6
	Value Added	11.0	8.6	8.9	9.8	9.3	8.3	7.5	9.4	9.1	9.6	6.6
Beverage	Employment	4.1	4.4	4.5	3.8	3.7	3.5	3.2	3.6	3.3	2.8	2.4
	Value Added	9.0	11.1	11.6	10.1	8.4	8.1	7.9	8.9	8.9	8.7	7.1
Textile	Employment	27.8	26.0	27.6	24.1	24.7	25.2	25.7	24.4	24.3	23.6	24.6
	Value Added	19.5	16.3	16.6	14.9	17.1	15.3	15.8	15.2	14.9	16.9	17.3
Clothes	Employment	4.4	4.9	4.8	6.8	8.5	7.1	7.5	6.7	8.3	9.1	8.9
	Value Added	4.2	3.2	3.6	4.5	6.6	4.9	4.0	3.3	4.0	4.7	4.8
Wood	Employment	3.1	3.2	2.7	3.4	3.5	4.2	4.2	4.3	4.0	3.7	3.8
	Value Added	3.6	2.9	2.4	3.5	3.3	4.5	3.4	3.5	4.6	4.2	4.3
Furniture	Employment	1.4	1.4	1.4	1.6	1.6	1.6	1.5	1.1	1.1	1.0	0.7
	Value Added	0.9	1.2	1.0	0.9	0.9	0.9	0.7	0.4	0.4	0.4	0.2
Paper	Employment	2.8	3.3	2.3	2.6	2.4	2.5	2.2	2.3	2.5	2.5	2.3
	Value Added	3.7	3.5	3.3	4.0	2.9	3.0	2.6	2.5	2.6	2.7	3.0
Printing	Employment	4.1	4.7	4.3	4.1	3.5	3.5	3.4	3.6	3.7	3.4	2.7
	Value Added	6.1	7.2	4.0	5.0	3.4	3.4	3.3	3.0	3.6	2.8	1.8
Leather	Employment	0.5	0.6	0.5	0.6	0.3	0.3	0.3	0.4	0.4	0.4	0.8
	Value Added	0.3	0.4	0.3	0.4	0.3	0.3	0.2	0.2	0.2	0.2	0.6
Rubber	Employment	4.8	4.8	5.0	4.2	3.6	3.5	2.9	3.2	3.8	3.8	4.2
	Value Added	2.8	3.3	3.3	2.2	2.3	2.5	2.0	2.1	2.3	2.2	2.3
Chemical	Employment	6.6	6.2	5.6	5.3	5.3	6.3	6.5	5.8	5.9	4.8	5.2
	Value Added	10.1	6.1	8.2	7.4	7.9	12.4	12.8	11.8	12.0	10.8	10.4
Petroleum and Coal	Employment	3.8	3.8	3.4	2.8	2.1	2.0	1.7	1.9	1.7	1.6	1.3
	Value Added	2.7	7.4	6.1	5.9	9.6	6.4	8.9	9.2	9.6	7.4	7.6
Nonmetallic	Employment	6.0	6.0	7.0	6.0	7.3	6.8	6.1	6.0	5.8	4.7	4.6
	Value Added	6.3	7.9	7.7	7.4	7.5	6.7	6.7	5.5	6.9	6.1	6.1
Basic Metal	Employment	3.4	3.3	3.4	3.3	4.1	3.9	3.6	3.7	3.1	2.9	3.3
	Value Added	4.3	3.3	5.4	4.9	4.6	4.6	5.0	4.4	4.2	4.8	8.2
Metal Product	Employment	3.8	4.1	4.0	4.4	3.9	3.9	3.8	4.2	4.6	4.0	3.8
	Value Added	2.7	2.0	2.8	2.9	2.7	2.7	2.5	2.6	2.4	2.3	2.7
Machine	Employment	3.7	4.2	3.4	4.0	4.0	3.3	3.0	3.1	2.5	2.7	3.1
	Value Added	3.0	3.4	3.3	3.5	3.6	2.6	1.9	1.5	2.4	1.9	2.7
Electrical	Employment	2.6	2.8	2.9	3.3	3.3	3.8	4.6	4.6	5.1	6.5	8.4
	Value Added	2.7	2.8	3.3	3.8	2.3	3.5	3.8	4.4	4.5	6.1	9.9
Transportation	Employment	5.1	4.3	4.7	5.5	5.2	5.0	5.4	5.1	4.5	4.1	3.8
	Value Added	3.3	2.7	4.5	6.0	4.6	5.6	7.6	5.9	4.7	4.3	5.0
Miscellaneous	Employment	3.1	2.7	2.7	5.0	4.7	5.2	6.7	7.4	6.8	8.4	7.5
	Value Added	1.5	1.0	1.8	2.2	2.8	3.3	3.8	4.6	3.8	4.9	4.9
Total		100	100	100	100	100	100	100	100	100	100	100

Sources: Appendix I.

APPENDIX V

Sectoral Wage Share
2-Digit Korean Manufacturing Industries, 1963-1973
(Per Centage)

Sector	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973
Food	19.2 (20.9)	23.2	25.3	24.4 (20.7)	23.8 (21.1)	23.0 (21.3)	27.9 (24.0)	26.9 (22.6)	27.2 (20.5)	29.1 (20.3)	32.2 (27.5)
Beverage	11.8 (12.6)	9.5	10.1	9.9 (10.0)	10.8 (12.0)	9.4 (9.8)	10.2 (10.0)	10.5 (10.2)	10.1 (10.5)	9.8 (12.0)	10.8 (10.9)
Textile	34.0 (34.8)	31.4	31.3	31.4 (31.4)	30.8 (31.7)	34.4 (34.4)	36.0 (36.2)	38.0 (35.3)	34.4 (33.7)	30.0 (28.4)	27.1 (28.3)
Clothes	41.7 (37.5)	42.2	35.8	36.4 (31.5)	32.8 (32.7)	28.2 (34.8)	43.1 (39.6)	42.4 (39.4)	39.1 (34.7)	39.3 (35.0)	34.2 (36.2)
Wood	24.5 (25.9)	25.0	31.7	25.6 (25.4)	30.0 (33.3)	30.8 (24.7)	43.6 (39.9)	35.7 (33.6)	23.1 (22.0)	24.4 (21.0)	20.3 (23.2)
Furniture	45.3 (41.0)	22.7	36.2	43.1 (38.8)	41.2 (38.7)	38.1 (37.9)	49.6 (46.3)	57.6 (45.8)	57.9 (43.9)	53.2 (43.5)	51.1 (51.4)
Paper	18.8 (20.6)	25.3	16.5	14.7 (18.3)	20.6 (23.8)	23.9 (23.7)	26.4 (25.8)	26.1 (27.9)	28.7 (27.1)	29.4 (29.7)	20.6 (20.8)
Printing	34.0 (36.7)	26.8	43.2	36.7 (37.4)	40.0 (43.8)	35.6 (45.4)	39.0 (41.6)	45.8 (43.5)	37.7 (39.9)	45.7 (44.8)	50.4 (50.7)
Leather	40.2 (42.1)	44.6	37.3	35.3 (33.7)	26.1 (30.4)	30.4 (29.7)	46.4 (39.8)	46.5 (37.5)	37.5 (32.5)	38.5 (31.9)	21.8 (23.9)
Rubber	40.2 (40.4)	33.3	35.4	41.7 (44.1)	35.5 (40.7)	33.1 (37.5)	35.7 (39.0)	35.6 (38.6)	33.7 (35.9)	37.4 (37.6)	34.2 (37.2)
Chemical	17.3 (21.4)	23.6	15.0	17.0 (21.6)	17.4 (23.3)	14.6 (23.0)	19.9 (18.6)	18.6 (19.6)	20.0 (19.6)	19.9 (20.7)	21.4 (20.0)
Petroleum and Coal	34.6 (34.3)	13.2	17.4	16.8 (15.1)	7.7 (7.0)	12.3 (9.7)	7.1 (6.9)	8.2 (8.5)	6.5 (6.8)	8.0 (9.2)	6.4 (7.5)
Nonmetallic	28.7 (29.0)	23.2	24.1	21.6 (25.7)	25.9 (26.2)	29.5 (24.3)	28.6 (27.1)	30.0 (26.8)	27.6 (23.4)	26.1 (22.2)	22.6 (19.8)
Basic Metal	27.5 (31.1)	38.1	23.4	25.6 (26.4)	39.7 (29.8)	41.6 (32.2)	31.3 (31.0)	32.2 (30.1)	28.0 (29.3)	25.6 (23.5)	16.3 (13.7)
Metal Product	35.1 (35.1)	47.0	32.6	36.5 (35.2)	39.9 (36.2)	40.4 (35.1)	39.1 (39.9)	41.2 (40.2)	48.8 (37.9)	48.6 (42.4)	34.9 (33.7)
Machine	52.3 (43.3)	47.7	36.5	36.5 (34.7)	37.4 (43.0)	37.6 (38.0)	39.3 (37.5)	44.1 (39.9)	42.9 (42.2)	44.5 (41.2)	34.7 (31.0)
Electrical	24.6 (28.2)	26.6	20.5	22.0 (22.1)	36.8 (36.6)	25.6 (31.2)	34.9 (30.2)	31.4 (30.0)	32.9 (31.2)	32.0 (33.7)	25.3 (27.2)
Transportation	58.0 (60.4)	57.1	36.4	32.4 (30.3)	45.4 (43.1)	42.0 (32.8)	34.1 (27.6)	37.3 (33.7)	37.3 (32.4)	37.7 (32.0)	22.4 (27.2)
Miscellaneous	30.6 (32.8)	39.2	22.2	33.3 (32.6)	45.6 (41.4)	35.3 (32.5)	44.8 (36.0)	38.6 (36.4)	46.6 (36.4)	46.0 (31.9)	36.8 (30.9)
Tobacco	(7.7)			(9.5)	(8.2)	(9.0)	(6.1)	(6.2)	(6.3)	(5.6)	(7.0)
Total	28.2 (25.6)	25.1	24.8	25.3 (25.6)	26.9 (27.4)	26.7 (26.9)	28.5 (26.9)	28.9 (26.9)	27.3 (24.9)	27.9 (25.0)	23.6 (23.7)

Notes:
a) Wage share is calculated on the basis of the formula, wage share=w.L/V, where w: real wage rate, L: number of workers and V: value added in real terms.
b) Numbers without parentheses are calculated on the bases of the BOK wage data.
c) Numbers in the parentheses are calculated on the bases of the Survey data by the EPB and KDB (for 1967 only).
d) The purpose of these two figures are to investigate the consistencies between the Survey and BOK wage data.
e) Tobacco industry is included to show the evidence that this industry has been monopolized by the Korean government. Low wage share less than 10 % suggests this evidence.

Sources: Appendix I.

APPENDIX VI

This Appendix illustrates the derivation of the Jorgenson model of the user cost of capital and shows the estimated result with respect to the Korean manufacturing sector. The model is the static one. The non-static model includes variables whose data are difficult to obtain. Furthermore, Jorgenson and Hall reference the static model rather than non-static in the recent articles, which seems to be empirical reasons. Also, from the side of the statistical data, we assume that capital gains in the Korean economy are moderate.

For the more theoretical details including the non-static model, see Jorgenson and Hall's articles whose references are attached in the Bibliography.

Assume that the firm's production function is

$$X = F(K,L)$$

where X: output

K: capital stock and

L: labor

and the rate of growth of capital stock is

$$I = \dot{K} + \delta K$$

where I: gross investment and

δ: rate of depreciation

If the firm's object is to maximize the present value of the firm's revenue, the revenue maximization function will be

$$V = \int_0^{\infty} e^{-rt} [R(t) - T(t)]\, dt$$

where $R = X - wL - qI$ and

V: maximized present value of net revenue

r: discount rate

R: net revenue

q: price of new investment goods

T: amount of tax

t: time

w: wage rate

Then rental can be calculated from the basic relationship between the price of new investment goods and the discounted value of all the future services derived from these investment goods. In the absence of direct taxation, this relationship takes the form of

$$q(t) = \int_t^{\infty} e^{-r(s-t)}\ c(s)\ e^{-\delta(s-t)}\ ds$$

where s: time at which capital services are provided by the goods

c: rental of the capital services

Differentiating this relation with respect to time, then

$$c = q(r+\delta) - \dot{q}$$

which is the rental of the capital services supplied by the firm to itself. Under static expectation about the price of capital goods

$$c = q\ (r+\delta)$$

Now we can introduce the proportional tax on business income. We assume the tax administration prescribes a depreciation formula which gives the proportion of the original cost of an asset of age s that may be deducted from income for tax purpose. Also we assume that a tax credit is allowed on investment expectation and that depreciation base is reduced by the amount of tax credit. Then the formula will be

$$q(t) = \int_t^{\infty} e^{-r(s-t)} \left[(1-u)\ c(s)\ e^{-\delta(s-t)} + u(1-K)\ q(t) \right.$$

$$\left. D(s) \right] ds + kq(t)$$

where u: business income tax rate

k: investment tax credit and

D: depreciation formula described by tax administration

If the present value of the depreciation deduction on one dollar's investment after the tax credit is

$$z = \int_0^{\infty} e^{-rs}\ D(s)\ ds$$

then, the final formula for the user cost of capital will be

$$c = q(r+\delta)\ \frac{(1-k)(1-uz)}{(1-u)}$$

On the basis of the Jorgenson model, I estimated the user cost of capital in the Korean manufacturing sector. Row (6) in the following table is the estimated result over the period 1963 to 1973.

Measurement of the User Cost of Capital:
The Korean Manufacturing Sector, 1963-1973

		1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973
(1)	Price Index of Capital Goods (1970 = 100)	47.1	60.1	68.3	74.4	78.6	88.3	89.1	100.0	105.8	118.1	123.6
(2)	Discount Rate (%)	15.79	16.23	19.47	25.07	24.51	24.09	22.36	21.01	19.28	14.86	12.72
(3)	Rate of Depreciation (%)	5.63	6.74	7.31	6.16	6.53	9.02	10.01	10.16	9.92	13.13	16.97
(4)	Investment Tax Credit (%)	0	0	0	0	0	6.0	6.0	6.0	6.0	6.0	6.0
(5)	Business Income Tax Rate (%)											
	Less than 1 mill. won	20.0	25.0	25.0	20.0	20.0	20.0	15.0	15.0	15.0	16.0	16.0
	1 mill. to 5 mill. won	25.0	30.0	30.0	30.0	30.0	35.0	35.0	35.0	35.0	30.0	30.0
	More than 5 mill. won	25.0	30.0	30.0	35.0	35.0	35.0	25.0	25.0	25.0	27.0	27.0
(6)	User Cost of Capital	10.09	13.80	18.29	23.23	24.40	27.48	27.11	29.30	29.13	31.07	34.57
	Index (1970 = 100)	34.44	47.10	62.42	79.28	83.28	93.79	92.53	100.0	99.42	105.84	117.98

Sources: a) Price Index of Capital Goods --- Economic Statistics Yearbook 1974 (BOK), p.227.
b) Discount Rate --- Monetary Statistics in Korea 1960-1973 (BOK,1974).
c) Rate of Depreciation --- Rate of depreciation was calculated on the basis of formula $K_t^n = I_t^g + K_{t-1}^n - D_t$ where $D_t = \delta K_{t-1}^n$, n = net term and g = gross term. The basic data are available from W. Hong, "Export and Employment in Korea"(KDI Interim Progress Report 7410, Dec., 1974), p.A-25 and A-27.
d) Business Income Tax Rate --- Various tax laws published by the Office of National Tax Administration, Korea.
e) Money and Real Wage Rates --- Same as Table 1.

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