RELATIVE WAGE INCOME SHARES IN THE KOREAN AGRICULTURAL AND MANUFACTURING SECTORS

Kim Young-Sik*

I. Introduction

This study is based on the distributional problem which has been called increasingly into question with many different dimensions since the Korean economy has succeeded in achieving growth objectives beyond ex-expectations in the last decade or so.

The distributional questions are broad—for example, how has the distribution of output been changed between sectors, regions, different resource ownership, and some other economic groups classified as having different interests? What have been the major economic forces causing these changes, and how does the distribution itself affect other economic variables, thus interacting between distribution and other economic variables in the dynamic growth process? However, this study is mainly concerned with how the relative positions of wage earners have changed, and with what the major economic forces were behind this change in the process of the various changes of output growth, resources employment, and economic structure.

Distribution of income between different productive factors alone may have limited meaning to the contemporary question of personal or size distribution. For many individuals or groups, income consists of both labor and capital income, even though there are some differences in the proportions of the sources of income. This will be particularly true in the agricultural sector in which most of the farmers are self-employed.

Thus the distributional question between any groups or individuals which are not classified as pure wage earner or capitalist, is related to the income distribution between productive resources, and also to the distribution of resource ownership. But assuming that the ownership of some resources is more equitably distributed than others, a more favorable shares of income among the first resources will lead to more equitable distribution of income as a whole.

II. Analytical Framework

Various theories have been developed to explain the income distribu-

*Senior Fellow, Korea Rural Economics Institute.

tion among different resource owners (1, 2, 3). But two theories dominate in recent economic literature. The first is the marginal productivity theory with production function, and the second is the so-called neo-Keynesian macro distribution theory with the equilibrium relationship of saving and investment. Both theories are basically long-run equilibrium theories. But a main distinction between the two theories is that one assumes that the wage rate will equilibriate the labor market and the other assumes that the wage rate will clear the product market. Acceptability of both theories is at least subject to empirical testing.

The analytical framework used for the analysis is based on the neoclassical marginal productivity theory with a specified CES production function. The distribution mechanism of the theory is basically the process of determining factor prices and employment. At a given factor ratio, the relative share of each factor is determined by the price ratio, which is equal to the marginal rate of substitution between factors under the assumption of the theory.

The marginal rate of substitution between factors can be changed, and as a result the distribution of output to each of the factors changed. There are basically two possibilities for the change: the changes in factor ratio and biased technical change. Two important neoclassical propositions about the relative income shares (4) are related to these changes. The first holds that a factor-saving technical progress, other things constant, reduces the relative share of the income, or the output elasticity of that factor. The second maintains that if one factor increases in supply more rapidly than another, and if the elasticity of substitution is less than unity, then the relative share of the first factor decreases.

We specified the aggregate production relation as a CES function with a factor augmenting form of technical progress. The augmenting form of factor efficiency was specified as $K_t^* = t^{\alpha}K_t$ and $L_t^* = t^{\beta}L_t$, where K_t^* and L_t^* are capital and labor inputs in efficiency units, K_t and L_t are conventional units of respective input, and α and β are factor augmenting indexes of the respective factors due to technical progress.[1]

With such a specified production relation, we can derive the theoretical relationships of the rate of change in the wage income share (S_L) to related variables and parameters as

$$\dot{S}_L = -(1\text{-}S_L)\left(\frac{\sigma - 1}{\sigma}\right)[(\dot{K} - \dot{L}) + (\alpha - \beta)t^{-1}]$$

where σ is the elasticity of substitution between factors. From the expression, it is clear that the rate of change in wage income share depends on the

[1] One common specification is to assume that factor augmentation occurs at a constant exponential rate. But Lianos (5) specified the form as $a(t) = a_0t^{\alpha}$ and $b(t) = b_0t^{\beta}$. This formulation implies that the rate of factor augmentation is declining since $\dot{a} = \alpha^{t-1}$ and $\dot{b} = \beta^{t-1}$. And the dot over a variable indicates the proportional rate of change of the variable.

changes in the capital-labor ratio and the differential growth rate of factor efficiency at a given technical condition of factor substitutability. Using the theoretical relationships described above, this study attempts to explain the behavior of the actual wage income share for both the sectors.

III. Trends in Wage Income Shares

Using various sources of data, the actual wage income share was estimated during the last two decades. The results showed that the behavior of the share has been significantly different between the sectors (Table 1,2).

Agricultural wage income as a share of total gross agricultural income (where the wage share calculation was based on the hired wage rate) has decreased from 51 percent for 1955–1957 to 35 percent for 1972–1974, some 16 percentage points, or about one-third. It was also calculated that the wage income share has decreased at an average annual rate of about 2.0 percent. But the rate of change in the agricultural sector fluctuated widely compared to the rate in the manufacturing sector. For the first ten-year period, 1955–1964, the annual rate of change was –1.3 percent, but it accelerated in the second ten-year period to a –2.6 percent annual rate of change.

For the manufacturing sector, the estimate of the actual wage income as a share of the total value added showed an increasing trend during the period 1957–1974, contrary to the trend in the agricultural sector. The share has increased, from 33 percent for 1957–1959 to 41 percent for 1972–1974, some 8 percentage points, or about one-fourth. The average annual rate of change is calculated as 1.5 percent during the whole period.

Recent studies indicate that there have been various trends in wage income share in different sectors and in different countries or regions[2]. Comparing our estimates with those of other countries, we find the wage income share in Korea significantly low, particularly in the manufacturing sector, which may have contributed to the attraction of a large inflow of foreign capital in the last decade.

[2] For the U. S. national economy, the wage income share changed with a significant increasing trend from 55 percent for 1900–1909 to 67 percent for 1949–1957 (6). For U. S. agriculture, the wage income share to net agricultural income increased fairly steadily from 58 percent for 1910–14 to 65 percent for 1954–46 (7). But since 1946 it declined fairly steadily from 55 percent to 44 percent for 1954–57 (8). For the U. S. manufacturing sector, the wage share has significantly increased at the rate of 0.4 percent per annum during the period 1948–1962 (9). For the Canadian manufacturing sector, no significant trend with about 50 percent of wage share from 1926–58 (10). For Canadian agriculture, the share of labor in gross agricultural output decreased from about 51 percent for 1941–45 to 25 percent for 1961–65 (11). For the Israel agricultural and manufacturing sectors, the wage income share showed a steadily declining trend during the period 1942–69, at the rate of 1.3 percent and 0.8 percent per year, respectively (12).

Table 1 Rates of Change in Actual and Predicted Wage Income Shares for Specified Periods in theAgricultural Sector, 1955–1974

Periods	Proportional Annual Rate of Change in Wage Share (S_L) (Percent)								
	Predicted						Actual	K/L	S_L
	by capital[1] deepening (1)		by biased[2] technical change (2)		1 + 2				
	I	II	I	II	I	II			
1955–74	— .805	—.337	—.229		—1.034	—.337	—.1.970	5.278	.4583
1955–64	— .046	—.019	—.440		— .486	—.019	—1.299	.331	.5113
1965–74	—1.629	—.683	—.201		—1.830	—.638	—2.641	9.730	.4053
1955–59	.271	.114	—.766		— .495	.114	2.425	—2.053	.5307
1960–64	— .320	—.134	—.329		— .649	—.134	—5.022	2.238	.4918
1965–69	—2.104	—.844	—.221		—2.235	—.844	—2.180	12.762	.4396
1970–74	—1.187	—.497	—.177		—1.364	—.497	—3.102	6.698	.3709

[1] Calculated by $-(1-S_L)(1-\frac{1}{\sigma})\,K/L$, where $\sigma = 1.3929$ for I and $\sigma = 1.134$ for II.

[2] Caculated by $-(1\text{-}S_L)(1-\frac{1}{\sigma})(\alpha\text{-}\beta)t^{-1}$, where $\alpha\text{-}\beta = .175$ for I and $\alpha\text{-}\beta = 0$ for II. The value of t was taken as of the midpoint of each of the respective periods (with $t = 1$ for 1955).

Table 2. Rates of Changes in Actual and Predicted Wage Income Shares for Specified Periods in the Manufacturing Sector, 1957–1974

Periods	Proportional Annual Rate of Change in Wage Share (S_L) (percent)								
	by capital[1] deepening (1)		by biased[1] technical change (2)		1 + 2		Actual	$\dot{K/L}$	S_L
	I	II	I	II	I	II			
1957–74	.407	.178	1.319	.325	1.726	.503	1.544	1.374	.3618
1965–74	1.112	.486	.950	.233	2.062	.719	2.171	3.910	.3877
1957–64	—.699	—.306	2.079	.763	1.380	.457	.649	—2.246	.3295
1965–69	1.253	.548	1.204	.296	2.457	.844	3.058	4.280	.3693
1970–74	.976	.427	.819	.200	1.795	.627	1.284	3.540	.4060

[1] Calculated by $-(1-S_L)\left(1-\frac{1}{\sigma}\right)\dot{K/L}$, where $\sigma = .6839$ for I and $\sigma = .831$ for II.

[2] Calculated by $-(1-S_L)\left(1-\frac{1}{\sigma}\right)(\alpha-\beta)t^{-1}$, where $\alpha-\beta = .4351$ for I and $\alpha-\beta = .300$ for II.

IV. Estimation of Factor Substitutability and the Bias of Factor Efficiency Growth

For the explanation of the actual behavior of the wage income share, we estimated the parameters determining the wage share.

One of the major difficulties in the estimation was the availability and reliability of basic data. The definitions of data used for the measurement are not identical in the sectors, partially because of a lack of availability and partially because of conceptual differences.

For the agricultural sector, output was measured by the total gross output concept. The measure of the labor input was an adult-man-day equivalent unit adjusted by age and sex, and the capital input was measured by the flow service concept.

For the manufacturing sector, output was measured by the total value added concept. The measure of the labor input was unadjusted physical units of labor, and the capital input was measured by the stock concept.

After experimenting with various different estimation procedures, we derived two sets of estimates for each sector. For both sectors, one set of the estimates (estimate I) was based on the marginal productivity relationships, and the other one (estimate II) was the result estimated directly from the specified production function by a linear approximation or nonlinear least-squares procedure.[3]

For the agricultural sector, estimate I was based on the estimating equation which was derived from the production expansion path with a partial adjustment assumption. Estimate II was based on a linear approximation of a specified CES function by expanding the logarithm of the function. The Hildreth-Lu estimation procedure was applied for both the estimating equations with a first order autoregressive scheme.

For the manufacturing sector, estimate I was based on the two-stage Zellner-Aitken's efficient estimation method, with the assumption that the disturbance terms of each marginal productivity relation were mutually correlated. Estimate II was based on the nonlinear least-squares method, and Bard's version of the Gauss-Newton method was applied for the solution.

The major estimation results are summarized as follows: First, the elasticity of substitution is greater than unity for the agricultural sector and less than unity for the manufacturing sector. For the agricultural sector, the point estimates of the elasticity of substitution were 1.392 and 1.134 in estimates I and II respectively. But for the manufacturing sector, it was .683 in estimate I and .831 in estimate II.

Second, for both the sectors, the estimated capital augmenting parameter α turned out to be greater than that of labor β. For the agricultural

[3] For the specific estimating equations and its estimation results, see chapters IV and V of Kim (13).

sector, the estimate of α-β was .175 (estimate I), and for the manufacturing sector, the estimates of α and β were .599 and .064 respectively (estimate I). Thus, the results seem to indicate that during the sample period the growth in productivity has been mainly the result of the efficiency growth of the capital input, which has been rapidly expanded in the last decade.

Third, the point estimate of the scale parameter was consistently close to unity for both the sectors, which agreed with the assumption used in deriving the marginal productivity theory of distribution. For the agricultural sector, the estimate of the adjustment coefficient, $\lambda = .409$, was significantly below unity, which implies that the input adjustment process to the price change has been fairly slow for Korean agricultural production during the period. But for the manufacturing sector, the adjustment coefficient, $\lambda = .848$, was relatively close to unity.

The confidence interval estimates, or significance tests, for the estimated parameters were also made. However, the usual significance test of the ratio of regression coefficients presented a difficulty because the distribution of the ratio of two normal variables with non-zero means is unknown. For this reason, we derived a formula to find the maximum and minimum values of the ratio of two normal variables within the joint confidence region of the variables with a specified probability.[4]

Using the above procedure, we derived the 95 percent confidence interval estimate of the elasticity of substitution as $.9041 \leq \sigma \leq 2.7517$ for the agricultural sector and $.3849 \leq \sigma \leq .9409$ for the manufacturing sector. This result implies that the usual CD function will have a specification bias at least for the manufacturing sector.

The significance test based on the same procedure showed that the factor augmenting bias α-β for agriculture and the labor augmenting parameter β for manufacturing are not significantly different from zero, but the capital augmenting parameter α for manufacturing was significantly positive at the 95 percent significance level.

Using the estimation results, the bias of technical progress was calculated for both the sectors. As in usual terminology, the bias of technical change was defined as a differential growth rate of marginal productivity between factors at a given capital-labor ratio. In our notation, the bias (B) can be calculated as

$$B = \frac{\sigma - 1}{\sigma} (\alpha - \beta) t^{-1} = \dot{MPK} - \dot{MPL}$$

At the year 1965 or $t = 10$, the calculated B turned out to be .51 percent for the agricultural sector and -2.49 percent for the manufacturing sector, which means that the technical progress was capital-using for the agricultural sector and —2.49 percent for the manufacturing sector, which means that the technical progress was capital-using for the agricultural sector and labor-using for the manufacturing sector. Thus at a given capital-labor ratio

[4] For the deriving procedure of the formula, see the Appendix of Kim (13)

technical progress results in a decrease in the wage income share for the agricultural sector, but it causes an increase in the wage income share for the manufacturing sector. It also appears that the technical progress has been more significantly biased in the manufacturing sector than in the agricultural sector during the period.

V. Analysis of Changes in Wage Income Shares, Marginal Products and Actual Returns to Labor

Using the theoretical relationship derived from the marginal productivity theory, we attempted to explain the behavior and sources of changes in wage income shares. For this purpose, the theoretical rate of change in the wage income share was predicted and it was also separated into two sources—capital deepening and biased technical change.

For the *agricultural* sector, the theoretical relationship predicts the wage income share to decrease at an average annual rate of 1.03 percent with estimate I and .34 percent with estimate II, which are compared with the 1.97 percent of the actual rate of the change during the whole period.

Based on estimate I, the rate of the change was separated into two sources. The results show that, of the 1.03 percent of the annual rate of change, the capital deepening factor contributed .81 percent. Thus the capital deepening factor appears to be a major source of the change with an elastic substitutability between capital and labor.

The actual and predicted rates of the change are in the same direction, but there are large differences in the actual magnitudes of the rates. In average terms, it is calculated that our theoretical relationship can explain only about 52 percent of the decreasing trend of the actual share with estimate I and only 17 percent with estimate II.

Using the estimated rate of the change, the wage income share index was derived for both the actual and predicted shares. The derived index showed that the actual wage income share index was substantially above that of the predicted share for the earlier period. But the differences between the two indexes have significantly decreased over time. (Table 1)

For the *manufacturing* sector, the annual predicted rate of increase in the wage income share is about 1.7 percent with esiimate I, which is fairly close to the 1.5 percent actual rate of the change during the whole period. But estimate II predicts the rate of change as only .50 percent, which is much lower than the rate of actual change. Based on estimate I, the marginal productivity theory seems to better explain the behavior of the wage income share in the manufacturing sector than in the agricultural sector.

With estimate I, it is also calculated that the capital deepening factor has contributed to the growth of the wage share at an annual rate of .41 percent, while the labor-using biased technical progress has increased the

share at an annual rate of 1.32 percent. Using estimate II, about .18 percent of the annual rate was contributed by capital deepening and .35 percent of the annual rate by biased technical progress. Thus for the manufacturing sector, the biased technical progress has been more siginificant in changing the wage income share than has the capital deepening. (Table 2)

The analysis showed that the general direction of the predicted rates of change in the wage shares, based on the marginal productivity theory, were consistent with the actual rates of the changes for both the sectors, but there are large differences in actual magnitudes. Thus the results may indicate that the theory we used could not be a complete explanation of the changes in wage income shares for the sample period in the Korean economy. However, any conclusions are tentative due to the various possible sources of bias in the estimates of the parameters.

With the same estimates, this study also attempts to estimate the marginal product of labor, and examines the extent of variations between the estimated value of the marginal product and the actual wage rate over time and between sectors.

For the agricultural sector, the estimated value of the marginal product of labor is far below the actual wage rate, particularly until the

Table 3. Marginal Products and Actual Returns to Labor for the Agricultural Sector, 1955–74

Year	MPL[1]	VMPL[2] (Won)	W (Won)	W/VMPL
1955	316	51	76	1.481
56	315	59	85	1.438
57	332	65	92	1.420
58	336	61	92	1.518
59	319	59	93	1.574
60	329	60	96	1.589
61	310	73	106	1.452
62	324	88	115	1.308
63	336	113	143	1.263
64	349	178	198	1.121
65	363	176	221	1.254
66	394	206	256	1.245
67	381	247	307	1.242
68	413	296	381	1.288
69	474	396	463	1.169
70	483	483	579	1.169
71	494	597	695	1.164
72	514	746	803	1.070
73	536	850	886	1.042
74	580	1,232	1,141	. 926

[1]The unit is 1970–constant won.

[2]VMPL = P * MPL.

early 1960's. However, the difference between the value of the marginal product and the actual wage rate has been considerably reduced over time. It is calculated that the value of the marginal product was only about 67 percent of the actual wage rate in 1955–1959 and 93 percent in 1970–1974. (Table 3)

The marginal product of labor for 8 hours of work in the agricultural sector rose from 316 won in 1955–1956 to 558 won in 1973–1974 (in 1970 constant prices). Thus during the last two decades, the marginal product of labor has increased about 77 percent.

Quite unlike the agricultural sector, the data for the manufacturing sector show that the estimated value of the marginal product of labor is far above the actual wage rate for the whole period. The actual wage rate was only 56 percent of the value of the marginal product in 1957–1958, and 63 percent in 1973–1974 (Table 4).

Table 4. Marginal Products and Actual Returns to Labor for the Manufacturing Sector, 1957–74

Year	MPL[1]	VMPL[2] (Won)	W (Won)	W/VMPL
57	560	138	77	.558
58	561	148	84	.568
59	566	150	86	.573
60	558	154	92	.594
61	550	174	104	.598
62	582	207	112	.541
63	520	228	128	.561
64	532	304	179	.589
65	549	333	205	.616
66	538	411	265	.645
67	566	441	295	.669
68	636	534	347	.650
69	742	676	444	.657
70	858	858	571	.666
71	837	870	683	.785
72	1,003	1,187	798	.672
73	1,096	1,394	878	.630
74	1,167	1,881	1,194	.635

[1]The unit is 1970–constant won.
[2]VMPL = P * MPL.

The marginal product of manufacturing labor rose from 611 won in 1957–1958 to 1,132 won in 1973–1974 (at 1970 constant prices). Thus during the period, the marginal product of manufacturing labor has about doubled, compared with the 77 percent increase in the agricultural sector.

The data indicate that there were significant differences between the actual returns and values of marginal products of labor in both the sectors.

But the directions of the differences were not the same between the sectors. The value of marginal products of manufacturing labor was far above the actual wage rate, implying that wage earners have been paid too little compared to their actual contributions to production. But the value of the marginal product of agricultural labor was lower than the wage rate, implying that the self-employed agricultural workers received low returns for their labor. However, the actual wage rate has tended to approach the value of the marginal product over time for both the sectors.

The data also show that the value of the marginal product of agricultural labor is only about 52 percent of that of manufacturing labor, on the average for the whole period, which implies that there was also a large disequilibrium between the sectors. However, the disequilibrium between the sectors has been significantly reduced over time. The relative value of the marginal product of agricultural labor to that of manufacturing labor rose from 42 percent in 1957–1959 to 63 percent in 1970–1974(Table 5).

Table 5. Comparisons of Actual Wage Rates, Marginal Products, and Value of Marginal Products of Labor Between the Agricultural and Manufacturing Sectors for Specified Periods

Periods	MPL_A /MPL_M	$VMPL_A$ /$VMPL_M$	W_A /W_M
1955–59	.583	.423	1.123
60–64	.604	.466	1.064
65–69	.670	.546	1.048
70–74	.580	.628	1.003
1955–74	.597	.516	1.059

[1]Calculated from Tables 3 and 4. Subscripts A and M stand for the agricultural sector and the manufacturing sector, respectively. Marginal products are in value units at 1970 prices.

VI. Concluding Remarks

While it is hard to judge the validity of our analysis, one may draw a conclusion that the marginal productivity theory seems to be consistent with the actual movements of wage income shares in their general directions, but there are considerable differences in actual magnitudes. This may indicate that there are some other factors, or disequilibrium factors, playing an important role in the Korean economy during the period.

However, the importance of the disequilibrium factors within and between the sectors has apparently decreased over time. Thus the Korean economy may have been in the process of adjusting to an equilibrium during the period. But the conclusion is very tentative, and it is only valid when the data and the estimates of parameters used for the analysis reflect true values.

There are various possibilities the data and estimates may have been

biased. The weakness in the data and possible errors in estimation could mean that the economy may not have been in the disequilibrium indicated by the results. More work on this possibility is needed.

If such a disequilibrium does in fact exist, there are various possible disequilibrium factors stemming from the rapid growth of the Korean economy in the last decade. The analysis of various possible factors or the causes of disequilibrium is another important subject to be investigated.

There are basically two possible sources of differences in factor substitutability between the different sectors. One is the difference in the basic nature of the production technology, and the other one is the change in the commodity structure of each sector. However, the sources which have caused the differences in the degree of substitutability between the sectors are not clear in our aggregated sector study. Thus more disaggregated study is needed to provide more evidence for the estimate when the data become available.

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