Labor Values, Prices of Production, and Wage-Profit Rate Frontiers of the Korean Economy

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This paper extends the empirical analysis of the labor theory of value using input-output data from the Korean Economy for the years 1995 and 2000. The results of the analysis suggest that the Korean economy displays similarities with a number of other economies as regards to the proximity of labor values, Sraffian prices and prices of production to actual market prices. Furthermore, our findings of the wage-profit rates frontiers for the Korean Economy for the years 1995 and 2000 preclude the case of reswitching of techniques. This result lends additional support to the labor theory of value as an analytical tool for the understanding of the laws of motion of modern economies.

Keywords: Values, Prices of production, Wage-profit rate frontiers, Input-output

JEL Classification: B12, B14, C67, D57

I. Introduction

The purpose of this paper is to extend the empirical investigation on the relationship between labor values, Sraffian prices, prices of production, and market prices to the case of the Korean economy.

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Although many studies, among which Jeong (2005) is the most comprehensive one, tried to estimate Marxian ratios of Korean economy, most of them mainly focused on the trend of rate of profit and surplus value. To our knowledge, however, there is no serious study in the relation between labor values and prices.

Despite the fact that the debate about the relation between labor values and prices of production, *i.e.*, the transformation problem has been around for quite a long time, researchers only relatively recently have enriched the discussions by introducing the empirical dimension in the analysis. The motivation of this research is the view that the empirical testing of the labor theory of value with actual data from various countries will help in the derivation of more useful conclusions with regard to the validity and the logical coherence and therefore the practical significance of the labor theory of value as a tool for the analysis of modern economies.

The remainder of the paper is organized as follows: Section II deals with the empirical research on price value relations and derives estimates using actual input-output data from the Korean economy for the years 1995 and 2000, that is, the two years for which we have adequate data for this kind of analysis. Section III derives wage-profit rate frontiers for the Korean economy for the years 1995 and 2000. Section IV concludes and makes some remarks about future possible extensions of the research.

II. Empirical Research on Price Value Relations

Economic theory has repeatedly raised the question of the determinants of prices and their variations. A casual look at market prices would lead to the idea that their fluctuations are random or chaotic and, therefore, are not amenable to abstract theorization. However, economists since the time of Adam Smith or even earlier have strived to identify regularities in the apparently chaotic movements of market prices. Classical economists argued that there is one set of fundamental prices, the natural prices as they called them that operate as a center of gravity around which the market prices fluctuate. Marx (1982) continuing on this tradition, argued in the first two volumes of *Capital* that labor values, which can be defined as the direct and indirect abstract labor time that is socially necessary for the production of commodities and more

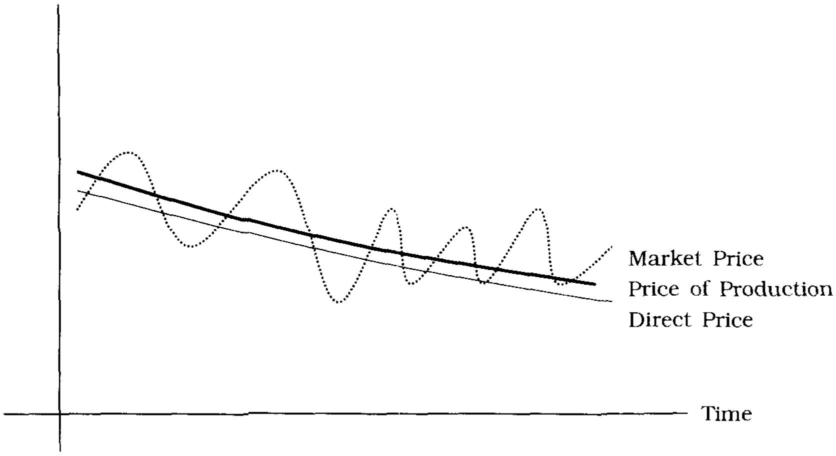

FIGURE 1
DIRECT PRICES, PRICES OF PRODUCTION, AND MARKET PRICES

specifically their monetary expression, that is, prices proportional to values, *i.e.*, direct prices, while in volume three of *Capital* he further argued that prices of production that is a hypothetical set of equilibrium prices that incorporate the economy's average rate of profit constitute a more concrete center of gravity of actual prices. The so called transformation problem is about the relationship between direct prices and prices of production. Figure 1 portrays the relationship between the various prices in Marx's analysis

The empirical research on the relation between labor values (direct prices) and market prices using input-output data for the economies of the U.S.A., former Yugoslavia, Italy, England, and Greece has shown that the direct prices and market prices are very close to each other. The same is also true for prices of production and market prices. The article by Shaikh (1984) finds that the deviations of direct prices or prices of production from market prices are in the order of 17-19% for the economy of Italy, while for the U.S. economy are of the order of 20-25%. More specifically, for the U.S. economy Ochoa (1984 and 1989) using more completely Shaikh's methodology, as well as more detailed data finds that the Mean Absolute Deviation[1] (MAD) of prices pro-

[1] This statistic is defined as the average percentage absolute deviation of values from market prices and thus positive and negative deviations do not

portional to values (direct prices) and market prices for a series of years that span the period 1947-77 is in the order of 12%, while the MAD of direct prices and prices of production is 17%, results which render the so-called "transformation problem" of limited empirical importance. The value rate of profit and the rate of profit estimated in terms of prices of production differ on an average by 4%, while all the estimated wage profit rate curves were near linear because of the proximity of direct prices and the prices of production. A few years later Chilcote (1997) and also Shaikh (1997) utilizing more recent data and more refined estimating methodology in their analysis pretty much validated the conclusions that stem from Marxian analysis. The empirical research for the U.K. (Cockshott *et al.* 1995) and the former Yugoslavian economy (Petrovitc 1987) for the years 1976 and 1978, and for the Greek Economy (Tsoulfidis and Maniatis 2002) were similar with those of the U.S. economy.[2]

The above results indicate that empirically in the real economies that have been examined up until now the differences in the capital intensity (*i.e.*, the organic composition of capitals) across sectors of the economy do not give rise to substantial differences in terms of the various price sets. As a consequence, all the categories of prices be it direct prices (where the differences in the organic composition of capitals of the individual sectors play no role whatsoever) or Sraffian prices (prices with a uniform rate of profit on circulating capital) or even prices of production (prices with a uniform rate of profit on capital stock) will be very close to each other, as well as with the observed market prices. The question pursued in this paper is to what extent may similar results be derived for a rapidly growing economy such as the Korean one. In order to answer to such a question we calculate below, on the

cancel each other out.

[2] A referee of this journal raised the issue that if computed prices and market prices are about the same then why do not we restrict ourselves to market prices? Our response is that although the aggregate results may not differ by much and so one can estimate the general rate of profit, the rate of surplus value, *etc.* in terms of market prices. The results for the individual industries, however, may differ and these differences play a significant role in the reallocation of value and surplus value between industries. Furthermore, market prices are superficial and therefore volatile phenomena and one is interested in deriving their more permanent and therefore their fundamental determinants.

basis of input output data for the years 1995 and 2000 direct prices, Sraffian prices, and prices of production in an effort to draw comparisons between them, as well as, with the market prices.

We estimate the labor values (λ), as the sum of direct and indirect labor requirements per unit of output produced for each sector of the economy from the solution of the following system of equations:

$$\lambda = a + \lambda(A + D) \text{ and } \lambda = a(I - A - D)^{-1} \tag{1}$$

where λ is a row vector of labor values, A is a square matrix of input-output coefficients, a is the row vector of adjusted for skills direct labor coefficients, D is the square matrix of depreciation coefficients, and I is the identity matrix. In what follows we scale the so-estimated labor values to prices proportional to values, that is, we equate the sum of values expressed in money terms (direct prices) to the sum of market prices according to the usual condition of the transformation problem.[3] That is,

$$v = \lambda \frac{ex}{\lambda x} \tag{2}$$

where v is the row vector of direct prices, and e is the row unit vector identified with the market prices, the latter being in input-output analysis by definition equal to one (see *e.g.*, Miller and Blair 1985, p. 356), and x is the column vector of gross output. With this normalization the equality between the gross output evaluated in direct prices (vx) to the gross output evaluated in market prices (ex) will always hold. In other words, the normalization of prices maintains the value of money constant.

The Sraffian prices of production S are derived (Pasinetti 1977; Shaikh 1997, *inter alia*) from the solution of the following

[3] The equation of the sum of values in terms of gross output to the sum of gross output evaluated at market prices is just one option routinely used in this kind of analysis. Similar results are obtained using for example the value-added of each sector as the so called "new interpretation" to the transformation problem suggests (Da Silva 1992, p. 156). In the first appendix we cite the results of our empirical exercise using the normalization condition proposed by the "new interpretation" for comparison purposes.

eigenequation:

$$S = Sba + SD + (1+r)SA \tag{3}$$

where r is the normal rate of profit estimated on the circulating capital only and wages are assumed to be paid *ex post*. The Sraffian prices of production are estimated by solving the following eigenequation:

$$S\left(\frac{1}{1+r}\right) = SA\,[I - D - ba]^{-1} \tag{4}$$

The Perron-Frobenious theorem suggests that the maximum eigenvalue of the above equation, $1/(1+r)$, will be the only one associated with a unique positive left-hand eigenvector defined up to a multiplication by a scalar (Pasinetti 1977), which corresponds to the relative equilibrium prices. The so derived left hand side eigenvector is normalized in a way similar to that of labor values, that is,

$$s = S\frac{ex}{Sx} \tag{5}$$

It goes without saying that the condition $sx = ex$ holds. Finally, the prices of production are estimated from:

$$P = PA + PD + Pba + \pi PK \tag{6}$$

The difference from the Sraffian prices is that the rate of profit π is estimated on capital stock K and not on circulating capital. In principle, however, the wages must be paid *ex ante* while we must also account for the circulating capital advanced. Such a treatment, however, requires turnover times for both wages and circulating capital, which we do not have for the case of the Korean economy. These considerations led us to the estimation of the following eigenequation:

$$P(\frac{1}{\pi}) = PK(I - A - D - ba)^{-1} \qquad (7)$$

We know from the Perron-Frobenious theorem that the maximal eigenvalue $(1/\pi)$ corresponds to the rate of profit which is associated with a positive left-hand eigenvector defined up to multiplication by a scalar. We apply our usual normalization condition according to which we have:

$$p = P\frac{ex}{Px} \qquad (8)$$

This ensures that the gross output evaluated in terms of prices of production (*px*) will be equal to gross output evaluated in market prices (*ex*). The results, of direct prices, Sraffian prices and prices of production are displayed in Table 1, together with the usual measures of deviation, *i.e.*, the MAD defined above and the Mean Absolute Weighted Deviation (MAWD), whose difference from the MAD is that the sum of absolute deviations is not simply divided by the number of sectors, but is weighted by the proportion of each industry's output to the total economy's output. The MAWD is certainly more accurate than the MAD, their difference, however, is negligible as the result depicted in the last rows of Table 1 shows.

A common drawback that has been routinely stated in these studies is that both of the above measures of deviation are dependent on the normalization condition. While such a claim is mathematically correct, the empirical findings suggest that all measures of deviation (apart from the correlation coefficients) are not affected in any significant way by the normalization condition.[4] Nevertheless, Steedman and Tomkins (1998) brought this issue to

[4] In fact, in the estimation of various measures of deviation the market prices are equal to one and so they display no variability. Consequently, in a regression between market prices and computed prices, we essentially regress the vector of actual gross output vector against the same output vector multiplied element-by-element by the calculated prices. Since calculated prices are extremely small, relatively to the output vector, then it comes as no surprise that the estimated correlation coefficients are usually found between 90 and 99 percent. Clearly, these are the results of spurious regressions.

TABLE 1

DIRECT PRICES, SRAFFIAN PRICES, AND PRICES OF PRODUCTION, 1995 AND 2000

Industry Number	Labor Values		Sraffian Prices		Prices of Production	
	1995	2000	1995	2000	1995	2000
01	0.93466501	1.1679526	0.71920465	0.85565020	0.92686439	1.14256320
02	0.82255497	0.84848782	0.67822846	0.69110696	0.71844207	0.80324646
03	0.86120729	1.0072212	0.89276223	0.98333220	0.85940584	0.99013964
04	1.10725000	1.089888	1.19448910	1.18956440	1.09161640	1.07654080
05	0.98549385	0.96590819	1.13955710	1.17435460	1.15593110	1.18962190
06	1.11805290	1.1578255	1.06828420	1.16379610	1.01184360	1.10783030
07	0.65185763	0.65116475	0.71749335	0.70214605	0.63880367	0.65624319
08	0.91324490	0.90825311	1.13164560	1.14893280	1.05162190	1.01768770
09	0.97557899	0.98347008	0.98723816	0.99860754	1.19279050	1.34241500
10	0.87447067	0.87455383	1.53380310	1.45905260	1.14767350	1.17061040
11	1.04142970	1.0878520	1.40985340	1.33185940	1.10686180	1.14454630
12	1.00343810	1.0142731	1.28636620	1.27509790	1.01202620	1.00026330
13	0.88356032	0.88383919	1.15660130	1.25677010	0.98391755	0.93516203
14	1.06205770	1.0440173	1.10942340	1.23229460	0.93113542	0.96157416
15	0.98116655	1.0148859	1.32750670	1.41994970	1.31027360	1.38837880
16	1.03238420	1.0295509	1.10379050	1.14406220	1.00522050	1.04166310
17	0.79747530	0.77872335	0.86722136	0.83703781	1.05163780	0.97161560
18	1.04475250	1.0823222	1.07344280	1.04339320	0.92251940	0.96041631
19	0.98502515	1.0413595	0.65630407	0.68463711	0.88559350	0.90106228
20	1.18403270	1.2188635	0.88340748	1.00554830	1.51271210	1.50170470
21	1.08288670	1.1191724	0.89771787	1.01395580	1.21838660	1.31917130
22	0.97237789	0.89963496	0.71532990	0.76857370	0.91648779	0.81587039
23	1.20365280	1.0593082	0.72326880	0.65119331	0.86292672	0.73883764
24	0.79047104	0.74088662	0.64968527	0.57928210	0.62068052	0.56324924
25	1.40640540	1.3655934	0.99612122	0.96907705	1.18722530	1.20125950
26	1.57150390	1.4301481	0.95422172	0.93456735	1.19033910	1.09936830
27	0.98617787	1.1212640	0.68519044	0.87259084	1.24567190	1.24220170
MAD	0.12750071	0.13024355	0.20412476	0.19743813	0.15648352	0.17364479
MDWD	0.13061033	0.14335459	0.21316421	0.21738507	0.15167427	0.18112909
d	0.17912051	0.16433373	0.24071708	0.23003729	0.18962212	0.20327262

attention and suggested the d statistic as an alternative measure of deviation defined as $d=[2(1-cos\theta)]^{1/2}$, where θ is the angle between the two vectors under comparison. The d statistic, possesses an advantage over the MAD and the MAWD measures of deviation that it does not depend on the normalization condition, one does not expect to find qualitatively different results from the other measures of deviation. The results of the d statistic, along with the MAD and the MAWD are displayed in the last three rows of Table 1.

The proximity of values, Sraffian prices and prices of production to actual prices, ensures that the various economic categories usually estimated in market prices will not be far-off from those estimated in values or in equilibrium prices. Below we provide estimates of the rate of surplus-value, rate of profit and simple capital intensity (composition of capital) and we observe that their differences, when estimated at various prices, are minimal. More specifically, the rate of surplus-value (s') in value terms, as well as in terms of Sraffian prices, prices of production, and market prices is given by the respective formulae:

$$s'_v = \frac{1-\lambda b}{\lambda b}, \quad s'_s = \frac{s(I-A-D-ba)x}{sbax},$$

$$s'_p = \frac{p(I-A-D-ba)x}{pbax}, \quad s'_e = \frac{e(I-A-D-ba)x}{mbax} \tag{9}$$

where λb is the labor embodied in the basket of wage goods normally consumed by workers, whereas sb, pb, and eb are the wage goods evaluated in terms of Sraffian prices, prices of production and market prices, respectively. The rate of profit in different type of prices is estimated as follows:

$$r_v = \frac{v(I-A-D-ba)x}{vKx}, \quad r_s = \frac{s(I-A-D-ba)x}{sKx},$$

$$r_p = \frac{p(I-A-D-ba)x}{pKx}, \quad r_e = \frac{e(I-A-D-ba)x}{eKx}, \tag{10}$$

Simple compositions of capital (cc) in terms of values, Sraffian prices, prices of production, and market prices will be respectively:

$$cc_v = \frac{vK[I-A-D]^{-1}x}{vbax}, \quad cc_s = \frac{sK[I-A-D]^{-1}x}{sbax},$$

TABLE 2
FUNDAMENTAL VARIABLES ESTIMATED IN DIFFERENT TYPE OF PRICES

Variables	Market Prices		Values or Direct Prices		Sraffian Prices		Prices of Production	
	1995	2000	1995	2000	1995	2000	1995	2000
Rate of Profit	12.3%	11.6%	13.1%	13.6%	12.4%	11.1%	12.3%	13.3%
Rate of Surplus-Value	72.4%	73.9%	82.0%	84.0%	91.1%	92.8%	81.3%	86.3%
Composition of Capital	6.30	6.36	6.22	6.14	8.50	8.30	6.60	6.44

$$cc_p = \frac{pK[I-A-D]^{-1}x}{pbax}, \quad cc_e = \frac{eK[I-A-D]^{-1}x}{ebax}, \tag{11}$$

The estimates of the above fundamental variables are given in the Table 2.

The closeness of the various estimated prices to the actual ones indicates that the usual economic variables can be expressed (for practical purposes) in market prices without problems in identifying their possible trends in the economy.

III. The Wage-Profit Rate Frontiers for the Korean Economy, 1995 and 2000

The difference between labor values and prices of production raised the question whether or not choices made in terms of one set of prices will be different in terms of another set of prices (Steedman 1977). In this analysis, however, it is assumed that the wage-profit rate (henceforth, $w-r$) frontier which represents the technique in use displays many curvatures, which makes possible the existence of at least two switch points. For the estimation of the $w-r$ curves we assumed firstly the Sraffian model and the case of circulating capital, since most of the arguments for the estimation of $w-r$ curves and the associated with these reswitching of techniques are carried out in terms of circulating capital, an approach which stems from the commonly held view that the treatment of capital stock is theoretically problematic and empirically very difficult to measure. Thus we begin with the Sraffian prices and by taking into account that the money wage is equal to the basket of wage goods evaluated in these prices (*i.e.*, $w=sb$) and after substitution and some manipulation in (3) we get:

$$s[I-D-(1+r)A]=wa \quad \text{or} \quad s=wa[I-D-(1+r)A]^{-1} \tag{12}$$

Postmultiplying (12) by x (the column vector of the gross output of each sector) and with the usual normalization $sx=ex$, we arrive at the $w-r$ relation in the case of circulating capital model, which one usually finds in the Sraffian literature:

$$w=\frac{ex}{a[I-D-(1+r)A]^{-1}x} \tag{13}$$

If we now consider one of the variables, for example the rate of profit, as the independent one and we assign to it different hypothetical prices starting from zero, which corresponds to the maximum wage, up until we reach the maximum rate of profit, that is the rate of profit that corresponds to zero wage, we can generate the $w-r$ curve. Such a curve, of course, conveys the effects of 27 sectors and mathematically speaking has as many curvatures as the number of sectors minus one. Two such curves are depicted on the upper part of Figure 2 and refer to the Korean economy for the years 1995 and 2000, respectively. We observe that the $w-r$ frontiers for these two years are in fact non-linear, but their curvatures are not far from the linear trend. The shape of curves is such that excludes the case of reswitching as a realistic possibility for the total economy.

A similar picture is obtained in the next pair of graphs of the lower part of Figure 2, which refers to the $w-r$ frontiers of the Korean economy for the years 1995 and 2000 in the case of prices of production. These curves were estimated in a way similar to that of the circulating capital model. More specifically, we begin with the formula, of prices of production (6), and by equating the wage rate to the basket of goods that comprise the real wage evaluated in terms of the prices of production (*i.e.*, $w=pb$) we get:

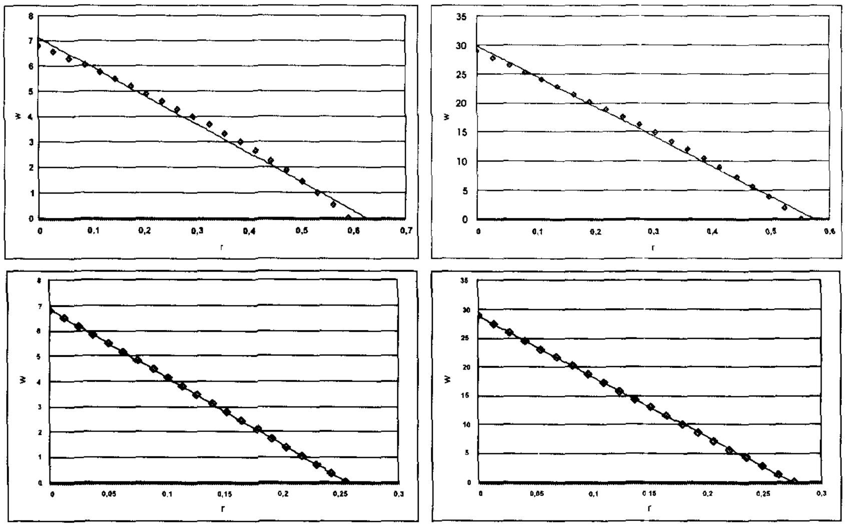

FIGURE 2
WAGE-PROFIT FRONTIER OF THE KOREAN ECONOMY, 1995 AND 2000

$$p[I-A-D-rK]=wa \quad \text{or} \quad p=wa[I-A-D-rK]^{-1} \tag{14}$$

Post-multiplying (14) by x and invoking the normalization condition $px=ex$, we arrive at the $w-r$ relation:

$$w=\frac{ex}{a(I-A-D-rK)^{-1}x} \tag{15}$$

In this case we observe that the $w-r$ "curve" is indistinguishable from a linear $w-r$ curve, which means that the alternative techniques either must be in the interior of the $w-r$ curve or they can cross the $w-r$ curve only at one point at the most.

We showed that value magnitudes do not differ significantly from the prices of production or Sraffian prices. Consequently, choices that are being made in terms of values should not differ from those made in terms of equilibrium prices (prices of production or Sraffian prices). Moreover, while it is true that the mathematical structure of the problem allows the theoretical possibility of many curvatures in the $w-r$ curve (and, therefore, the Sraffian plea is absolutely justified from a strictly mathematical viewpoint), from a practical viewpoint, however, such a possibility of reswitching is not likely to occur. The shape of the $w-r$ curves is *quasi* linear, a result which has been observed in the economies of West Germany (Krelle 1977), the U.S. economy (Ochoa 1984; Leontief 1985; Shaikh 1997), Brazil (Da Silva 1992) and Greece (Tsoulfidis and Maniatis 2002). Furthermore, in the Korean economy in the case of circulating capital technology there will be only one switch point taking place at a rate of profit very close to the maximum rate of profit. On the other hand, in the case of capital stock and prices of production the $w-r$ frontier of the year 1995 is in the interior of the $w-r$ profit curve of the year 2000, which implies the fact that the 1995 technology is not considered as an alternative in the year 2000 at any $w-r$ combination. Alternatively, the technological change from the year 1995 to 2000 was so rapid that it rendered the switching (let alone the reswitching) of techniques impossible.

IV. Concluding Remarks

Our empirical investigation for the economy of Korea gave results similar to those of other countries. More specifically, we found that labor values constitute extremely good approximations of observed prices. In fact, we found them to be closer to market prices than the equilibrium prices either in their Sraffian or their Marxian version of prices of production. This result indicates that the so called "transformation problem" has no empirical significance. All kinds of estimated prices were very close to each other and to actual prices as this can be judged by their measures of deviation. These results encourage us to characterize our findings as stylized facts of capitalist economies. Although major economic variables such as the rate of profit, the rate of surplus value, the composition of capital, *etc.* which in principle must be estimated in terms of values or prices of production, the available data do not allow on an annual basis and so it is impossible to generate time series data in terms of values or prices of production. The proximity of market prices to values or prices of production, however, ascertains that the measurement of the above variables in terms of market prices does not distort their underlying log-run tendencies. Furthermore, our analysis of the $w-r$ curves showed that choices made in one set of prices cannot change in another set of prices. The results of the analysis suggest that the labor theory of value possesses the features of a powerful microeconomic theory with high predictive capacity of the observed phenomena and, therefore, it can be used to lay bare the dynamics that are being developed in modern economies.

Future research efforts could enrich this line of research by using more disaggregating input-output data and carrying the analysis at a more concrete level so as to include taxes which certainly affect the prices of production for they reduce the rate of profit and, therefore, one expects them to come even closer to market prices. In addition, the inclusion of turnover times across industries will make possible the treatment of circulating capital advanced which includes the materials and wages advanced. Finally, in the estimation of prices of production, the rate at which capital stock is utilized is also important and, therefore, must also be accounted for. If all these requirements for the complete estimation of prices of production are fulfilled, then we expect that labor values (direct prices) can be treated as a center of gravity for market prices and prices of production are on the one hand closely related to labor values and on the other hand constitute a much more concrete center of gravity of market prices.

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Appendix 1. Estimates According to "New Interpretation"

Since the early 1980s a growing literature around the transformation problem has suggested a new interpretation according to which one should be interested in maintaining the equality between the sum of prices of production and the sum of values in terms of net output (value-added) and not gross output as traditionally has been hypothesized. Despite the fact that after the publication of the seminal article by Liepietz (1982) the immediate reaction (*e.g.* Flaschel 1984) pointed out that this new interpretation had to be tested empirically, little research to this direction has been carried out. In this appendix we put to empirical testing the new interpretation in an effort to compare it with the results that we cite in the main text. If by y we symbolize the net output then

APPENDIX TABLE 1

DIRECT PRICES, SRAFFIAN PRICES, AND PRICES OF PRODUCTION, 1995 AND 2000

Industry Number	Labor Values		Sraffian Prices		Prices of Production	
	1995	2000	1995	2000	1995	2000
01	0.91145534	1.1489487	0.77691128	0.9392917	0.94850285	1.1932613
02	0.80212932	0.83468197	0.73264741	0.75866403	0.73521485	0.83888828
03	0.83982177	0.99083254	0.96439459	1.0794549	0.87946948	1.0340743
04	1.0797546	1.0721543	1.2903309	1.3058467	1.1171011	1.1243093
05	0.96102209	0.95019177	1.2309915	1.2891501	1.1829174	1.2424081
06	1.0902891	1.1389863	1.1539997	1.2775594	1.0354658	1.1569872
07	0.63567062	0.64056957	0.77506265	0.7707822	0.65371709	0.68536215
08	0.89056726	0.8934748	1.2224454	1.2612433	1.0761731	1.0628448
09	0.95135327	0.96746791	1.0664508	1.0962234	1.2206372	1.4019809
10	0.85275594	0.86032385	1.6568707	1.6016778	1.1744671	1.222553
11	1.015569	1.0701514	1.5229757	1.4620512	1.1327027	1.1953323
12	0.97852066	0.99776975	1.3895802	1.3997412	1.0356529	1.0446472
13	0.86161966	0.86945813	1.2494032	1.3796219	1.0068879	0.97665724
14	1.0356846	1.0270299	1.1984399	1.3527538	0.95287356	1.0042413
15	0.95680222	0.99837252	1.4340217	1.5587526	1.3408633	1.4499842
16	1.006748	1.0127989	1.1923551	1.2558965	1.0286883	1.087884
17	0.77767211	0.76605265	0.93680409	0.91885991	1.076189	1.0147283
18	1.0188092	1.0647116	1.1595725	1.145387	0.94405648	1.0030321
19	0.96056482	1.0244154	0.70896364	0.75156174	0.90626839	0.94104442
20	1.1546309	1.1990312	0.95428934	1.1038426	1.5480278	1.5683387
21	1.0559964	1.1009622	0.9697479	1.113072	1.246831	1.3777059
22	0.94823189	0.88499688	0.77272583	0.8437033	0.93788413	0.85207237
23	1.1737636	1.0420721	0.78130149	0.71484874	0.88307247	0.77162151
24	0.77084193	0.72883155	0.70181387	0.63590807	0.63517082	0.58824186
25	1.3714816	1.3433737	1.076047	1.0638062	1.2149423	1.25456226
26	1.5324801	1.406878	1.0307852	1.0259231	1.2181285	1.1481497
27	0.961689	1.1030198	0.74016787	0.95788832	1.2747532	1.2973209
MAD	0.12868478	0.12487072	0.22442368	0.2400184	0.16497031	0.19372066
MAWD	0.15364767	0.16206557	0.22099681	0.23343100	0.16641239	0.20896953
d	0.17912051	0.16433373	0.24071708	0.23003729	0.18962212	0.20327262

values are normalized as follows $vy=ey$, which means that the value of money will be $m=\lambda y/ey$ and will be held constant. We may proceed in a similar fashion with Sraffian prices and prices of production. The results of the normalization according to the new interpretation are presented in the Appendix Table 1. The last three rows of the table contain the different measures of deviation, which show that the new normalization leads to similar results.

With results such as the above it comes as no surprise that the estimates of the value composition of capital, the rate of profit and the rate of surplus value for the total economy are extremely close to those estimated when gross output was used in the normalization condition.

Appendix 2. A Note on the Data and Their Source

The input output tables for the years 1995 and 2000 are from the Bank of Korea (http://www.bok.or.kr) in three levels of industry detail, small (27 industries), medium (67 industries), and large (200+ industries). Although, we would like to work with input-output tables of higher industry detail, nevertheless, data limitations on sectoral employment, wages, depreciation, and capital stock restricted the analysis to 27 industries level of detail (see below for the industry nomenclature). In this classification, non-productive sectors, such as for example the real estate (a fictitious sector) and the public administration (whose output is really the wages of workers employed) are also included. As Shaikh (1997) points out, the distinction between productive and non-productive labor does not seem to play any significant role in the formation of individual prices of production and, therefore, the distinction although extremely important for other issues, insofar as the problem at hand is concerned can be safely left aside.

The matrix of input-output coefficients, A, is obtained for both years of our analysis by dividing element-by-element the inputs of each industry by its total input row 35 or column 38 listed as Gross Domestic Output (see below for the classification of industries).

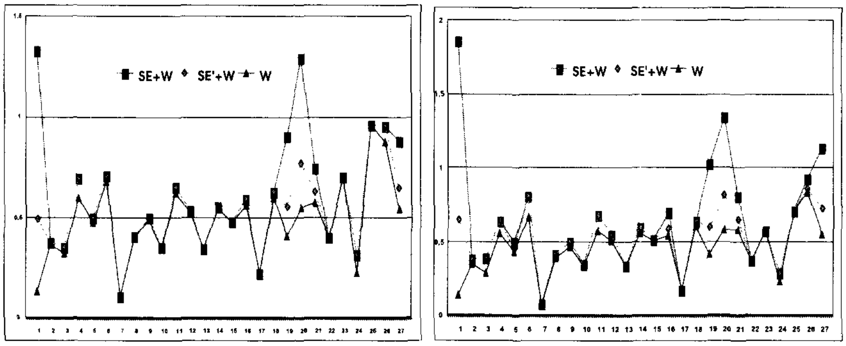
Since there is no matrix of capital stock coefficients, K, published for the Korean economy, we had to create one from the available data. To this end we used the published fixed capital flow matrices companions of input-output tables of the years 1995 and 2000. This matrix allocates the gross fixed capital formation of each industry to itself and others. We use this matrix to form weights, assuming - in the absence of an actual capital stock matrix - that capital stock is allocated among producing industries in a way similar to that of gross investment. A gross capital stock vector corresponding to the 27 input-output industry detail is fortunately published by Shin (2005). This vector was allocated to each industry according to the weights that we formed with the fixed capital formation.

Depreciation coefficients are directly provided by the Bank of Korea and they are derived through the fixed capital flow matrices companions of the input-output data for the years 1995 and 2000. The depreciation coefficients matrix D is derived in a way similar to that of the input-output coefficients of matrix A.

The vector of direct labor coefficients a is estimated in the following way:

$$a=\left(\frac{L}{x}\right)_j \left(\frac{w_j}{w_{\min}}\right) \quad \text{(A.1)}$$

where L is the employment in sector j, x is the gross product, w_j is the wage of each sector while $w_{\min}$ is the minimum wage of the total economy. We used data for the total wages of each sector from the input-output table of the Korean economy, in other words, we used the product $L_j w_j$. The trouble with this estimation is that the self-employed population (by no means a small figure) is not accounted for. For this purpose we multiplied the product $L_j w_j$ by the index of the self-employed of each industry that we calculated as the ratio of the total employed population (wage earners and the self-employed population) to the number of the wage earners. The overall result of this multiplication gives us, in principle, the total wages of each sector of the economy and the wage equivalent of the self-employed population. In an economy such as Korea's self-employment is widespread especially in the agricultural sector as one can see in Appendix Figure 1 below. We, therefore, tried various alternative scenarios, all of which gave qualitatively similar results with regard to our estimates. More specifically, three of these alternative scenarios for both years of our analysis are depicted in Appendix Figure 1, where we present the sectoral wage data - without the wage equivalent of the self-employed population - as a share in total value added (line W, in Appendix Figure 1). However, we think that a more accurate estimation of the economic



APPENDIX FIGURE 1
ALTERNATIVE SCENARIOS OF THE SHARE OF SELF-EMPLOYED AND THE SHARE OF WAGES IN VALUE-ADDED, 1995 AND 2000

categories that we are interested in requires the inclusion of the total labor time, so self-employment must be accounted for. Thus, we estimated the total wages of each sector as the sum of the wages of the employed population plus the product of the wage equivalent times the number of the self-employed in each of the 27 sectors of our analysis. The so derived total wages of each sector is divided by the respective value-added and the results are depicted in Appendix Figure 1 (line $SE+W$). An inspection of the graph reveals that in agriculture there has been an obvious over-estimation of the employment and the same is also true for sectors 19, 20, 21, and 27. In all other sectors we observe that when we estimate the wage equivalent of self-employed there is a reasonable increase in the share of wages in the value-added of the sector (with the exception of sectors 1, 19, 20, 21, and 27). Furthermore, there is no change in the order of sectors, which means that self-employment is approximately proportional to employment and so are the total wages as a share in the value added.

Focusing on the problematic sectors, we observe that in agriculture the wage share in value-added, when the self-employed are accounted for is 1.8 times greater than the value added. Such a result, which is common in sectors 19, 20, 21, and 27, is unacceptable for consistency reasons and so we opted to consider only one-third of the self-employed in these sectors as full time employment or what amounts to the same thing, we assumed that the same number of self-employed worked only one-third of the

APPENDIX TABLE 2

INPUT OUTPUT NOMENCLATURE

01	Agriculture, forestry, and fisheries
02	Mining and quarrying
03	Food, beverages, and tobacco
04	Textile products and leather products
05	Wood and paper products
06	Printing, publishing, and reproduction of recorded media
07	Petroleum and coal products
08	Chemicals and allied products
09	Nonmetallic mineral products
10	Primary metal products
11	Fabricated metal products
12	General machinery and equipment
13	Electronic and other electric equipment
14	Precision instruments
15	Transportation equipment
16	Furniture and other manufacturing products
17	Electric, gas, and water services
18	Construction
19	Wholesale and retail trade
20	Eating and drinking places, and hotels and other lodging places
21	Transportation and warehousing
22	Communications and broadcasting
23	Finance and insurance
24	Real estate and business service
25	Public administration and defense
26	Educational and health service
27	Social and other services
28	Dummy sector
29	Total intermediate input
30	Compensation of employees
31	Operating surplus
32	Depreciation of fixed capital
33	Indirect taxes (Less subsidies)
34	Total value added
35	Total input
36	Scrap

time during the year, which is not an unreasonable assumption for this type of sectors.

In order to account for the differences in skills across sectors we divided the so derived total wages of each sector by the minimum wage of the economy. The latter figure was divided by the output produced of each sector and we got the adjusted labor coefficients a, that now express labor in terms of minimum dexterity and intensity, that is to say, simple labor. This reduction of course is only meaningful when the relative wages express with precision the differences in skills and intensity of labor that is employed in each sector of the economy.

Finally, the real wage vector, b, is estimated by transforming the personal consumption expenditures data to a set of relative weights. This is obtained by dividing each industry's consumption with the economy's total consumption. The so derived vector is multiplied by the minimum wage of the economy.

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