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The Rate of Profit in the Greek Economy 1988-1997. An Input-Output Analysis*

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ABSTRACT

The evolution of the rate of profit reflects both changes in income distribution and technical conditions of production. The purpose of this paper is to present estimates of the rate of profit for the Greek economy using input-output data spanning the period 1988-1997 and, at the same time, to decompose the evolution of the rate of profit to its constituent components. These estimations are carried out in terms of (i) market prices; (ii) labour values; and (iii) prices of production.

Keywords: Greek Economy, Rate of Profit, Profit-Wage Ratio, Productivity of Labour and Capital, Input-Output Analysis

JEL classification: B24, B51, C67, D30, D57, E11

1. Introduction

The rate of profit is the most important variable of an economy for it regulates the rhythm of capital accumulation and the growth rate. The rate of profit can be decomposed into two other important economic variables, the profit-wage ratio and capital productivity. The profit-wage ratio is inversely related to the share of wages in the net product, which is equivalent to saying that the profit-wage ratio depends inversely on money wage and directly on labour productivity, whereas capital productivity is inversely related to capital intensity. Consequently, the evolution of the rate of profit reflects both the changes in income distribution as well as the technical conditions of production. This paper presents estimates of the rate of profit of the Greek economy using input-output data spanning the period 1988-1997 and, at the same time, decomposes the evolution of the rate of profit to its constituent components. These estimations are carried out in terms of (i) market prices; (ii) labour values; and (iii) prices of production.

The remainder of the paper is organized as follows: Section 2 describes the way in which the decomposition model is applied to the available input-output tables.[1] Section 3 presents and critically evaluates the results of the analysis. Finally, Section 4 concludes and makes some remarks about future research efforts.

2. The Analytic Framework

We begin with by assuming a linear model of production where n commodities are being produced by n single-product sectors. We further suppose that homogeneous labour is the only primary input and there is only circulating capital. Labour is not an input to the household sector. The net product is distributed to profits and wages which are paid in the beginning of the common production period and there are no

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savings out of this income. All commodities are "basic" *à la* Sraffa (1960, §6) and there are no alternative techniques. The system is productive, *i.e.*, the Perron-Frobenius (henceforth P-F) eigenvalue of the nxn matrix of input-output coefficients, **A**, is less than one. Finally, the givens in our analysis are (i) the technical conditions of production, that is the pair $[\mathbf{A},\mathbf{a}]$, where $\mathbf{a}$ is the $1xn$ vector of direct labour coefficients; (ii) the real wage rate, which is represented by the $nx1$ vector $\mathbf{b}$; (iii) the gross output, which is represented by the $nx1$ vector $\mathbf{X}$; and (iv) the market prices of produced commodities, which are represented by the $1xn$ vector $\mathbf{p}$.

From the above it follows that the vector of the net product, $\mathbf{Y}$, equals $\mathbf{X}-\mathbf{AX}$, and the total quantity of employed labour, L, equals $\mathbf{aX}$. In addition, the profit-wage ratio, Π, and the rate of profit, r, of the system can be estimated in terms of (i) market prices; (ii) quantities of "embodied" labour, *i.e.*, labour values; and (iii) prices of production. As a consequence, we have:[2]

(i) Total profits, P, equal $\mathbf{pY}-wL$, whereas total money wage, W, equal wL, where w $(=\mathbf{pb})$ is the money wage rate. Thus, we may write

$$\Pi \equiv P/W = (\mathbf{pY}-wL)/wL = (\pi_L/w)-1 \qquad (1)$$

where π_L $(\equiv \mathbf{pY}/L)$ is the labour productivity. From equation (1) it follows that Π is a strictly increasing function of π_L and a strictly decreasing function of w. More specifically, we have:

$$\Delta\Pi > (<)0 \Leftrightarrow \hat{\pi}_L > (<)\hat{w} \qquad (2)$$

where Δx symbolizes the period to period change in a variable x, and $\hat{x} \equiv \Delta x/x$. The rate of profit in a circulating capital model is written as follows:

$$r \equiv P/(K+W) = \Pi/[(K/\mathbf{pY})(\mathbf{pY}/W)+1] = \Pi/\{[(1+\Pi)/\pi_K]+1\} \qquad (3)$$

where K (or $\mathbf{pAX}$ in matrix terms) represents the money value of the means of production, and π_K $(\equiv \mathbf{pY}/K)$ is the net product-capital ratio or the capital productivity. Finally, K/W is the capital-wages ratio, which can be further written as $(1+\Pi)/\pi_K = k/w$, where k $(\equiv K/L = \pi_L/\pi_K)$ is the index of capital intensity. From (2) and (3) it follows that r is a strictly increasing function of π_L and π_K, and a strictly decreasing function of w.

(ii) The vector of labour values, $\mathbf{v}$, is determined by the system:

$$\mathbf{v} = \mathbf{vA}+\mathbf{a} \qquad (4)$$

Consequently, $\mathbf{v}=\mathbf{aB}$, where $\mathbf{B}$ $(\equiv[\mathbf{I}-\mathbf{A}]^{-1})$ is the Leontief inverse. Given that $\mathbf{vY}=\mathbf{aB}[\mathbf{I}-\mathbf{A}]\mathbf{X}=L$, it follows that $\pi_L=1$ and $\Pi=(1/\mathbf{vb})-1$. As a result Π, that now expresses the Marxian 'rate of surplus value', changes inversely with respect to the labour value of the real wage rate, $\mathbf{vb}$, whereas the change in the latter can be split up as follows:

$$\Delta(\mathbf{vb}) = (\Delta\mathbf{v})\mathbf{b}+\mathbf{v}(\Delta\mathbf{b})+(\Delta\mathbf{v})(\Delta\mathbf{b}) \qquad (5)$$

and $\Delta\mathbf{v}$ can be further decomposed as

$$\Delta\mathbf{v} = (\Delta\mathbf{a})\mathbf{B}+\mathbf{a}(\Delta\mathbf{B})+(\Delta\mathbf{a})(\Delta\mathbf{B}) \qquad (6)$$

Finally, the rate of profit expressed in terms of labour values is estimated from the following equation:

$$r = [(1/\mathbf{vb})-1]/[(1/\mathbf{vb})(\mathbf{vAX}/L)+1] \qquad (7)$$

where $L/\mathbf{vAX}$ is the capital productivity in terms of labour values, and $\mathbf{vAX}/\mathbf{vb}L$ is the capital-wages ratio in terms of labour values or the Marxian "value composition of capital".

(iii) Prices of production, $\mathbf{p}^*$, and the rate of profit are estimated from the following eigenequation:

$$\mathbf{p}^* = \mathbf{p}^*\mathbf{C}(1+r) \qquad (8)$$

where $\mathbf{C}$ ($\equiv \mathbf{A}+\mathbf{ba}$) is the nxn matrix of the "augmented" input-output coefficients, *i.e.*, each coefficient represents the sum of the respective material and wage good input per unit of output, and r is now the uniform rate of profit. Consequently, $\mathbf{p}^*$ is the left hand side P-F eigenvector of the matrix $\mathbf{C}$, and

$$r = \lambda^{-1} - 1 \qquad (9)$$

where λ is the P-F eigenvalue of $\mathbf{C}$. Finally, relations (1) and (3) hold in terms of prices of production, whereas r can be expressed in terms of the rate of surplus value as follows: Let $\mathbf{q}^*$ be the right hand P-F eigenvector of $\mathbf{C}$, that is, $\lambda\mathbf{q}^* = \mathbf{Cq}^*$. Pre-multiplying the last relation by the row vector $\mathbf{v}$, and by invoking (9), gives

$$r = [(1/\mathbf{vb})-1]/[(1/\mathbf{vb})(\mathbf{vAq}^*/\mathbf{aq}^*)+1] \qquad (10)$$

where $\mathbf{aq}^*/\mathbf{vAq}^*$ is the capital productivity (in terms of labour values) in the system that produces $\mathbf{q}^*$ as gross output, known as Charasoff's "Standard system", and $\mathbf{vAq}^*/\mathbf{vbaq}^*$ is the value composition of capital in the same system.[3]

3. Results and their Evaluation

The results from the application of the relations (1) - (10) to the input-output tables of the Greek economy during the period 1988-1997 are displayed in Tables 1 through 4.

Table 1 gives the evolution of the money wage rate, labour productivity, profit-wage ratio, capital productivity, capital intensity, capital-wages ratio and rate of profit in terms of market prices.

Table 1. Fundamental variables in terms of market prices

Years	w	π_L	Π	π_K	k	k/w	r
1988	0.872	1.474	0.690	1.100	1.340	1.537	0.272
1989	1.104	1.881	0.704	1.105	1.703	1.542	0.277
1990	1.144	1.944	0.699	1.107	1.756	1.536	0.276
1991	1.553	2.791	0.797	1.168	2.390	1.539	0.314
1992	1.560	3.035	0.946	1.183	2.566	1.645	0.358
1993	1.654	2.864	0.732	1.316	2.177	1.316	0.316
1994	2.015	3.676	0.824	1.252	2.936	1.457	0.335
1995	2.127	3.740	0.758	1.245	3.005	1.413	0.314
1996	2.316	4.077	0.760	1.264	3.225	1.392	0.318
1997	2.172	3.854	0.774	1.314	2.934	1.351	0.330

On the basis of Table 1 we derive the following conclusions: (i) The profit-wage ratio follows a rather upwards trend, which is relatively stronger in the sub-period 1988-1992, and weaker in the sub-period 1993-1997. In fact, we tried to fit the following trend line $y = a + b\ln t$ in the profit-wage ratio data of Table 1, and the OLS results for the period 1988-1997 gave us $a = 0.700$, $b = 0.046$, $c.c. = 0.439$, where $c.c.$ is the "correlation coefficient". When we tried the same regression for the two sub-periods, we got $a = 0.643$, $b = 0.130$, $c.c. = 0.760$ for the sub-period 1988-1992, whereas we got $a = 0.758$, $b = 0.012$, $c.c. = 0.217$ for the sub-period 1993-1997.[4] The profit-wage ratio falls in the years 1990, 1993 and 1995, whereas it rises in the remaining years. In the years 1990 and 1995 we observe that the money wage rate, w, increases together with the labour productivity, π_L, whereas in the year 1993 the increase in w is associated with a decrease in π_L. With the exception of the year 1997, where w decreases, every increase in Π is associated with an increase in w and π_L. (ii) With the exception of the year 1993, k moves in tandem with w. (iii) The rate of profit always moves in the same direction with the profit-wage ratio. However, the rate of profit does not always move in the same direction with the capital productivity or in the opposite direction to the capital-wages ratio.

Table 2 gives the evolution of the profit-wage ratio, capital productivity, capital-wages ratio and rate of profit in terms of labour values.

Table 2. Fundamental variables in terms of labour values

Years	Π	π_K	k/w	r
1988	0.573	0.922	1.707	0.212
1989	0.598	0.934	1.711	0.220
1990	0.587	0.911	1.741	0.214
1991	0.649	0.965	1.709	0.240
1992	0.718	0.940	1.829	0.254
1993	0.588	1.052	1.511	0.234
1994	0.639	0.982	1.669	0.239
1995	0.584	1.020	1.553	0.229
1996	0.616	1.052	1.536	0.243
1997	0.611	1.047	1.538	0.241

On the basis of Table 2 we derive the following conclusions: (i) The profit-wage ratio follows a rather upwards trend, which is relatively stronger in the sub-period 1988-1992 and weaker in the sub-period 1993-1997. The OLS regression $y = a + b\ln t$ gives $a = 0.592$, $b = 0.016$, $c.c. = 0.272$ (for the period 1988-1997), $a = 0.552$, $b = 0.076$, $c.c. = 0.812$ (1988-1992), and $a = 0.600$, $b = 0.008$, $c.c. = 0.227$ (1993-1997). The profit-wage ratio falls in the years 1990, 1993, 1995 and 1997, whereas it rises in the remaining years. The sources of these changes can be determined on the basis of the results derived from equations (5) and (6), and are displayed in Table 3. Thus, the rise in the profit-wage ratio in the years 1989, 1991, 1992 and 1996 comes from the positive effect attributed to $\mathbf{a}$, $\mathbf{B}$, which more than compensates the negative effect that is caused by the changes in $\mathbf{b}$. The rise in the profit-wage ratio in the year 1994 comes from the change in $\mathbf{a}$, which negates the negative effects that are exerted from the changes in $\mathbf{b}$ and $\mathbf{B}$. Thus, we come to the conclusion that every rise in Π is connected to $\mathbf{v}(\Delta\mathbf{b}) > 0$. On the other hand, the fall in the year 1990 is attributed to the change in $\mathbf{b}$. The fall in the year 1993 is attributed to the changes in $\mathbf{b}$ and $\mathbf{a}$. As for the fall in the year 1995, we observe that this is attributed to the changes in $\mathbf{b}$ and $\mathbf{B}$. Finally, the fall in 1997 is attributed to the changes in $\mathbf{a}$ and $\mathbf{B}$.[5] (ii) The money wage rate w $(= \mathbf{vb} = 1/(1+\Pi))$ moves in tandem with k $(= 1/\pi_K)$ during the sub-periods 1989-1991 and 1996-1997. (iii) The rate of profit always moves in the same direction with the profit-wage ratio. However, the rate of profit does not always move in the same direction with the capital productivity or in the opposite direction to the value composition of capital.

Table 3. Decomposition of the profit-wage ratio in terms of labour values

Years	Δ(**vb**)	(Δ**v**)**b**	**v**(Δ**b**)	(Δ**v**)(Δ**b**)	(Δ**a**)**Bb**	**a**(Δ**B**)**b**	(Δ**a**)(Δ**B**)**b**
1989	-0.010	-0.138	0.164	-0.036	-0.135	-0.003	0.0001
1990	0.004	-0.016	0.020	-0.0002	-0.010	-0.007	0.0010
1991	-0.023	-0.185	0.227	-0.065	-0.178	-0.010	0.0030
1992	-0.024	-0.029	0.006	-0.001	-0.007	-0.022	0.0002
1993	0.047	0.022	0.028	-0.002	0.026	-0.004	-0.0005
1994	-0.020	-0.125	0.129	-0.024	-0.126	0.00005	0.0008
1995	0.021	-0.021	0.045	-0.003	-0.044	0.026	-0.0030
1996	-0.013	-0.061	0.054	-0.006	-0.046	-0.015	-0.0001
1997	0.002	0.064	-0.052	-0.010	0.055	0.007	0.0020

Table 4 gives the evolution of the money wage rate, labour productivity, profit-wage ratio, productivity of capital, capital intensity, capital-wages ratio and rate of profit in terms of prices of production. In the same Table, in the last two columns, we also show the capital productivity, in terms of labour values, and the value composition of capital, respectively, in Charasoff's "Standard system".

Table 4. Fundamental variables in terms of prices of production

Years	w	π_L	Π	π_K	k	k/w	r	$\mathbf{aq}^* / \mathbf{vAq}^*$	$\mathbf{vAq}^* / \mathbf{vbaq}^*$
1988	0.826	1.294	0.566	0.933	1.387	1.679	0.212	0.920	1.710
1989	1.050	1.673	0.593	0.945	1.770	1.686	0.221	0.937	1.706
1990	1.087	1.730	0.592	0.929	1.863	1.714	0.218	0.939	1.691
1991	1.503	2.485	0.653	0.982	2.530	1.683	0.244	0.989	1.667
1992	1.550	2.738	0.766	0.991	2.763	1.782	0.275	1.069	1.607
1993	1.609	2.555	0.588	1.067	2.396	1.489	0.236	1.067	1.488
1994	1.915	3.204	0.673	1.014	3.161	1.651	0.254	1.081	1.516
1995	2.063	3.273	0.586	1.024	3.196	1.549	0.230	1.030	1.538
1996	2.243	3.642	0.624	1.066	3.419	1.525	0.247	1.082	1.494
1997	2.045	3.292	0.610	1.036	3.178	1.554	0.239	1.033	1.560

On the basis of Table 4 we derive the following conclusions: (i) The profit-wage ratio follows a rather upwards trend, which is relatively stronger in the sub-period 1988-1992, and weaker in the sub-period 1993-1997. The OLS regression $y = a + b\ln t$ gives $a = 0.590$, $b = 0.024$, $c.c. = 0.293$ (1988-1997), $a = 0.537$, $b = 0.101$, $c.c. = 0.801$ (1988-1992), and $a = 0.612$, $b = 0.004$, $c.c. = 0.0779$ (1993-1997). The profit-wage ratio falls in the years 1990, 1993, 1995 and 1997, whereas for the remaining years it rises together with its constituent components w and π_L. In the years 1990 and 1995 we observe an increase in w and π_L, in 1993 the increase in w is associated with a decrease in π_L, whereas in 1997 we observe a decrease in w and π_L. (ii) With the exception of the year 1993, k moves in tandem with w. (iii) The rate of profit always moves in the same direction with the profit-wage ratio, the rate of surplus value (see Table 2) and, with the exception of the year 1990, the capital productivity in Charasoff's "Standard system". However, the rate of profit does not always move in the same direction with the capital productivity of the economy or in the opposite direction to the capital-wages ratio of the economy and the value composition of capital in Charasoff's "Standard system".

Table 5. Correlation coefficients

	Π^1	Π^2	Π^3	r^1	r^2	r^3
Π^1	-					
Π^2	0.951	-				
Π^3	0.964	0.988	-			
r^1	0.895			-		
r^2		0.802		0.952	-	
r^3		0.907	0.923	0.941	0.949	-

Finally, from Tables 1, 2 and 4 we derive that, with the exception of the year 1997, the three profit-wage ratios and the three rates of profit move together (see also Table 5, which gives the correlation coefficients of linear regressions between the profit-wage ratio and the rate of profit evaluated in different price systems; superscripts 1, 2 and 3 refer to market prices, labour values and prices of production, respectively).

4. Concluding Remarks

It has been shown that, regardless of the way in which the profit-wage ratio and the rate of profit are being evaluated in the Greek economy during the period 1988-1997, the two variables under question move in tandem and they follow rather rising trends, which are relatively stronger in the sub-period 1988-1992, and weaker in the sub-period 1993-1997. However, the rate of profit evaluated in different price systems does not always move together with the corresponding capital productivity or inversely to the corresponding capital-wages ratio. With the exception of the year 1997, the profit-wage ratio always moves in the same direction. Finally, the money wage rate moves together with the capital intensity (especially when they are evaluated in terms of market prices and prices of production).

Our results show that the rate of profit and the profit-wage ratio are robust to the type of price system used for their evaluation. These findings should not come as a surprise since in a study of ours we have found that the vectors of labour values and prices of production of the Greek economy are close to the vector of market prices.[6] Nevertheless these phenomena need further investigation, whereas a more reliable estimation of the evolution of the income distribution and the technical conditions of production requires data on (i) fixed capital; (ii) non-competitive imports;[7] (iii) turnover times; and (iv) sectoral rates of capacity utilization.

Footnotes

1. See the Appendix A for the available input-output data.

2. For a detailed presentation see Fujimori (1982, ch.1) and Kurz and Salvadori (1995, chs. 4 and 13).

3. For the details of this system, see, e.g., Kurz and Salvadori (1995, pp. 387-90). It is important to point out that from the relations (8)-(10) we get:

$$r^{-1} = \lambda(1-\lambda)^{-1} = \mathbf{p}^{*}\mathbf{CX}/\mathbf{p}^{*}\mathbf{U} = \mathbf{pCq}^{*}/\mathbf{pU}^{*}$$

where $\mathbf{U} \equiv [\mathbf{I}-\mathbf{C}]\mathbf{X}$ is the vector of surplus product in the economy and $\mathbf{U}^{*} \equiv [\mathbf{I}-\mathbf{C}]\mathbf{q}^{*}$ is the vector of surplus product in Charasoff's "Standard system". It has been argued that r^{-1} can be viewed as a rather reliable indicator of the aggregate intensity of the demand for intermediate products (means of production and wage goods), which is independent from both relative prices of commodities and the composition of the surplus product and reflects therefore only the structural characteristics of the productive system (Marengo, 1992).

4. It may be noted that we tried, for the period 1988-1997, other trend lines such as $y = a + bt$ or $\ln y = \ln a + bt$, which gave us lower correlation coefficients (this is also true for the other evaluations of the profit-wage ratio which are estimated below).

5. The available input-output tables are expressed in monetary terms, whereas the price indices for the individual commodities are not available. Consequently, the results of Table 3 must be taken with extreme caution. It is important to stress that the severity of the problem becomes more pronounced the more the *relative* market prices change over time.

6. See the Appendix B.

7. In this case we have more complications in the determination of the labour values. See Steedman and Metcalfe (1981, pp. 140-1), Okishio and Nakatani (1985, pp. 62-3), Steedman (2003, pp. 6-14).

References

Fujimori, Y. (1982), *Modern Analysis of Value Theory*, Berlin: Springer-Verlag.

Kurz, H.D. and Salvadori, N. (1995), *Theory of Production. A Long-Period Analysis*, Cambridge: Cambridge University Press.

Marengo, L. (1992), The Demand for Intermediate Goods in an Input-Output Framework: a methodological note, *Economic Systems Research*, vol. 4, pp. 49-52.

Mylonas, N.A., Economakou, M., Frankoulopoulos, N., Krasadakis, A., Molfetas, K., Stromplos, N. and Vlachos, P. (2000), *Natural Resource Accounts and Environmental Input-Output Tables for Greece 1988-1998*, Athens: Institute of Computer and Communications Systems (ICCS) of National Technical University of Athens (NTUA).

Ochoa, E. (1989), Values, Prices and Wage-Profit Curves in the U.S. Economy, Cambridge *Journal of Economics*, vol. 13, pp. 413-430.

Okishio, N. and Nakatani, T. (1985), A Measurement of the Rate of Surplus Value, in M. Krüger and P. Flaschel (eds) (1993), *Nobuo Okishio-Essays on Political Economy*, Frankfurt am Main: Peter Lang, pp. 61-73.

Shaikh, A. (1998), The Empirical Strength of the Labor Theory of Value, in R. Bellofiore (ed.), *Marxian Economics: A Reappraisal*, vol. 2, New York: St. Martin's Press, pp. 225-251.

Sraffa, P. (1960), *Production of Commodities by Means of Commodities*, Cambridge: Cambridge University Press.

Steedman, I. (2003), Marx After Sraffa and the Open Economy (Some Notes), *Discussion Papers in Economics*, Manchester Metropolitan University.

Steedman, I. and Metcalfe, J.S. (1981), On Duality and Basic Commodities in an Open Economy, *Australian Economic Papers*, vol. 20, pp. 133-141.

Steedman, I. and Tomkins, J. (1998), On Measuring the Deviation of Prices from Values, *Cambridge Journal of Economics*, vol. 22, pp. 379-385.

Tsoulfidis, L. and Mariolis, T. (2006), Labour Values, Prices of Production and the Effects of Income Distribution. Evidence from the Greek Economy, mimeo.

Appendix A: Data and their Sources

The symmetric input-output tables of the Greek economy are available for the years 1988 through 1998, and they are provided at the 25x25 sector detail. However, we do not have the necessary data on employment and wage for the year 1998, and so our analysis extends until the year 1997. From the 25 sectors only the first 19 are consistent with the requirements of our analysis: the concepts of labour values and prices of production have no meaning in sectors such as public administration and education, whereas the concept of output is problematic to sectors such as finance and real estate. Thus, we decided to eliminate from our analysis the last 6 sectors making the necessary adjustments in the output vector (the 25 sectors of the Greek economy and their correspondence to NACE is reported in Table A1 below).

In the available input-output tables we do not have data on the matrix of fixed capital coefficients and the non-competitive imports. As a result, our investigation is based on a model of circulating capital and we cannot treat the foreign sector of the economy separate from the domestic.

The market prices of all sectors are taken to be equal to one, that is to say, the physical unit of measurement of the output of each sector is that unit which is worth of a monetary unit. The vector of prices of production, $\mathbf{p}^*$, is normalized according to the equation $\mathbf{p}^*\mathbf{Q} = \mathbf{VQ}$, where $\mathbf{Q} \equiv \mathbf{q}(\mathbf{VX}/\mathbf{Vq})$, $\mathbf{V} \equiv \mathbf{v}(\mathbf{eX}/\mathbf{vX})$, $\mathbf{q}$ is the right-hand P-F eigenvector of the matrix of input-output coefficients, **A**, *i.e.*, Sraffa's (1960, chs 4-5) "Standard commodity", $\mathbf{v}$ is the vector of labour values, $\mathbf{e}$ is the vector whose elements are equal to one and, therefore, represents the vector of market prices, and $\mathbf{X}$ is the vector of gross output. In particular this normalization ensures the following equalities $\mathbf{p}^*\mathbf{Q} = \mathbf{VQ} = \mathbf{VX} = \mathbf{eX}$ (see also Shaikh, 1998).

In our estimation of employment we also accounted for the self-employed. Wage differentials were used to homogenize the sectoral employment (see, e.g., Sraffa, 1960, §10, and Kurz and Salvadori, 1995, pp. 322-5), that is the j element of the vector of inputs in direct homogeneous labour $\mathbf{a}$ is determined as follows: $\mathrm{a}_{\mathrm{j}} = (L_j / X_j)(w_j / w_{\min})$, where L_j, X_j, w_j are total employment, gross output and money wage rate of the j sector, respectively, whereas $w_{\min}$ is the minimum sectoral wage rate. Finally, by assuming that workers consumption has the same composition as the vector of the private households consumption expenditures, $\mathbf{c}$, directly available in the input-output tables, the vector of the real wage rate, $\mathbf{b}$, is determined as follows: $\mathbf{b} = (w_{\min} / \mathbf{ec})\mathbf{c}$ (see, e.g., Okishio and Nakatani, 1985, and Ochoa, 1989).

Table A1. Correspondence of the input-output tables to the NACE (REV.1)

IOT(25)	NACE	Nomenclature
1	01-02	Agriculture, Hunting and related service activities, Products of Forestry: logging related services
2	5	Fish and other Fishing products
3	10-12	Mining of coal and lignite; Extraction of peat, extraction of crude oil and natural gas, mining of nuclear materials
4	13-14	Mining of metal ores, other mining and quarrying products
5	15-16	Manufacture of food products and beverages, tobacco products
6	17-19	Manufacture of textiles, manufacture of clothes process and Dyeing of fur, manufacture of tanning and dressing of leather
7	20	Wood and wood products
8	21-22	Pulp, paper and paper products publishing printing and reproduction of recorded media
9	23	Manufacture of coke: refined petroleum products and nuclear fuel
10	24-25	Manufacture of chemicals and chemical products, manufacture of rubber and plastic products
11	26	Manufacture of other non-metallic mineral products
12	27	Basic metals and fabricated metal products
13	28	Fabricated metal products except machinery and Equipment
14	29-37	Machinery and equipment, office machinery and computers, electrical machinery and apparatus, radio, television and communication equipment and apparatus, medical precision and optical instruments, Watches and clocks, motor vehicles trailers and semi-trailers
15	40-41	Electricity, gas, steam and hot water, collection purification and distribution of water
16	45	Construction Work
17	50-52	Whole sale and retail sale of motor vehicles, whole sale and retail sale except vehicles and retail trade
18	55	Hotel and Restaurant Services
19	60-64	Transports, water transport services, air transport services, post and telecommunications
20	65-67	Financial intermediation services, insurance and pension funding services, Services auxiliary to financial intermediation
21	70-74	Real estate services, renting services of machinery and equipment, computer and related services, Research and development services, other business services
22	75&90	Public administration and defense services, Sewage and refuse disposal services sanitation
23	80-85	Membership organization services n.e.c.
24	91	Membership organization services n.e.c.
25	92,93,95&99	Recreational, cultural and sporting services, other services n.e.c, domestic services

Source: Mylonas *et al.* (2000), pp. 70-2

Appendix B: Deviations of Prices of Production from Market Prices and Labour Values

In Table B1 we report the deviations of the vector of prices of production from the vectors of market prices and labour values as these are estimated on the basis of MAD (Mean Absolute Deviation) and the 'd statistic'. The advantage of the d statistic over the MAD is its independence of the normalization condition. Consider the deviation of vector $\mathbf{x} \equiv [x_j]$ from vector $\mathbf{y} \equiv [y_j]$, where $j = 1, 2, ..., n$. The MAD of the two vectors is defined as

$$MAD \equiv (1/n)\sum_{j=1}^{n}\left|(x_j / y_j) - 1\right|$$

whereas the d statistic, which has been proposed by Steedman and Tomkins (1998), is defined as

$$d \equiv \sqrt{2(1-\cos\theta)}$$

where θ is the angle between the vector $[x_1 / y_1, x_2 / y_2, ..., x_n / y_n]$ and the unit vector.

According to the two measures of deviation we realize that (i) in general terms the deviations are in the range of 20%; (ii) the deviations of prices of production from the labour values are much smaller than those of prices of production from market prices; and (iii) the deviations of prices of production from market prices are the largest in the year 1997, the only year that the profit-wage ratio and the rate of profit estimated in both prices of production and labour values do not move in the same direction with the profit-wage ratio and the rate of profit estimated in market prices.

Table B1. Statistics of deviations of prices of production, labour values and market prices

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	
Prices of Production vs. Market Prices	0.178 0.228	0.174 0.219	0.205 0.235	0.200 0.227	0.196 0.219	0.220 0.208	0.231 0.242	0.208 0.251	0.204 0.228	0.250 0.287	*MAD* *d*
Prices of Production vs. Labour values	0.075 0.093	0.082 0.098	0.076 0.090	0.084 0.100	0.083 0.097	0.064 0.079	0.080 0.089	0.075 0.090	0.074 0.089	0.093 0.094	*MAD* *d*

Source: Tsoulfidis and Mariolis (2006)