TECHNICAL PROGRESS (TOTAL FACTOR PRODUCTIVITY) IN THE GREEK MANUFACTURING INDUSTRIES : 1963-1980

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I. INTRODUCTION

In this paper we shall attempt to measure changes of total factor productivity (technical progress) that took place in the Greek manufacturing sector, as a whole as well as in the individual industries over the period 1963 — 80.

Conceptually, total factor productivity is denoted as the ratio of output to all associated inputs, all measured in real terms. The general form of the exprès-sion in simplest terms is $Pr = \frac{Qi}{f(Ii)}$ where Pr is Productivity, Q is the quantity of output, I is the quantity of each of the inputs, f is the functional relationship used to aggregate the various inputs. If for a given percentage increase in the level of all inputs, output increases more than proportionally, then productivity can be said to have increased and the economy is better utilising its resources. Productivity, therefore, is a measure of the efficiency of an industry or activity. Changes in total factor productivity measure changes in productive efficiency, a term which no doubt needs further explanation. Productive efficiency may change due to changes in the scale of output, external economies, changes in the rate of utilization of existing capacity and technological innovations. Likewise, change in total productivity may reflect changes in the inputs of intangible capital such as : better education, training and skill of labour force, improvement in health, better management, changes in the composition of stock of capital in terms of classes of assets, changes in product - mix and other factors.

The relationship between productivity and efficiency is undeniable. In fact, productivity is a measure of efficiency. If the term efficiency has to have an economic meaning, it has to be interpreted in terms of productivity. A production system shall be called more efficient only if is more productive. Suppose that we have a situation in which inputs have grown faster than total output. This will result in total factor productivity being negative. This will suggest that inputs are not being combined in the most efficient manner, and partial productivity of labour or capital should decline. Thus, it can be said that total. factor productivity, no matter how rudimentary and crude, is a measure of economic efficiency. The total factor productivity, often referred to as the index of «Technical Progress», is defined as output per unit of labour and capital combined. Technical Progress- broadly speaking - includes technical progress in the narrow sense, economies of scale, better management, improved health, education and so on. Changes in total productivity are estimated as a residual after the contribution of the conventionally defined inputs of labour and capital to the growth of output has been accounted for.

2. MEASUREMENT OF OUTPUT, LABOUR AND CAPITAL INPUT

In order to measure changes of total productivity, it is necessary to quantify the changes of output per combined unit of input over the time to which the measurement is related. This involves the construction of an index, and the definition of the variables and the respective weights that are to be included in the index. The first problem which one is concerned with is whether the figures of output and capital should be net or gross of depreciation.

Output

The neo-classical production theory which underlies the productivity analysis requires that output should be measured in real terms. Some authors prefer net output at constant prices. Yet some others prefer to work with gross output. Those in favour of the net concept of output give a theoretical justification that capital consumption is not a part of final output which reaches final consumers. Those in favour of gross output argue that more often than not the data on capital consumption are not very reliable. Denison (9) in his analysis of sources of growth uses net rather than gross output. The reason advanced for this choice is that net output is the final output which reaches the consumers. Kendrick (8) uses real G.N.P. as a proxy for real N.N.P. He argues that it is difficult to distinguish between real capital consumption allowance and the book value of depreciation. Yet another view is adopted by Jorgensen and Griliches (6) how have attempted to provide a justification for the use of gross output and gross capital input as compared to net product and net capital input in the analysis of production change. They hold : Exclusion of depreciation on capital introduces an entirely arbitrary distinction between labour, input and capital input, since the corresponding exclusion of depreciation of the stock of labour services is not carried out.

Capital

As regards the capital, all economists working in this field such as Kendrick, Denison and Reddaway and Smith to mention a few, argue that the productive capacity of capital decreases as it ages, and that therefore some deduction from the value of the gross stock of capital should be made. They suggest that net capital figures should be used rather than gross stock. Since the net stock of capital represents a better measure of the capacity of capital to contribution to production. An alternative approach calls for the use of gross stock, instead of net stock, as a suitable measure of capital inputs. This approach is based on the consumption that the conventional depreciation methods allow for a relative quick appreciation, which overestimates the decline of the productive capacity of old equipment (see Donar (3) and (4).

Those in favour of the net concept of Solow (12) and (13) and Jourgensen and Griliches (6) used gross stock figures, together with gross output figures. A further reason, already referred to above, is that the exclusion of depreciation from both input and output introduces an inconsistency into the measurement of capital and labour inputs, since the corresponding exclusion of depreciation from the stock of labour force is not taken into cosnsideration.

In this paper, in estimating total factor productivity (Technical Progress) (applying the Reddaway and Smith formula (10) which will be analysed below), we shall use gross value added and gross fixed capital formation.

Gross value added is not a true measure of the contribution of labour and capital to output because this figure is obtained by subtracting from gross output only raw materials and fuel, and it includes, therefore, depreciation plus the value of purchased inter mediate services (communication, management consuiting, advertisings insurance, etc.) and indirect taxes less subsidies. The latter items do not represent contributions by the primary factors.

Industries use different amounts of service inputs, so the use of gross value added as a measure ot output upwards biases the productivity of service intensive industries. The inclusion of depreciation in value added is not a serious problem if value added, which includes depreciation, is associated with gross capital formation.

The estimate of capital input will be based on gross fixed capital formation. This figure includes land, buildings, plant and machinery, transport equipment, etc. (The Machinery constitutes the bulk of the investment, nearly over 60 %). No allowance is made for depreciation because estimates of depreciation are generally not considered reliable. No adjustment has been made for relative utilization. This is usually done by a utilization index. The capital is multiplied with the index of utilization in order to arrive at the estimates of capital - in - use which s used as a measure of capital input.

Further, the computation of capital input (the contribution of capital to output) poses challenging conceptual and statistical problems. The main problem is related to the appropriete weight that has to be used. The usual way of obtaining a quantity index is to weight labour by the wage rate and capital by a fixed percentage which represents the average rate of return on capital in manutacturingindustry.

The return to capital in the base year or in any particular year is not considered as even a reasonable proxy of cost of capital. Since returns in a single year are not necessarily representative. The return on capital depends upon the profits. Profits in turn are affected by contractual payments, the level of demand in that year and other cyclical phenomena. In the short- run, the amount of capital employed is fixed. Thus, a change in the degree of utilization might lead to considerable changes in the return to capital. For all these reasons the return to capital tends to be an extremely volatile figure which tends to change over time, thereby making the return on capital of a particular year an improper measurement of cost of capital.

Economists working it this field, among them Kendrick, Reddaway and Smith, Dunning and Utton, etc., dealt with this problem by using an alternative rate of teturn. Reddaway and Smith (10) (measuring the progress in British manufacturing industries in the period 1948 - 54), imputed an opportunity cost to capital of 15 per cent, based on the estimated profits earned on written down capital at repacement cost in 1948, whereas Dunning and Utton (5) (measuring the changes in productivity and efficiency in U.K. industry in the period 1954-63), used a lower opportunitx cost in their calculations ranging from 12,5 % to 10 % according to the period considered.

In our calculations of total factor prodnuctivity (technical progress) which are carried out below, a charge of 12 per cent on capital will be made,.

The average long-term rate of return on capital in the Greek manufacturing sector was estimated to be 9.9. per cent over the period 1959 - 73 (G. Countsoumared to be 9.9 per cent over the period 1959 - 73 (G. Coutsomaris : The Financial Structure of the Greek Industry, Athens 1976-in Greek). That rate is therefore regarded as a reasonable opportunity cost of capital. This figure maybe accepted if net value added were used as a measure of outmput ; it can not be justified when used with value added which includes depreciation. A higher figure of 12 per cent should be used to compensate for the depreciation included. As mentioned above, value added is a gross concept of output that includes depreciation ; therefore, it is combined with a measure of gross fixed capital. As in other works in this field, the average rate of return on capital is applied uniformly ooo the capital employed in each industry. As far as labour is concerned, oo oooiform wage rate is not applied, since it can be assumed that the diferent degrees of skill required by each industry are reflected in ooooo - industry variations in salary.

The theoretical framework employed in this study requires that all magnitudes be measured in real terms (at 1963 constant prices).

oooooordingly, the raw data obtained from the several annual industrial ooooeys of the national Statistical Service of Greece was deflared by the following indexes : (a) the value added, was deflated by the home Manufacturing production wholesale price index for individual manufacturing industries, obtained from the N.S.S.G. β) the gross fixed capital formation in currentdrs. Isconverted in the gross fixed capital formation in (1963) constant drs by deflation with the gross fixed capital formation price index formanufacturing, obtained from the National Accounts of OECD countries c) the 1977 wage and salary bill {labour remuneration) at 1963 constant (Wage and Salary) rates was obtained as follows. First we calculate the base year (1963) average wage and salary rate figures by dividing the total amount of wages and salaries paid in the individual industries during the base year (1963(by the average number of paid wage earners and salaries employees employed during that year respectively. Secondly we multiphy the number of wage earners and salaries employees of the individual industries in 1977 by the base year (1963) average wage and salary rates respectively.

Then we add these two figures and wegent the 1977 wagand salary bill at con- cibhenwe add these two figures and weget the 1977 Wageand salary bill at constant 1963 rates.

3. APPROACHES TO THE MEASUREMENT OF TOTAL FACTOR PRODUCTIVITY

As discussed earlier, total factor productivity is defined as the ratio of total output to total input, where total input is a weighted sum of all inputs. Diffe-rent approaches to total factor productivity differ from each other mainly in thei aggregation procedure of inputs. There are many ways of measuring total factor productivity ; but the two indices most often used in empirical research are Kendrick's arithmetic measure and R. Solow's geomertric index.

Kendrick' s method : In his research paper, John Kendrick (7) has attempted the measurement of total productivity of 33 industry groups and the private domestic economy of the U.S. He divides total productivity into broad factor classes, Labour and Capital. The labour input used in this study denotes man-hours worked in various industries by all thypes of persons engaged in productive activity (including proprietors), weighted by basic period average hours earnings. He thus takes into account the difference in quality and skill of labour. With regard to capital, the concept of constant dollar value of the stock of the real capital, - plant, equipment and inventories - has been used. The capital input has also been weighted, accerding to the rate of return in the base year.

In formula, Kendrick's Arithmetic Index in given by :

$$\frac{dA}{A} = \frac{Qi/Qo}{(WL_1+rK_1)\ I\sqrt{Wlorko}} - 1$$

where

$$\frac{dA}{A} = \text{index of total Productivity}$$

Qi = output in the current year,

Qo = output in the base year,

K = wage rate,

r = rate of return on capital.

In his empirical work Kendrick allows for variations in the weights used for aggregation of inputs. These weights are derived not from statistical production function but are estimated shares of factor income. Thus the index becomes :

$$\frac{Q}{bL+(l-b)\ k}$$ with changes from period to period.

Sollow's measure (146) is based on the Cobb – Douglas production function, with constant returns to scale and autonomous and neutral technological change,

i.e.

$$\frac{dA}{A} = \frac{da}{a} - (a\frac{dl}{L} + b\frac{dk}{k} \quad b = (1-a).$$

where a and b are the shares of labour and capital and dq, dL and dk are the time derivatives of Q, L and K. Under the assumption of competitive equilibrium the Kendrick measure can be stated as :

$$\frac{dA}{A} = \frac{Q1/Qo}{do\ \frac{(L1)}{Lo} + bo\ \frac{(K1)}{Ko}} - 1$$

This is equivalent to Solow's measure for small changes in the quantities of and outputs.

Other approaches to measurement of total factor productivity are Salter's Method (128) and Jorgensen and Griliches Approach (76). Salter has tried to decompose total factor productivity. First he gives a measure of neutral technological change defined as :

$$T = \frac{W\ (dL/dt + r\ (dK/dt)}{WL + rK}$$

where W is the wage rate and r is the price of capital.

Next, Salter tries to quantity the changes in the capital labour ratio attributable to technological change by the following index :

$$D = \frac{d\,(K/L)}{dt}\ \frac{L}{K}$$

If D is positive, technological advance is said to be labour saving, bereuse there is more saving of labour than capital. Thus «... the rate of growth of labour productivity exceeds the rate of technical advance and the rate of capital productivity is retarded» (Salter, 11, p. 39). If D is negative, the bias in technological change is decrease saving, which retards the productivity of labour but increases that of capital. However, this measure is not completely reliable, as D can take a value of zero even if there is no change in the bias of technological change but factor price changed (Brown, 1, pp. 107- 108).

Jorgensen and Griliches reconciled the productivity analysis with the theory of production. They view total factor productivity as a shift in the production function. Thus, the main problem is to isolate the shift in the production function from a movement along the production function.

4. APPROACH (ADOPTED IN THIS STUDY) TO THE MEASUREMENT OF TOTAL FACTOR PRODUCTIVITY

The measure of performance that will be used here include both the capital and the labour inputs in their derivation. This measures is as follows :

$$\text{Technical Progress} = \frac{P1\Delta 0 - (W_1\Delta L + r\Delta C)}{P_1 0_1 + (W_1\Delta L + r\Delta C)}$$

The above measure was initially developed by Messrs. Reddeway and Smith (10).

Reddaway and Smith attempted to compare the rate of growth of output with the rate of growth of combined input for different industries. They have done this in effect by using the above first formula, i.e. by weighting the physical increase in labour by wages in the hase year and increased capital (in value terms) by a notional fiffteen per cent normal return to capital. This gives a value of increased input, which when unducted from the increase in the value of net output will measure progress, i.e. that part of output increase which is not attributable to increased doses of capital and labour input, but to improvements in the quality of these factors and of the skill with which they are organised and combined for use in production.

For lack of reliable data on capital stock, Reddaway and Smith used the above formula in measuring changes in productivity which requires capital formaticon figures in contrast to the other measures which require capital stock figures. They start by assuming that labour and capital returns exhaust net output in the base year .

With this, the total productivity index equals =

$$= \frac{P_1 O_2}{W_1 L_2 + r_1 C_2} \qquad (1)$$

With : ΔO = Extra net output compared with the base year produced in the final year.

AL = Extra labour compared with the base year employed in the final year.

(1) Where O_1 = base year net output, O_2 = end year net output, W_1 = base year wage rate, L_1 = the size of the work force in the base year, L_2 = the size of the force in the end year, r_1 = the average rate of return on net capital in the base year, C_1 = the stock of capital in the base year, C_2 = thé stock of capital in the end year.

AL = Extra labour compared with the base year employed in the final year.

ΔC = Extra capital compared with the base year employed in the final year. Then (by definition) : $W_1 L_2 = W_1 L_1 + W_1 \Delta L$

The total productivity index can now be written as follows :

$$\text{Productivity Index} = \frac{P_1 O_2}{P_1 O_1 + W_1 \Delta L + r_1 \Delta C}$$

In effect, this formula is comparing net output produced in the final year (F_1 O_2), with net out put produced in the base year (P_1 O_1), together with an allowance for additional factors employed ($W_1 \Delta L + r_1$ AC). Given that

p_1 o_2 = P_1 O_1+P_1, ΔO, Total Productivity Index =

$$= \frac{P_1 O_1 + P_1 \Delta O}{P_1 O_1 + W_1 \Delta L + r_1 \Delta C}$$ and the change in productivity equals

$$\frac{P_1 O_1 + P_1 \Delta O}{P_1 O_1 + W_1 \Delta L + r_1 \Delta C} - 1 = \frac{P_1 \Delta O - (W_1 \Delta L + r_1 \Delta C)}{P_1 O_1 + (W_1 \Delta L + r_1 \Delta C)}$$

Technical Progress is thus equal to :

(Increase in net output less output attributable to the extra inputs)
(Net output which could have been obtained with unchanged productivity)

Of course we might obtain a negative result which would mean that total productivity has fallen.

It is worthwhile to say something more about the meaning and implications of a negative total factor productivity. Total factor productivity is usually accepted as an index of efficiency of the production process. Now, it is possible to visualize three kinds of situations (a) the total factor productivity is zero, i.e. observed growth in total output and growth in combined factor input is exactly equal in magnitude, (b) the total factor productivity is more than zero, i.e. observed growth in total output is more than the growth, in total inputs, (c) the total factor productivity is negative, i.e., observed growth in total output is less than the growth in total input. In case (a), the production process is «just efficient» in the sense that growth of output is proportional to growth of input, case (b) suggests a more efficient production process as a relative smaller growth of input yields a larger growth in, output. It means that both factors are combined in a more productive manner. Hence, the magnitude of total factor productivity becomes an index of efficiency of the production process. The higher the magnitude of total factor productivity, the more efficient the production process is. In case (c), likewise, the production process may be regarded as inefficient as a large growth of total inputs leads to a relative smaller growth of output. Thus, a negative total factor

productivity might be taken as an index for inefficiency of the production process.

Examples of negative factor productivity are not totally absent in the economic literature. Solow (12), in his seminal article on the aggregate production function and technological change, reported that the contribution of total factor productivity to the growth rate of output was negative in the U.S. in 11 different periods from 1909 to 19/9. Reddaway and Smith (10) reported that negative progress was recorded in five instances, in Leather and in Food, Drink and Tobacco in 1948 - 51 and in Metal Goods N.E.S., Textiles and Leather in 1951 - 54. Similarly, Dunning and Utton (5) found that the technical progress was negative in the U.K. metal manufacturing industry over period 1954 - 63, as well as in the Textile industry in the subperiod 1954- 58.

5. REVIEW OF THE RESULTS

Table 1 presents the estimates of changes in Technical Progress over the period 1963 - 80. The first column of the table (1) gives the increase in value added (including depreciation) for total manufacturing and individual industries between 1963 and 1980 (ΔO). The next two columns give the increase in the wage and salary bill (WAL) and the contribution of the additional capital introduced between 1963 and 1980 (0.12 AC, 0.12 is the opportunity cost of capital and AC Cresents the additional capital). All the above measurements are done at 1963 constant urices.

The four/h column Cresents the residuals, i.e. the increase in value added in forteen years (1963 - 80) due to technical 5rogress. Column five shows the value added (output) that would have been obtained in 1980 without change in total productivity ($O^1P^1+W^1AL+0.12AC$). By dividing the extra output due to changes in total productivity, i.e. the residual by column five, the technical progress for all the period is obtained. Column seven gives the average annual rate of technical progress for each industry.

Table 2 gives the results for labour productivity (1) In this case labour productivity [1] is defined as

$$\frac{\Delta OP_1 - W_1\Delta L}{OP_1 + W_1\Delta L}$$

Technical Progress: (Changes in total factor productivity).

The annual average rate of technical progress for the total manufacturing sector for the period 1963- 1980 was 3.3 per cent. Naturally the rate of growth for the manufacturing industry as a whole conceals considerable differences in the records of individual industries.

Experience between industries in rate of progress has been varied. For the period 1966- 80 the estimates for the different industries range from about -3.5 per cent in Petroleum and Coal Refining to 10.8 per cent in Manufacture of Footwear and Sewing of Fabrics.

All the individual manufacturing industries considered have progress of more than 0.8 per cent per annum (Wood and Cork), with the exception of the Petroleum and Coal Refining (-3.5 per cent).

(1) More about labour productivity i.e., criticism of labour productivity, factors affecting about productivity etc, see Papanicolaou (9, chapter V pp 143-153 and chapter IX, pp 345-353).

The highest increase in the growth of progress was recorded for Manufacture of Footwear and Serwing of Fabrics (10.8 per cent per aunnum), followed by 8.5 per cent in the Chemical Industries, 8,0 per cent in the Rubber and Plastic Products, about 7.3 per cent each in the Leather and Fur Products and in Furniture and Fixtures, about 6.0 per cent each in Food Preparation, in the Beverage Industries, in the Basic Metal Industries and in Electric Machinery, about 5.0 per cent each in Manufacture of Textiles, in Non-Metalic Mineral Products and in Fabricated Metal Products Except Machinery, 4.3 per cent in Tobacco Manufactures, 3.8 per cent in Printing and Publishing, 3.0 per cent in Machinery Except Electrical and 2.7 per cent in Wood and Cork.

Labour Productivity

We now turn to an examination of the labour Productivity, (here defined as

$$\frac{P_1\Delta O - W_1\Delta L}{OP_1 + W_1\Delta L}).$$

Over the period 1963-77, labour productivity increased significantly in all the industries considered (with the exception of the Petroleum and Coal Refining which experienced a fall of 0.5 per cent per annum. It will be seen that the total manufacturing sector had experienced a rise in labour productivity of almost 12.2 per cent per annum. As regards the individual manufacturing industries, the highest increase was registered in the Basic Metal Industries (28,7 per cent per annum), followed by 23.3 per cent in the Chemical Industries, 19.1 per cent in Rubber and Plastic Products, 18.8 per cent in Footwear and Serwing of Fabrics, 17,4 per cent in Non- Metalic Mineral Products, 15.2 per cent in Beverage Industries, 14.0 per cent in Manufacture of Textiles, 13.6 per cent in Food Preparation, about 13.1 per cent each in Wood Cork and in Electrical Machinery, 12.6 per cent in Furniture and Fixtures, 12,5 per cent in Fabricated Metal Products except Machinery, 11.4 per cent in Transport Equipment, about 10.7 per cent each in Manufacture of Paper and in Fur and Leather Products, 7.4 per cent in Machinery and Appliances except Electrical, 7.1 per cent in Printing and Publishing and 4.8 per cent in Tobacco Manufactures.

In all the manufacturing industries, the rate of growth of inwestment was appreciably much higher that that of labour. Thus, the increases in labour productivity are bound to appear much larger than the increases in total productivity.

It will be observed from Table 2 that the introduction of an allowance for additional capital input reduces the labour productivity substantially in all the industrial es under review. The increase in labour productivity for the total manufacturing sector falls from 180.2 per cent to 64.2 per cent (due to the charge for capital). For the individual industries the consequent reduction in labour productivity due to the charge for capital ranges from 7.2 percentage points for Tobacco Manufactures to 318.0 percentage points for Basic Metal Products.

It is tempting to conclude from these high figures that labour productivity is a rather poor and not very relable indicator of the overall changes in total factor productivity (Technical Progress).

The Rank, Correlation Coefficient between the changes in labour productivity and total productivity is +0.70. There appears to be a statistical association between the growth rates of labour productivity and technical progress, despite these wide gap between the trends in these two measures.

6. CONCLUSION

It emerges from the above analysis that labour productivity in both all manufacturing and the individual manufacturing industries had increased very rapidly over the period 1963 - 80. This growth was due to increase of investment and the labour force, to increase of the quality of both to «disembodied» technical change such as improvement in the quality of management., economies of scale, external economies, and so on.

Given that the machinery installed in the Greek manufacturing industries (over the decade 1963-80) had been imported, and given the importance of the machinery in the total investement of the Manufacturing industries (the proporon of machninery and other technical equipment to total investment is over 60 % and sometimes over 70 %), it must be expected that a good deal of technical change would have been embodied in it. When account has been taken of the expansion of investment, as well of its quality improvement and the growth in labour inputs, any residual technical change may be attributed to genuinely domestic improvements, i.e. in the quality of management and workers, economXies of scale, in the realisation of external economies of scale as the infrastructure improves, the reallocation of resources from less to more «efficient» enterprises, changes in product mix and many others have been involved.

Technical Progress (attributed to genuinely endogenous factors) in both total manufacturing sector and the individual industries, was found to have been large over the period 1963-80.

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Table 1 Technical Progress in the (Large – Scale) (1) Manufacturing Industries : 1963 – 1980

(Million drs, at 1963 prices)

Manufacturing Sector	Change in Value Added Including Depreciation	Change in the Wage and Salary Bill	Change in the Contribution of Cross Fixed Capital Formation	Extra Output due to Progress (Residual)	Output which would have been obtained in 1980 w/out change in Total Productivity	Progress Over the period 1963 – 1980	Annual Average Rate in Progress
	ΔO	WΔL	r*ΔC	ΔO–(WΔL+ r*ΔC)			
	1	2	3	5	5	6	7
Total Manufacturing	38,573	/,634	13,311	20,628	32,141	64.18	4.58
Food Preparation Except Beverages	5,050	511	1,356	3,183	3,745	85.00	6.07
Beverage Industries	1,570	212	437	922	1,077	85.60	6.11
Tobacco Manufactures	438	–81	254	611	1,020	59.92	4.28
Manufacture of Textiles	6,793	586	2,206	4,000	5,376	74.41	5.31
Manufacture of Foott Wear and Sewing of Fabric	2,865	467	256	2,142	1,1678	83.43	13.10
Wood et Cork	654	92	323	238	631	37.79	2.70
Furniture et Fixtures	575	65	107	403	397	101,6	7.26
Manufacture of Paper	776	105	417	253	865	29.31	2.09
Printing et Publishing	730	87	194	449	843	53.25	3.08
Leater et Fur Products	305	–5	48	263	255	02.90	7.35
Rubber et Plastic Products	2,142	268	509	1,365	1 211	112.69	8.05
Chemical Industries	5,182	540	1,352	3,290	2,777	118.47	8.46
Petroleum et Coal Refining	125	171	673	719	1,306	– 55.05	– 3.93
Non – Metalic Mineral Product	3,798	317	1,482	1,998	2,911	68.63	4.90
Basic Metal Industries	3,116	341	1,475	1,815	2,165	83.85	6.00
Fabricated Metal Products Except Machinery	2,198	326	548	1,218	1,714	71.04	5.07
Machinery et Appliances	681	140	227	315	746	42.20	3.01
Except Electrical							
Electrical Machinery							
Apparatus, Appliances.	2,210	352	555	1,302	1,569	83.00	5.93
Transport Equipment	2,871	631	704	1,535	2,103	73.02	5.22
Miscellaneous Manufacturing Ind	660	63	57	540	209	258.71	13.48

r* = 0.12 = the oportunity cost of capital

(1) Large – scale = ten person and over.

Table 2 : Technical Progress et Labour Productivity, in the Large – Scale (ten persons and over) Manufacturing Industries : 1963 – 1980

Manufacturing Sector	Technical Progress		Labour Productivity	
	1963 – 1980	Annual Average Rate	1963 – 1980	Annual Average Rate
Total Manufacturing	64.18	4.58	180.24	12.87
Food Preparation Except Beverages	85.00	6.07	190.02	13.57
Bevarage Industries	85.60	6.11	212.41	15.17
Tobacco Manufactures –	59.92	4.28	67.80	4.84
Manufacture of Textiles	74.41	5.31	195.79	13.98
Manufacture of Footwear et Sewing of Fabrics	183.43	13.10	263.05	18.79
Wood et Cork	37.79	2.70	182.80	13.06
Furniture et Fixtures	101.60	7.26	176.11	12. 58
Manufacture of Paper	29.31	2.09	149.92	10.65
Printing and Publishing	53.25	3.80	99.03	7.07
Leather and Fur Products	102.90	7.35	149.76	10.70
Rubber and Plastic Products	112.69	8.05	266.95	19.07
Chemical Industries	118.47	8.46	325.87	23.28
Petroleum and Coal Refining	–55.06	– 3.93	– 7.32	– 0.52
Non–Metallic Mineral Products	68.63	4.90	243.59	17.40
Basic Metal Industries	83.85	6.00	401.88	28.71
Fabricated Metal Products Except Machinery	71.04	5.07	175.02	12. 50
Machinery and Appliances Except Electrical	42.20	3.01	104.25	7.45
Electrical Machinery Apparatus, Appliances	83.00	5.93	183.27	13.09
Transport Equipment	73.02	5.22	160.19	11.54
Miscellaneous Manufacturing Industries	258.71	18.48	394.94	28.21

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