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SIMULTANEOUS ESTIMATION OF PRODUCTION FUNCTION AND BENEFICIARIES OF GROWTH FOR A DEVELOPING ECONOMY

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In this paper we have identified the sources of growth and its beneficiaries in Pakistan's large-scale manufacturing sector using a simultaneous equation model. The use of such a model was necessitated since the Sims Test revealed endogeneity in the variables. We find the single equation estimates biased when compared with the ones obtained from the use of the simultaneous model. Using the latter estimates we find the contribution of capital much less, and the contribution of labour almost double as compared with the single equation estimates. The contribution of technological change declines just a little. The single equation estimates revealed constant returns to scale, while the simultaneous model indicated the presence of increasing returns. We find that every one per cent increase in productivity leads to a 0.6 per cent increase in wages and a 0.6 per cent decline in prices.

I. Introduction

It seems strange that more than thirty years after the simultaneous equation bias in single equation production function estimates was pointed out, there are very few such estimates available in the literature, both for the developed and the developing countries. It is our endeavour to provide estimates on the sources of growth for Pakistan's large-scale manufacturing sector which take cognizance of such a bias. We then compare these estimates with the single equation estimates obtained from our earlier

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study [Wizarat, (1988)] and find that single equation estimates might have been biased.

The literature on the beneficiaries of growth mostly pertain to the developed countries, while an 'astonishing void' [Berg, (1970)], has been observed for the developing countries. An earlier study by Salter (1966) for the U.K. for the period 1924–1950 found that industries that have recorded largest increases in productivity and reduction in cost have recorded price reductions commensurate with productivity increases and vice versa. His analysis therefore shows that the benefits from increase in productivity were passed on to the consumers and were not appropriated by the workers and the industrialists.[1] Reddaway (1966) found most of these relationships to be pretty much the same for the period 1954–1963. Investigating the trends in factor prices and productivity for the U.S. private economy for the period 1919–1960, Kendrick and Sato (1963) found that the rate of increase in real wages at 2.6 per cent per year was higher than the rate of increase in labour productivity at 2.4 per cent per year. On account of this, the share of labour income increased from 72 per cent in 1919 to 78 per cent in 1960. Lipschitz and Schadler (1984) reported similar trends for the U.K. and Japan during 1962–1982. They found that the share of labour in value added increased in Japan and the U.K., since actual wages increased more rapidly than warranted wages in both the countries.[2] Artus (1984) found that in France, Germany, Japan and the U.K. during the mid-50s to early-80s, the increase in labour's share in income[3] was unwarranted by long-run changes in production techniques and availability of labour and capital. In the U.S. and Canada, Artus did not find any real wage rate problem, while for Italy the evidence seemed inconclusive. For roughly the same period for seven OECD countries, McCallum (1985) reported a steady long-term decline in the aggregate profit share for all the countries, and for all the countries except France and Japan for the manufacturing profit share.[4]

[1] For the U.S., Salter (1966) found a high inverse correlation between productivity and unit labour costs and between productivity and wholesale prices. The correlation coefficients between productivity and earnings and between productivity and employment were, however, smaller.

[2] Warranted wages are defined as those increases in wages which leave the labour and capital shares of income unaltered, and the wage gap is the divergence of acutal wages from warranted wages.

[3] During the period 1956–1969 to 1973–1982 labour's share in manufacturing income increased from 75 to about 78 per cent in the U.S.; from about 67 to 68 per cent in Canada; from 45 to about 56 per cent in Japan; from 61 to 69 per cent in France; from 65 to 71 per cent in the Federal Republic of Germany; from 60 to 71 per cent in Italy and from 71 to 79 per cent in the United Kingdom.

[4] Some other studies for the developed countries are Geary and Kennan (1982); Malinvaud (1982); Sachs (1983); Grubb et al., (1983); Brush and Crane (1983); Moschos (1983); Fulco (1984); Fil'ev (1984); Kalleberg et al., (1984); and Clark (1984).

Whatever little evidence there is for the developing countries, seems to suggest that there is a positive correlation between productivity and earnings. For instance, the study by Reynolds (1964) for Puerto Rico found that average hourly wages of production workers in manufacturing tripled, which had a negative effect on employment during this period. Similarly, the study by Harris and Todaro (1969) found a positive and significant relationship between productivity and earnings in Kenya. Regarding the distribution of productivity gains in Pakistan, Ahmed (1980) found that the predominance of oligopolies with high barriers to entry created technological, administrative and financial discontinuities. On account of these the productivity gains were largely reflected in the inter-industry structure of factor rewards, especially excess profits.

The purpose of this paper is to provide estimates on the sources of growth for Pakistan's manufacturing in a simultaneous equation framework. Moreover, we will try to improve upon Ahmed's methodology and extend the analysis of the beneficiaries of growth to cover the decade of the 1970s i.e., from 1955-56 to 1980-81. In view of the tasks before us, we have pursued three objectives: the first objective is to identify the sources of manufacturing growth in Pakistan; the second objective is to study the relationship between productivity and wages, with a view to explore the extent of benefits enjoyed by the wage earners due to increase in productivity; and the third objective is to study the behaviour of productivity and price variables, with a view to assess the extent of benefits enjoyed by the consumers. There are three by-products of the study as well. Of great interest will be the light the study throws on the employment-output trade-off, and the employment-wage relationship. The findings of the study with regard to the wage-price relationship will have implications for the issue of cost push inflation in the manufacturing sector.

Following the Introduction in Section I, in Section II we test output, labour, capital, wages and prices for endogeneity by applying the Sims Test. Finding the variables endogenous, we formulate an eight equation simultaneous model which is laid out in this section. Data sources and their limitations are discussed in Section III, while Section IV presents the findings of the study. This is followed by the Summary and Conclusion in Section V.

II. The Model

We now go on to formulate a model to study the relationships between output, employment, capital, demand, productivity, wages and prices. In the Salter Model [Salter (1966)] output is endogenous due to the reverse causation from productivity to prices. We noted in Wizarat (1988) that

estimates of the sources of manufacturing output growth might be biased due to the Marschak-Andrews problem. Wold's (1957) proximity theorem, however, suggests that the asymptotic bias may be negligible. Empirical evidence also suggests that factor prices are endogenous in both the labour and investment demand equations [Sims (1972a)]. In what follows we test these variables for endogeneity, and formulate a model in the light of these findings.

We applied the Sims Test [Sims (1972b)] which consists of expressing all the variables in natural logs, and regressing the dependent variable on past and future values of the explanatory variables. The past values of the explanatory variables are prefiltered to take care of serial correlation in time series data.[5] Then if causality runs from the explanatory variable only, then the future values of the explanatory variable should be insignificantly different from zero. Taking into cognizance the endogeneity results on output, employment, capital, wages and prices as revealed by the Sims Test[6] we formulated an eight equation simultaneous system, consisting of six behavioural equations plus two identities.

Writing the Cobb-Douglas production function for Pakistan's large-scale manufacturing in the form:

$$S = A\ L^{z1}\ C^{z2} \tag{1}$$

where S = Output or value-added, L = Labour, C = Capital and A, z1 and z2 are the parameters to be estimated.
Total costs are given by:

$$TC = wL + rC \tag{2}$$

where TC is total cost, r and w are the rental and wage rates respectively.

In order to minimize equation (2) given the production function in equation (1), we set up the Lagrangian expression in equation (3):

$$\mathcal{L} = w\,L + r\,C + \in [S - A\ L^{z1}\ C^{z2}] \tag{3}$$

[5] The filter suggested by Sims (1972b) is $x(t) - 1.5\ x\ (t-1) + 0.5625\ x\ (t-2)$ where x is the explanatory variable.

[6] The future values of the relevant variables were large and statistically significant. In some cases the coefficient was not statistically significant, but as pointed out by Sims that a large coeffficient on the future values of a variable should not be set to zero no matter how statistically insignificant it is. Sims suggested that as long as the estimated coefficient on future values is equal to or larger than the coefficient on past values there would be substantial bidirectional causality.

The first order conditions for a constrained minimum are:

$$\frac{\delta \mathcal{L}}{\delta C} = r - \in A^{z2} \; L^{z1} \; C^{z2-1} = 0 \tag{4}$$

$$\frac{\delta \mathcal{L}}{\delta L} = w - \in A^{z1} \; L^{z1-1} \; C^{z2} = 0 \tag{5}$$

$$\frac{\delta \mathcal{L}}{\delta \in} = S - A \; L^{z1} \; C^{z2} = 0 \tag{6}$$

As can be readily seen the first two conditions can be used to derive the input demand function for labour, as expressed in equation (7) and for capital as expressed in equation (8).

$$\text{Ln } L = a + \frac{1}{1 + z1} \text{ Ln } S - \frac{z2}{z1 + z2} \text{ Ln } \left[\frac{w}{r}\right] \tag{7}$$

$$\text{Ln } C = b + \frac{1}{1 + z2} \text{ Ln } S - \frac{z1}{z1 + z2} \text{ Ln } \left[\frac{r}{w}\right] \tag{8}$$

The complete simultaneous equation model is presented in equations (9) to (16):

$$\text{Ln } S_i = \alpha_0 + \alpha_1 \text{ Ln } L_i + \alpha_2 \text{ Ln } C_i + \alpha_3 t_i \tag{9}$$

$$\text{Ln } L_i = \beta_0 + \beta_1 \text{ Ln } S_i - \beta_2 \left[\text{Ln } (W_i / P_i) - \text{LnEX}\right] \tag{10}$$

$$\text{Ln } W_i / P_i = \delta_0 + \delta_1 \text{ Ln } P \pm \delta_2 \text{ Ln } L_i + \delta_3 \text{Ln } Pr_i \tag{11}$$

$$\text{Ln } C_i = \in_0 + \in_1 \text{ Ln } S_i - \in_2 \left[\text{LnEX} - \text{Ln } (W_i / P_i)\right] \tag{12}$$

$$\text{Ln } D_i = \tau_0 - \tau_1 \text{ Ln } P_i + \tau_2 \text{ Ln } Y \tag{13}$$

$$\text{Ln } P_i = \sigma_0 - \sigma_1 \text{ Ln } Pr_i + \sigma_2 \text{ Ln } (W_i / P) \tag{14}$$

$$\text{Ln } S_i = \text{Ln } D_i \tag{15}$$

$$\text{Ln } S_i = \text{Ln } Pr_i + \text{Ln } L_i \; \textit{or} \; \text{Ln } Pr_i \equiv \text{Ln } S_i - \text{Ln } L_i \tag{16}$$

Endogenous variables are:

S_i = Manufacturing value added deflated by manufacturing price index.
L_i = Manufacturing employment in numbers.
W_i/P_i = Product wages in the manufacturing sector obtained by dividing employment cost by employment and deflating it by manufacturing prices i.e. P_i.
C_i = Value of fixed assets deflated by the machinery price index.
D_i = Demand for manufacturing output deflated by manufacturing price index i.e., P_i.
P_i = Manufacturing price index.
Pr_i = Labour productivity in manufacturing obtained by dividing deflated manufacturing value added by employment in manufacturing.

Exogenous variables are:

t_i = Technical change in the manufacturing sector.
P = Consumer price index.
EX = Effective exchange rate for capital goods.
Y = Disposable income i.e. GNP-Income and Corporation Taxes.

the α's, β's, δ's, $\in$'s, τ's and σ's are the parameters to be estimated.

Equation (9) is simply a Cobb-Douglas production function in a simultaneous equation framework. Keeping in mind the small sample properties of simultaneous equations when there are a number of explanatory variables and instruments, we used value added and not output as the dependent variable, as the latter would involve industrial cost i.e., another endogenous variable. Labour and capital are endogenous as already discussed while technical change is exogenous.[7]

Equation (10) is the labour demand equation after rewriting equation (7) where $\beta_0 = a$, $\beta_1 = [1/(1 + z_1)]$ and $\beta_2 = [z_2/(z_1 + z_2)]$; β_1 is the output elasticity of demand for labour and β_2 is the price elasticity of demand for labour. In the Keynesian model employment is constrained by aggregate demand, the inclusion of the output variable will capture the impact of demand on employment. But if increases in output are brought about with capital intensive techniques, then increase in demand will not lead

[7] In the earlier neo-Classical models technical change was disembodied like 'manna from heaven', and therefore exogenous. But the subsequent Vintage Model approach tended to treat the shift parameter in the production function as embodied, since it is affected by R & D and therefore endogenous e.g., Schott (1978). In Pakistan where R & D outlays are minimal, and the country imports most of the capital goods from abroad, there is justification for treating technical change as exogenous. Although we are aware that even in Pakistan the shift parameter can not be purely disembodied because embodied and disembodied technical change are basically interwined, and because we have not been able to separate the contribution of embodied technical change.

to a proportionate increase in employment. The value of β_1 will therefore reflect the employment-output trade-off in Pakistan's manufacturing sector. The price elasticity of demand for labour i.e., β_2 will test the neo-Classical argument of a negative relationship between wages and employment,[8] and if the argument holds then we expect β_2 to be negative.

Equation (11) relates product wages to the consumer price index. The expected sign of δ_1 is positive. It will reflect the extent to which prices lead wages. We have employment in the wage equation to test whether real wages move counter cyclically, varying inversely will output and employment as maintained by the neo-Classicals and the Keynesians, or move pro-cyclically as stated by Dunlop (1938), Tarshis (1939) and Barro and Grossman[9] (1971). The expected sign of δ_2 is negative if the neo-Classical and Keynesian theories hold, and positive if the counter argument holds. We also have productivity in the wage equation in order to explore the percentage of the increase in productivity passed on to the wage earners in the form of higher earnings in the existing oligopolistic market structure. The expected sign of δ_3 is positive.

Equation (12) is the demand for capital goods after rewriting equation (8) where $\in_0 = b$, $\in_1 = [1/(1 + z2)]$, and $\in_2 = [z1/(z1 + z2)]$. $\in_1$ is the output elasticity of demand for capital goods, and its expected sign is positive. Effective exchange rate for capital goods captures the effect of price of capital goods[10] and the foreign exchange availability into one variable, which is very desirable, keeping in mind the small sample properties of simultaneous equations discussed earlier. The expected sign of $\in_2$ is negative.

Equation (13) is the demand for manufacturing output, where τ_1 is the price elasticity of demand for manufacturing output, its expected value is therefore negative while τ_2 is the income elasticity of demand for manufactured goods, with a positive expected value.

Equation (14) is the price equation for manufactured goods. We have

[8] Dunlop (1938) did not find a negative relationship between employment and wages. Barro-Grossman (1971) maintained that at very low levels of aggregate demand, employment will be below the level predicted by real wages, and can therefore be increased without a fall in the real wage rate. Symons and Layard's (1984) conclusion that the neo-Classical model can not be refuted for the U.S.A., Canada, Japan, Germany, France and Britain during the period 1956 to 1980 is not convincing since the negative coefficient is significant only for Germany.

[9] Mitchell et al., (1985) found that during an expansion the share of younger and unskilled workers increases, and since they tend to earn less than older and skilled workers, the increase in the proportion of these workers imparts a downwards bias to the real wage rate. The opposite happens during a downswing. They found that wages behave pro-cyclically, and maintained that counter-cyclical aggregate wage behaviour is due to aggregation on account of change in employment shares.

[10] Effective exchange rate is also more appropriate because, of the total capital goods in use in the large-scale manufacturing sector in 1980-81, 95 per cent were imported.

productivity as an explanatory variable so as to explore the extent of benefits enjoyed by the consumers in the form of lower prices. The expected value of σ_1 is negative. We have real wages as an explanatory variable, in order to gauge the magnitude of causation from wages to prices,[11] and the expected value of σ_2 is positive.

Equation (15) states the identity between demand and supply of output, while equation (16) recognizes that labour productivity is an endogenous variable in our model.

We have checked the model for identification and found that according to the order condition all the equations are over identified, while according to the rank condition they are each identified.

III. Data Sources and Limitations

The main source of data for this paper is the Census of Manufacturing Industries (CMI) various issues. The data on manufacturing value added, employment, employment cost and capital stock all come from this source. It seems pertinent to point out some caveats to the CMI data at this point. First, although the study covers twenty-six years from 1955-56 to 1980-81, there are only fifteen observations. This is because the CMI surveys were not conducted every year. Second, the data have been subjected to a lot of criticism in Ahmed (1980) on account of non-response on the part of registered firms, under-registration of existing firms, etc. We however tried to explore whether any of the abberations in our data set were due to non-response, first by relating fluctuations in the labour index with similar fluctuations in the capital and value-added indices. Second, we related movements in the labour and capital indices to the number of reporting establishments. On both accounts we were unable to relate fluctuations in the data to non response [Wizarat, (1988)]. Third, the data on the capital input are in stock rather than flow terms. It would be ideal to do the analysis in terms of the flow of capital services, but as such data are not available, we have had no choice but to use whatever data were available.

Data on manufacturing price indices are from the 25 Years of Pakistan in Statistics and the 10 Years of Pakistan in Statistics. Disposable income is GNP obtained from the Pakistan Economic Survey minus income and corporation taxes, obtained from the 25 Years of Pakistan in Statistics, while the observation for the last year is from the Pakistan Economic Survey. Data on effective exchange rate for capital goods are from PIDE's

[11] Boehm (1984) found that causation was generally unidirectional from wages to prices in Australia during 1954–1982. During the first half of the 1970's bidirectional causation was detected, although causation from wages to prices was statistically more significant.

Econometric Model. The consumer price index (CPI) series are from the 25 Years of Pakistan in Statistics for the years 1955-56 to 1970-71, and from the Pakistan Economic Survey (1981-82) for the years 1975-76 to 1980-81. (The base year for these latter series was changed to 1959-60 by us).

IV. Empirical Findings

The model formulated in section II was applied to Pakistan's large scale manufacturing sector,[12] using the Two Stage Least Squares (2SLS) option for the TSP package to estimate the model. The results from our earlier single equation Cobb-Douglas production function have been reproduced from Wizarat (1988) in Table 1. This has been done to facilitate comparison between the two sets of results.

TABLE 1

Production Function Results from a Single Equation Estimation

Constant	Ln L_i	Ln C_i	t_i	n	R^2
−1.970	0.457***	0.552*	0.043*	15	0.993
(−1.015)	(1.982)	(4.868)	(7.438)	—	—

Note: *Significant at the one per cent level.
***Significant at the ten per cent level.
Source: Wizarat (1988).

[12] We applied this model to thirty-six industries at the 4-digit level of industrial classification. Because we tried to formulate a model with a common specification to aggregate as well as disaggregated group of industries, the model was mis-specified for the latter group with errors from this mis-specification varying from mild to gross on account of the following reasons:

1. Although the Cobb-Douglas production function seems to be the correct specification for most industries, Kmenta's approximation to the CES production function seemed more appropriate for some industries.
2. None of the variables in the wage equation were able to explain wage determination for the disaggregated industries, which implies that wages are centrally determined at the aggregate manufacturing level.
3. Our demand for capital goods equation uses effective exchange rate for capital goods, since in 1980-81 more than 95 per cent of the capital goods in use were imported. While this is true for total manufacturing, the percentage might be different for different industries. In some industries the capital goods may very well be indigenously produced, for example, bakery

Production Function Estimates

A comparison of production function estimates obtained from a single equation estimation (Table 1) with the ones obtained from a simultaneous model, (Table 2) reveals the following:

1. The magnitude of the coefficients change when a simultaneous model is used. We observe a decline in the magnitude of the capital coefficient from 0.552 to 0.379 and the time-trend coefficient from 0.043 to 0.039, while the magnitude of the labour coefficient has almost doubled from 0.457 to 0.846.
2. Single equation estimates give constant returns to scale, whereas the simultaneous model gives increasing returns to scale. This clearly shows that single equation estimates of returns to scale have been under estimated due to the simultaneous equation bias.
3. Because of change in the magnitude of the coefficients, there has been a tremendous change in the contributions of different sources to the growth of large scale manufacturing. These estimates are contained in Table 3. We find that the contribution of the capital input has been reduced substantially from 53.64 per cent to 36.84 per cent only. The contribution of the labour input has registered a spectacular increase from 18.45 per cent to 34.13 per cent, while the contribution of technological change has declined slightly from 28.68 per cent to 25.79 per cent. In single equation estimation there are constant returns to scale, whereas in the simultaneous equation model returns to scale add up to 1.225. The contribution of economies of scale was estimated following Denison (1967) as follows: 0.225/1.225 x 15.12 = 2.78 percentage points, which works out to be 18.39 per cent. Here 15.12 is the rate of growth of value added in the large scale manufacturing sector. It is very re-assuring to find that Ahmed (1980), working with a different data base and using a completely different methodology also reached the conclusion that economies of scale are an important source of growth in Pakistan's large scale manufacturing sector. Moreover, we find that due to some residual factor there is a retraction of 15.15 per cent from the growth of manufacturing value added.
4. We also observe declines in the significance levels of the labour and

products, knitting, thread and thread ball making, carpets and rugs, wearing apparel, footwear, leather and leather products, utencils, furniture and fixtures etc. For these industries the capital goods equation seems badly mis-specified.

4. For export oriented industries like carpets and rugs, textiles, leather and leather products, we have not incorporated exports in the demand equation.

On account of these mis-specifications the results obtained for the industries at the 4-digit level were implausible, they have therefore, not been reported in this paper.

TABLE 2

The Model Applied to Pakistan's Large Scale Manufacturing Sector – 1955-56 to 1980-81

Equation	Dependent Variable	Constant	Ln L_i	Ln C_i	t_i	Ln S_i	Ln(W_i/P_i)	Ln P	Ln Pr_i	Ln EX	Ln P_i	Ln Y	Ln(W_i/P)	n	R^2
9.	Value Added	−5.116 (−1.359)	0.846** (1.809)	0.379*** (1.696)	0.039* (4.969)									15	0.991
10.	Employment	4.994* (4.016)				0.594* (10.177)	−0.435** (−2.614)							15	0.969
11.	Product Wages	−0.156 (−0.039)	−0.276 (−1.180)					0.232* (2.768)	0.602** (2.353)					15	0.959
12.	Capital	1.860* (5.138)				0.981* (19.194)				−0.678* (−5.192)				15	0.978
13.	Value Added	−67.794* (−8.944)									−1.252* (−4.331)	3.503* (9.448)		15	0.946
14.	Price	16.298* (9.324)							−0.602* (−2.002)				3.092* (5.191)	15	0.849

Note: The model was estimated using both product wages and the factor price ratio in the labour demand equation. In the capital demand equation both effective exchange rate for capital goods (proxy for r) and the factor price ratio were used. Although the results obtained for both the models are quite similar, there is some decline in the t-ratios in all the equations and a decline in the Durbin Waston statistic in the capital demand equation (D.W. statistic 1.3) and in the output demand equation (D.W. statistic 1.0) in the model using factor price ratio. These results have therefore not been reported.

Figures in parenthesis are t-ratios.

*Significant at the 1 per cent level;
**Significant at the 5 per cent level;
***Significant at the 10 per cent level.

TABLE 3

Sources of Growth
(Simultaneous Equation Estimation)

Sources of Growth	Percentage Contribution
Capital	36.84
Labour	34.13
Technological change	25.79
Economies of scale	18.39
Residual	− 15.15
Total	100.00

capital coefficients, and an increase in the significance level of the time trend variable when a simultaneous model is used.

Productivity and Wages

The value of δ_3 in equation (11) shows that a one per cent increase in productivity leads to a 0.60 per cent (significant at the five per cent level) increase in wages. We therefore, find that although some of the benefits from increase in productivity have been passed on to the wage earners, the growth of real wages is less than the growth of productivity, due to which labour's share of income in net output might be falling. This is corroborated by our data which show that the share of labour in manufacturing value added declined from 37 per cent to 19 per cent during the period under review. Ahmed's (1980) analysis shows a similar downward trend in labour share. We find the behaviour of productivity and wages in Pakistan in marked contrast to that found for the developed countries, where the rate of growth of wages is higher than the rate of growth of productivity, due to which labour's share of income is increasing rapidly.

Productivity and Prices

The value of σ_1 is −0.620 and is significant at the one per cent level, reflecting that some of the increases in productivity have been passed on to the consumers, while the rest have been appropriated by the industrialists. We find prices more flexible than did Ahmed (1980) whose estimates were −0.20 and −0.40 in the two equations that he reported.

The inflexibility is in conformity with the theoretical expectation that in an oligopolistic setting, the presence of technical discontinuities, barriers to entry and market imperfections prevent the cost reductions due to productivity growth to lead to instantaneous and proportionate price reductions.[13]

Employment-Output Trade Off

Output elasticity of demand for labour i.e. β_1 in equation (10) is 0.594 (significant at the one per cent level), compared with the output elasticity of demand for capital goods i.e., $\in_1$ in equation (12) of almost one (also significant at the one per cent level). The analysis shows that while a one per cent increase in output leads to a proportionate increase in the demand for capital goods, the increase in the demand for labour is just over half, which reflects a bias towards capital intensive techniques.[14] Ahmed and Stern (1985) reported elasticity of employment with respect to value added of 0.28 for Pakistan for the period 1961–1972, which is much lower than ours. It is quite likely that during the 1960's which was a period of rapid industrial development, techniques were more capital intensive than they are over the longer period under our consideration. And this is corroborated by Ahmed's (1980) finding that the long-run elasticity of employment with respect to output is about 0.5.

Employment and Wages

The value of β_2 in equation (10) is negative and statistically significant, lending support to the neo-Classical argument that increase in wages lead to a decline in the employment level. In equation (11) δ_2 is negative pointing in the direction of counter-cyclical wage behaviour as postulated by neo-Classical and Keynesian theories, but the evidence is inconclusive since the coefficient is not statistically significant at any of the conventional levels. The insignificance of the estimated coefficient on δ_2 may have been due to the inclusion of both employment and labour productivity in the wage equation, and the resulting collinearity between δ_2 and δ_3.

[13] See for example Sylos Labini (1969), Baran and Sweezy (1966), Sutton (1975) and Ahmed (1980).

[14] Both Khan (1970) and White (1974) reported that capital intensities in Pakistan are one of the highest in the world.

Wages and Prices

Although we have empirical evidence to support bi-directional causation between wages and prices, causation from wages to prices is stronger than the one from prices to wages. The value of δ_1 is only 0.232 compared with the value of σ_2 of 3.092 (both statistically significant at the one per cent level).

V. Summary and Conclusion

1. The single equation estimates of the contribution of factor inputs, technical change and returns to scale may have been biased on account of simultaneity. Removal of the simultaneous equation bias led to a change in the magnitude of the coefficients, their significance levels and the returns to scale estimates, which led to a marked change in the sources of growth estimates.
2. We find that although some of the increase in productivity was passed on to the wage earners, the rate of growth of wages is less than the rate of growth of productivity, due to which the share of labour in manufacturing value added might be declining.
3. Prices have been rather inflexible on account of which the capital share of income might be increasing.
4. There are indications that on account of capital intensive techniques of production, employment in the large scale manufacturing sector is not keeping pace with the increase in output in this sector.
5. We find empirical support for the neo-Classical argument that wage increases are having a dampening effect on the demand of labour, but for the counter cyclical wage behaviour postulated by the neo-Classicals and the Keynesians, the evidence is inconclusive.
6. Although there is bi-directional causation between wages and prices, causation from wages to prices is more pronounced, reflecting the magnitude of cost push inflation in Pakistan's manufacturing sector.
7. And lastly, we find that both demand and supply side factors are providing stimulus to manufacturing output growth in Pakistan.

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