## Communication

# Substitution Elasticities in the Large-Scale Manufacturing Industries of Pakistan — A Rejoinder

A. R. KEMAL[*]

Estimates of the elasticity of substitution between capital and labour in 16 manufacturing industries and the manufacturing sector of Pakistan as a whole were reported in [18]. In most of the industries and the manufacturing sector as a whole substitution elasticities were found to be rather low. In the Spring 1982 issue of this *Review*, Ahmed [1] has suggested that the estimates of substitution elasticities may have been biased downwards due to the irrelevance of production functions in the developing countries and the nature of data employed in the study. He also believes that the evidence we presented regarding low substitution elasticities in the other developing countries was selective because according to him Morawetz [23] provides evidence to the contrary. Furthermore, he argues that low substitution elasticities are inconsistent with the declining share of labour in the output. In the following, without being drawn into polemics, we shall show that Ahmed's comments are a result of his misunderstanding and misinterpretation of our study.

Broadly speaking, Ahmed's comments may be divided into four parts: (i) conceptual and estimation problems relating to production functions; (ii) nature of data used in our study and their effect on the estimates of substitution elasticities; (iii) comparison of the substitution elasticities in Pakistan with those in other developing countries; and (iv) problems relating to interpretation of results and drawing of policy implications from the analysis. These comments are taken up in this same order.

### Production Function Analysis

Problems relating to production function analysis are quite well-known and well-documented in the literature. Therefore, we shall very briefly discuss issues

relating to the relevance of production functions in developing countries. The basic problem associated with the production function analysis is that capital and labour inputs — aggregates of elements that are basically heterogeneous — are assumed to be homogeneous. Although aggregation problems are equally relevant to both the factor inputs, aggregation of capital input has been more controversial. Mrs. Joan Robinson [27] and Kaldor [12] among others have argued that it is impossible to construct an index of capital stock because capital is essentially a value concept which is not independent of relative prices and distribution of income. If the capital is a value concept, one is confronted with problems of re-switching of techniques and capital reversals which render the concept of factor intensity meaningless and the neo-classical production function ceases to exist. However, the neo-classicists argue that under certain assumptions of malleability of capital goods, aggregation of capital is ensured. For details of the malleability conditions, see Samuelson [29].

The main problem associated with the existence of production function, as discussed above, is that the existence and relevance of production function is independent of the stage of development of a country, contrary to Ahmed's suggestion that the production functions may exist in developed countries but they are not very relevant in developing countries. As regards imperfections in markets, it should be noted that manufacturing industries in both developing and the developed countries are characterised by imperfect markets; the markets are either monopolistic or oligopolistic.

Substitution elasticities in Pakistan were obtained by estimating CES and VES production functions, both of which are non-linear. Both production functions have generally been estimated indirectly on the basis of an implicit assumption that markets are perfectly competitive. If imperfections in the market are allowed for, then it is assumed that the rate of factor exploitation has not changed in any significant way over time. As pointed out earlier, the rate of factor exploitation has not increased in any significant way in Pakistan; see Irfan [11].[1]

### Nature and Quality of Data

The elasticities of substitution between capital and labour reported in the study mentioned above were estimated by employing data contained in Kemal [14 and 15] and not just [14], as suggested by Ahmed. Consistent time-series data relating to capital stock, labour, employment cost, value of production, value added at market and factor cost on sixteen manufacturing industries of Pakistan were presented in the two studies. The census of manufacturing industries (CMI) data were adjusted for non-response and undervaluation of capital stock to arrive at the series of data reported in the two studies.

[1]Ahmed suggests that changes in factor share are a manifestation of distortions in the market. How changes in factor shares can be necessarily taken as a result of distortion is incomprehensible.

The CMI data suffered from significant non-response with the result that value added, labour, employment cost, capital stock and other relevant data were understated. In a meaningful time-series analysis, the need for time-series data fully adjusted for the non-response, cannot be overemphasised. Accordingly, in [14] an indirect technique was employed to generate consistent time-series data. Since data on investment for the entire period, and on capital stock for 1959-60 and 1963-64 were available, we constructed a series of book values of capital stock which did not suffer from non-response. The series of capital stock was generated with the use of the declining-balances method and by employing the rates of depreciation allowed by the government. We may note that the book values reported in the CMI are also arrived at by employing depreciation rates allowed by the government. The ratios of capital stock to other variables for each year were taken from various CMIs. These ratios together with the adjusted book values of capital stock yielded estimates of value of production, cost of production, labour, employment cost, value added, etc. In [15], capital stock data were adjusted for changes in the price of capital goods and the differences between the rates of depreciation allowed by the government and the actual depreciation rates.

Norbye [24] disagreed with our adjustment procedures and argued that, in arriving at the book values firms might not have applied depreciation rates allowed by the government. He doubted the quality of the investment data employed in the generation of capital stock series. Moreover, he argued that the double deflation method should have been preferred over the single deflation method for computing value added at constant prices. In order to substantiate his claim that our adjustment procedures were suspect, he pointed out fluctuations in employment in some of the industries. He also pointed out that indirect taxes reported in the consistent series differed from those contained in the Central Board of Revenue (CBR) files. To Norbye's comments, we replied in [16]. Of course, in [25] Norbye replied to our rejoinder, but he raised the same issues once again to which naturally, there was no need to respond.

In our rejoinder to Norbye, we argued that since tax holidays and accelerated depreciation allowances were provided as incentives to the industrialists, firms always liked to make the most use of these facilities. Therefore, it was safe to assume that book values reported in the CMI were derived in accordance with the depreciation rates allowed by the government than the otherwise. As regards investment data, we had already pointed out the problems associated with the data in [14], and argued that margin of error, due to limitations of investment data, was not significant. We also pointed out problems regarding the method of double deflation. In particular, the double-deflation method may yield negative value added at constant domestic prices. In addition to pointing out differences in the indirect tax data from the CBR files as reported by Norbye and those contained in the CBR files, we pointed out differences in the procedures of recording of indirect taxes in

the CMI and the CBR. Independent evidence from physical production, wherever available, was presented to show that the fluctuations in employment noted by Norbye were a reflection of fluctuations in output. Trends in the physical production data and the National Accounts data supported trends in the consistent time-series. Therefore, we concluded that there was nothing in Norbye's comments which should deter anyone from using these data for a time-series analysis.

It is interesting to note that Ahmed makes a sweeping statement that these data are liable to generate grossly misleading and spurious results. But why and how these data will lead to misleading and spurious results are questions which Ahmed unfortunately slurs over. We may also point out that the estimates of CES production function (corresponding to constant returns to scale) are based on unadjusted data because the production function relates productivity of labour to wages. The substitution elasticities were low even in this case. We may also point out that consistent time-series data are significantly better than the unadjusted CMI data because they take care of the problems of non-response and under-valuation of capital stock. Therefore, even though the data used in our study may have suffered from some shortcomings, these are the best set of data available for the period from 1959-60 to 1969-70.

### Substitution Elasticities: An International Comparison

As pointed out earlier, elasticities of substitution between capital and labour in most of Pakistan's manufacturing industries and the manufacturing sector as a whole are low, although in four manufacturing industries they do exceed unity.[2] To show that the substitution elasticities are low in other developing countries as well, we presented evidence from Argentina, Bangladesh, India, Israel and Chile. However, Ahmed alleges that our sample was purposive because, according to him, studies showing higher elasticities of substitution were left out. In this context, he makes a reference to Morawetz [23]. Interestingly enough, Morawetz does not contain any reference to such studies. In the following, we summarise the results of the studies analysed in Morawetz [23], in addition to those quoted in our study in order to show that the substitution elasticities in other developing countries are in line with

those obtained for Pakistan. Substitution elasticities in various developing countries are reported below :

1.  For Peru and United States, the plant-level substitution elasticities estimated by Clague [6] varied between zero and 0.5 with most of them below 0.3. The estimates of substitution elasticities for engineering varied between zero and 1.1.

2.  Reynold and Gregory [26] reported cross section estimates for Puerto Rico which averaged one.

3.  The substitution elasticities for Argentina, Chile, El Salvador, Korea, Paraguay, Peru, Portugal and Spain, as reported by Daniels [7], ranged between 0.4 and 1.8 depending on the country and the industry.

4.  Cross section estimates of substitution elasticities for Latin American countries obtained by Eriksson [9] averaged about 0.7.

5.  Cross-section estimates obtained by Bruton [5] range between 0.6 and 1.0 for Mexico and between 0.5 and 1.2 for 22 developing countries.

6.  Time-series estimates of substitution elasticities obtained by Harris and Todaro [10] for three sectors and the aggregate averaged around 0.8.

7.  Time-series estimates, obtained by Tidrick [32] for six industries in Jamaica, average about 0.6.

8.  Substitution elasticities obtained by Behraman [3] for nine industries in Chile averaged around 0.8.

9.  Diwan and Gujarati [8] estimated substitution elasticities ranging between very low values and 0.98.

10. Katz [13] obtained susbstitution elasticities ranging between very low values and 1.00 for various industries and 0.36 and 0.43 for the manufacturing sector as a whole corresponding to two different periods of time.

11. Williamson [30], using pooled cross-section and time-series data for the Philippines, found estimates ranging from 0.4 to greater than unity.

12. Roemer [28], using pooled and cross-section data for Ghana, found substitution elasticities ranging between 0.7 and 1.3.

Substitution elasticities range between very low values and 1.66, and the elasticity for manufacturing sector as a whole is 0.88 for Pakistan as reported in [18].[3]

Before drawing conclusions on the basis of international comparison of the substitution elasticities, it should be noted that cross-section elasticities are always higher than time-series elasticities because the former refers to long-run and the

---

[2] Ahmed has suggested that if we get negative substitution elasticities or if the substitution elasticities vary with changes in specification, econometrics is reduced *ad absurdum*. Probably he is unaware of the fact that it is not very uncommon to get perverse results. Moreover, changes in specification will affect the coefficient to the extent to which the coefficient is biased by the omission of variables which have been included later. Negative substitution elasticities for some industries have been found in numerous studies. For example, see McKinnon [22], Diwan and Gujarati [8] and Katz [13].

[3] These estimates have been derived through VES production function. Elasticities corresponding to CES function range between low values and 1.92, with an average of 0.56.

latter to short-run elasticities. Therefore, the comparison of results for Pakistan is strictly valid only with the time-series results for other countries. However, even if cross-section results are also considered for comparison, it comes out very clearly that the range of substitution elasticities for the manufacturing industries and the average elasticity for the manufacturing sector as a whole in other countries in general, are no higher than those obtained for Pakistan. Therefore, there is no truth in the allegation that our sample of developing countries was purposive. Elasticities of substitution are low in all the developing countries.

### Interpretation of Results

In this section, we shall discuss three main issues related to the interpretation of results and drawing of policy implications from those results. The three issues are: high capital intensity in the manufacturing industries of Pakistan, the presence of inefficiencies in various manufacturing industries of Pakistan and decline in the share of wages in Pakistan.

Capital intensity in any sector may be measured either by capital-labour ratio or by the capital-output ratio. Both measures are quite useful and the ranking of activities according to capital intensity by these two measures is not necessarily the same. It is well known and well documented that the real contribution of manufacturing industries per unit of capital is low in Pakistan, Therefore, it should hardly appear a 'bizarre' statement to anybody that capital-output ratio in Pakistan is one of the highest in the world. Ahmed distorted this statement by replacing capital-output ratio by capital-labour ratio and then went on to argue that capital-labour ratio in Pakistan cannot possibly be higher than that in the United States.[4] Since our measure of capital intensity was capital-output ratio and not capital-labour ratio, his whole discussion is irrelevant in the context of our study.

The efficiency of the manufacturing industries of Pakistan during the Sixties has been extensively analysed. For example, see Soligo and Stern [31], Lewis and Guisinger [20], Balassa [2], Little Scitovsky and Scott[21]. All of these studies concluded, on the basis of the significant difference between value added at domestic prices and value added at world market prices, that the industries in Pakistan were very inefficient. We argued in [17] that the difference between value added at world prices and that at domestic prices could not be attributed to inefficiency alone because a part of the difference could be accounted for by excess profits, higher

---

[4] we may point out that although Khan [19] presented estimates of capital-labour ratios for 1962-63 only, the estimates for capital-labour ratios for other years are available in Kemal [15]. The study also contains capital-output ratio for the Sixties. Ahmed's argument that Khan's estimates were biased upwards because of the nature of the 1962-63 CMI falls to the ground because the same or even higher capital intensities are observed in other years.

wages and higher prices of non-traded inputs. The study showed that for manufacturing sector as a whole, inefficiency explained only a small portion of the difference and the dynamic learning effects resulted in a decline in the inefficiencies. However, it will be incorrect to hastily conclude from these results that the manufacturing sector does not suffer from inefficiencies. The study for the manufacturing sector as a whole conceals technical and x-inefficiencies prevalent in various industries and allocative inefficiencies across various industries. It may be noted from the same study, that while some of the industries were highly efficient, others were terribly inefficient so much so that the value added at world market prices was even negative in one case. The allocation of resources to inefficient industries in the presence of very efficient industries is nothing but 'allocative inefficiencies' which should not 'surprise' anybody. Moreover, contrary to Ahmed's results, we found a very strong positive association between inefficiencies and the level of protection. Since Ahmed might not have accounted for other variables effecting the level of inefficiencies, such as concentration in the product market, he might have got biased estimates.

The third major issue relates to the decline in the share of wages when capital-labour ratios have slightly increased over time and capital labour substitution elasticity is less than unity.[5] Ahmed argues that the declining wage shares are inconsistent with the regime of neutral technical change. He believes that the technical change in Pakistan is neutral and he seems to infer this from my study [17]. It is most unfortunate that he has misinterpreted and misquoted my study. While in a number of industries, technical change was neutral, for the manufacturing sector as a whole it was capital-augmenting and the magnitude of bias in technical change was about .0219.[6] This warrants a decline in the wage share which has been observed over time. Therefore, there is no inconsistency in declining wage shares and elasticity of substitution being less than unity. It should be noted that the share of wages would not have fallen in any significant way, even if the substitution elasticity had exceeded unity. See Bronfenbrenner [4].

### CONCLUSIONS

The foregoing review of comments made by Ahmed leaves one wondering as to what should be made out of his suggestions. It shows that Ahmed has completely

---

[5] We would like to point out that since our study related to the 1959-60 to 1969-70 period, Ahmed's comparison of our results with a decline in wage shares over a period from 1958 to 1971 is not very meaningful especially because of wide fluctuations in the wage share over time. It should have been much more meaningful to estimate trend in order to see the direction and extent of changes in the wage share.

[6] We argued in the study that the capital-augmenting change was a reflection of the fact that capital utilization increased significantly over time; our capital stock data did not account for changes in the capital utilization over time.

failed to understand our study and his comments are a product of his misunderstanding, misinterpreting and, at times, even misquoting of our studies. Of course, there are some shortcomings in the data employed in the study, but such shortcomings are present in any set of data relating to developing countries. We shall be eagerly looking forward to a study on substitution elasticities based on data which do not suffer from any shortcomings and meet all the assumptions required for estimating a production function.

Let us summarise the main points emerging from the above discussion. The elasticities of substitution between capital and labour in the manufacturing sector of Pakistan are low as they are in most of the other developing countries. Capital-output ratios in Pakistan are higher than even those of developed countries, which shows both high capital intensity and degree of inefficiency in the use of capital. The bureaucratic advice that an underdeveloped country should blindly import technology instead of developing its own, because it cannot develop its technology is incorrect and therefore should be safely ignored. We must develop our own technology, guided by our factor endowment, and changes in techniques should correspond with changes in factor prices.

## REFERENCES

1.  Ahmed, Meekal. "Substitution Elasticities in the Large-Scale Manufacturing Industries of Pakistan: A Comment". *Pakistan Development Review*. Spring 1982.

2.  Balassa, B. *The Structure of Protection in Developing Countries*. Washington, D.C.: IBRD. 1971.

3.  Behraman, J. "Sectoral Elasticities of Substitution between Capital and Labour in Developing Economy: Time Series Analysis in the Case of Post War Chile". *Econometrica*. March 1972.

4.  Bronfenbrenner, M. "A Note on Relative Shares and the Elasticity of Substitution". *Journal of Political Economy*. May-June 1960.

5.  Bruton, Henery J. "The Elasticity of Substitution in Developing Countries". Williamstown, Massachusetts: Williams College, Center for Development Economics. 1972. (Research Memorandum No. 45)

6.  Clague, C. K. "Capital-Labour Susbstitution in Manufacturing in Underdeveloped Countries". *Econometrica*. July 1969.

7.  Daniels, Mark R. "Differences in Efficiency among Industries in Developing Countries". *American Economic Review*. March 1969.

8.  Diwan, R. K., and D.N. Gujarati. "Employment and Productivity in Indian Industries: Some Questions of Theory and Policy". *Artha Vijnana*. March 1968.

9.  Eriksson, John R. "Wage Policy and Economic Development in Latin American Countries". *Tijdschrift Voor Sociale Welenschappen*. 1969.

10. Harris, John R., and Michael P. Todaro. "Wages, Industrial Employment and Labour Productivity: The Kenyan Experience". *Eastern Africa Review*. June 1969.

11. Irfan, M. "Wage Structure in Pakistan". Unpublished Ph. D. Thesis, Cornell University, Ithaca, New York. January 1980.

12. Kaldor, Nicholas. "Marginal Productivity and the Macro-Economic Theories of Distribution". *Review of Economic Studies*. July 1966.

13. Katz, J. *Production Function, Foreign Investment and Growth*. Amesterdam: North Holland Publishing Company. 1969.

14. Kemal, A. R. "Consistent Time Series Data Relating to Pakistan's Large-Scale Manufacturing Industries". *Pakistan Development Review*. Spring 1976.

15. Kemal, A. R. "Sectoral Growth Rates and Efficiency of Factor Use in Large Scale Manufacturing Sector in West Pakistan". *Pakistan Development Review*. Winter 1976.

16. Kemal, A.R. "Are 'Consistent Time Series Data Relating to Pakistan's Large Scale Manufacturing Industries' Inconsistent? A Reply". *Pakistan Development Review*. Spring 1978.

17. Kemal, A. R. *An Analysis of Industrial Efficiency in Pakistan: 1959-60 to 1969-70*. Ph.D. thesis submitted to the University of Manchester, Manchester (U.K.). 1978.

18. Kemal, A. R. "Substitution Elasticities in the Large-Scale Manufacturing Industries of Pakistan". *Pakistan Development Review*. Spring 1981.

19. Khan, A. R. "Capital Intensity and the Efficiency of Factor Use". *Pakistan Development Review*. Summer 1970.

20. Lewis, S., and S. Guisinger. "Protection in a Developing Country — Case of Pakistan". *Journal of Political Economy*. Nov.-Dec. 1968.

21. Little, I., T. Scitovsky and M. Scott. *Industry and Trade in Some of the Developing Countries*. Paris: OECD. 1970.

22. McKinnon, R. "The CES Production Function Applied to Two-Digit Manufacturing and Three Mining Industries for the United States". Unpublished. Reported in Marc Nerlove's article "Recent Empirical Studies of the CES and Related Production Functions", in Murray Brown (ed.). *The Theory and Empirical Analysis of Production*. New York: National Bureau of Economic Research Studies in Income and Wealth. 1967.

23. Morawetz, David. "Elasticities of Substitution in Industry: What do we Learn from Econometric Estimates". *World Development*. Vol. 4. January 1976.

24. Norbye, O.D.K. "Are 'Consistent Time Series Data Relating to Pakistan Large Scale Manufacturing Industries' Inconsistent? A Comment". *Pakistan Development Review*. Spring 1978.

25. Norbye, O.D.K. "Are 'Consistent Time Series Data Relating to Pakistan's Large-Scale Manufacturing Industries' Inconsistent? Remarks to A. R. Kemal's Reply to a Comment". *Pakistan Development Review*. Winter 1978.

26. Reynold, L. G., and P. Gregory. *Wages, Productivity and Industrialization in Puerto Rico*. Homewood: Richard D. Irwin. 1965.

27. Robinson, Joan. "The Production Functions and the Theory of Capital". *Review of Economic Studies*. 1953.

28. Roemer, Michael. "The Neo-classical Employment Model Applied to Ghanian Manufacturing". Cambridge: Massachsetts Harvard University, Development Research Group. 1972. Mimeographed (Economic Development Report No. 225)

29. Samuelson, Paul A. "Parable and Realism in Capital Theory: The Surrogate Production Function". *Review of Economic Studies*. 1962.

30. Williamson, Jeffery G. "Capital Accumulation, Labour Saving and Labour Absorption Once More". *Quarterly Journal of Economics*. Feb. 1971.

31. Soligo, R., and J. Stern. "Tariff Protection, Import Substitution and Investment Efficiency". *Pakistan Development Review*. Summer 1965.

32. Tidrick, Gene M. "Wages, Output and Empolyment Lag in Jamaica". Williamstown, Massachusetts: Williams College, Center for Development Economics. 1970. (Research Memorandum No. 40)