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Shahnaz Kazi, Zahira Saleem Khan, Seemin Anwar Khan

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Production Relationships in Pakistan's Manufacturing Industries

SHAHNAZ KAZI, ZAHIRA SALEEM KHAN and SEEMIN ANWAR KHAN*

Introduction

Despite the fact that there are great disparities in factor endowments, techniques employed in the manufacturing sector of underdeveloped labour surplus countries are comparable to those of highly industrialized capital abundant countries like the United States. A.R. Khan in his paper on capital intensities and factor use [13] concluded from an international comparison of factor intensities that Pakistani capital intensities are near the American level in a number of industries while in some cases they are even higher.

Explanations of this paradox are based on two different assumptions regarding the magnitude of the elasticity of substitution between capital and labour. On the one hand it is assumed that the elasticity of substitution and thereby the possibility of labour absorption via changes in factor prices are very limited due to the dominance of techniques borrowed from the West and oriented to the needs of capital rich nations. On the other hand, significant substitution possibilities are assumed in production techniques and the presence of high capital intensities in the industrial sector is attributed to distortions in the factor markets in the form of exchange rate regulations, low rates of bank borrowing, etc., which lead to the price of capital being much lower than it's social cost.

Empirical estimates of elasticities in the manufacturing sector for a number of developing countries seem to suggest that considerable potential for capital-labour substitution exists in a number of industries [4]. For Pakistan no attempt has been made to estimate inter-industry variation in the elasticity parameter, however, some work has been done for the manufacturing sector as a whole [8], [1].

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In this paper an attempt is made to estimate these statistical relationships. The elasticity of substitution for manufacturing as a whole and for selected industries is estimated utilizing cross-section and time series data and compared with estimates obtained for other developing countries. Also, an attempt is made to estimate the returns to scale of the selected industries.

The paper consists of three sections. The first section discusses the methodology and data. The second section estimates the elasticities of substitution and compares these with estimates for other developing countries. The final section presents the conclusions of the analysis.

Model and Assumptions

We begin by assuming a specific form for the production function. There are several types to choose among and the form chosen is the Constant Elasticity of Substitution (CES) production function of Arrow, Chenery, Minhas, and Solow [2]:

$$(1) \quad Y = \gamma \left[\delta K^{-\beta} + (1-\delta) L^{-\beta}\right]^{-v/\beta}$$

where Y, K and L represent output, capital, and labour; and γ, δ, v, and β are the efficiency, distribution, scale, and substitution parameters.

By definition, the elasticity of substitution, σ, relates a proportional change in relative factor inputs to a proportional change in the marginal rate of substitution of labour for capital. For the CES production function, this elasticity derives from the substitution parameter by the following relation:

$$\sigma = \frac{1}{1+\beta}$$

Further assuming perfect competition in factor and product markets and constant returns to scale, Arrow, *et al.*, derived an indirect method of estimating σ from (1) by using the profit maximization condition of equating wages to marginal revenue product.

The derived estimation form of the CES production function is specified as follows:

$$(2) \quad \text{Log } V/L = a + b_1 \log W + u$$

Where V/L is value added per man, W is the nominal wage, and b_1 is the elasticity of substitution. The latter measures the impact of changes in factor prices on labour productivity via changes in factor proportions. An increase in wages leads to a substitution of capital for labour and thereby to an increase in labour productivity. The higher the values of b_1 the greater is the impact on productivity per man of a given increase in wage levels.

The above formulation, inspite of its restrictive assumptions has been utilized in most empirical studies for underdeveloped countries since it does not require a capital stock variable thereby doing away with problems related to capital stock data e.g. adjustment of book value figures, lack of capital price deflators, adjustments for capacity utilization etc.

Allowing for non constant returns to scale[1] the estimation equation can be written as follows:

(3) $\text{Log } V/L = a + b_1 \log W + b_2 \log V + u$

The coefficient of V measures the marginal effect of changes in output on labour productivity. The scale parameter (v) derives from b_2 by the following relation:

$$b_2 = \frac{(1 - \sigma)\ (v - 1)}{v}$$

where values of v greater (less) than unity denote increasing (decreasing) returns to scale. Note that the direction of the bias in b_1 which results due to the omission of the value added variable, V, in (2) would depend on the coefficient of log V and the relationship between value added and wages—if the two are positively correlated and there are increasing returns to scale along with $\sigma < 1$ then the bias is upward.

The forms of the above two equations appropriate for time series analysis are:

(2′) $\log V'/L = a + b_1 \log W' + ct + u$

and

(3′) $\log V'/L = a + b_1 \log W' + b_2 \log V' + ct + u$

where t is a time trend variable,[2] and V′ and W′ are value added and wages, respectively, deflated by an industry product price index.

Previous econometric studies of the elasticity of substitution indicate that the elasticity parameter is highly sensitive to the type of data used. Generally, estimates based on cross section data show larger values of σ than time series estimates. This is bacause cross sectional data tends to impart an upward bias to the elasticity parameter due to "positive correlation between size of operation and technical age on labour productivity on the one hand and wages on the other" [14]. Also, Gaude in his survey article [6] attributes the tendency for lower values of time series estimates to "simultanity between inputs and their prices, misspecification of adjustment lags between inputs and outputs and the dominance of cyclical conditions—e.g. underutilization of capacity". Finally, in time series data further problems arise in the empirical estimation of the scale parameter due to the difficulty of isolating the effect of economies of scale and technological change.

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[1]Here it should be noted that the presence of increasing returns to scale is not compatible with the assumptions of perfect competion and profit maximization since this would lead to factor payments being greater than total product. Due to lack of time series data we could not incorporate a variable for market imperfections into the model therefore estimates for (2) should be viewed keeping in mind this potential specification bias. Furthermore the direction of the bias cannot be ascertained without adequate information about the relationship between a measure of monoply power and wages.

[2]Allowing for partial adjustment in the current period of inputs to factor prices, time series estimates of elasticities were also derived from the following Koyck type lagged form used by Behrman [3]:

$\text{Log } V/L = (1-\lambda) \text{ Log } V/L_{t-1} + \lambda b_1 \log W + \lambda ct + u$ where λ is the adjustment factor. Only when the value of λ is equal to unity is the adjustment completed in the current period. This formulation also enables comparison of short run and long run values of elasticity. However, the results were insignificant.

Data and Variables

The cross-section estimates for twelve selected two-digit industries are based on Census of Manufacturing Industries (CMI) [15] data (1969-70). For each industry estimation the units of observation are groups of firms classified by fixed asset size for Punjab and Sind. The choice of industries is based on the availability of a reasonable number of observations. Inter-industry cross section estimation requires that factor prices vary within the industry. For Pakistan it has been noted [7] that considerable wage differentials by firm size do exist hence justifying the use of this model.

Equations (2) and (3) were also estimated with a dummy variable for provinces taking on the value of unity for Punjab and zero for Sind, thereby enabling each province to have its own intercept to account for differences in regional efficiency while maintaining the assumption of uniform elasticities. However, the estimated coefficients of the dummy variables were insignificant.

For the time series estimates, CMI data is available for these twelve selected two-digit industries from 1954 to 1969-70 with the exception of four years (1956, 1960-61, 1961-62, 1967-68). For these years product price-indices are obtained from 25 *Years of Pakistan in Statistics* [16].

A few words on the quality of the above data are in order. The time series CMI data suffers from considerable under-coverage. Kemal [11] points out that: "The rate of [gross] under-coverage not only has been very high but also fluctuated quite considerably over time. The rate was as high as 46.2 percent in 1963-64 but was only 8.4 percent in 1959-60". Moreover, there have been changes over time in the definition of certain variables. Also, note that the aggregative definition of sectors, implied by use of the two-digit industry classification, indicates an upward bias for time series estimates. Changes in factor prices affecting not only choice of techniques but also changing the composition of output. The results should be judged keeping in view the above data limitations.

The data necessitates the following specific definitions of the variables used in the study:

(1) Gross value added (V): Depreciation changes have not been deducted since they depend on tax policy rather than on capital consumption. Time series data on value added is deflated by a wholesale product price index. A true value added deflator could not be used for lack of detailed information on intermediate inputs and their prices.

(2) Employment (L): This includes production workers, other administrative and supervisory staff, and unpaid workers.

(3) Wage Rate (W): This is the average wage obtained by dividing total employment cost [including wages, salaries, and other cash and non cash benefits] by the number of employees. For time series data the average wage is also deflated by the wholesale price index.

Statistical Results

A. Comparison of Time Series and Cross Section Estimates

The regressions results for equations (2) and (2′) fitted for cross section and time series data are given in Appendix Table 1. There are three general observations which emerge from these results. First the time series estimates have consistently higher R^2, as compared to their cross section counterparts. The only exceptions being the paper and leather industries. Cross section estimates on the other hand show extremely poor fits for food, textiles, leather, and electrical machinery with R^2 ranging from 0.01 to 0.09. It seems that the model does not have much explanatory value for these cases.

Second, the time series estimates of σ are lower Industries than those derived from cross section data for a majority as can be seen from Table 1. For seven out of a total of thirteen categories industries cross section estimates of elasticities are greater than unity as compared to four for time series. Furthermore in only four out of thirteen estimations is the cross sectional elasticity not significantly different from zero, as compared to nine for time series. Katz [10] comparing the values of σ for different industries in Argentina observes that the time series value of this parameter are lower than its cross sectional counterpart. As noted in the section on Model and Assumptions, this phenomenon is common in other studies also.

Table 1

Cross Section and Time Series Elasticity Estimates

Industry	Equation 2	Equation 2′	Equation 3	Equation 3′
1. All industries	1.17	—0.22	0.72	—0.13
2. Textiles	0.18	0.46	0.35	0.35
3. Food	—0.30	0.26	—0.96	0.25
4. Leather	0.46	0.49	—0.01	—0.13
5. Footwear	0.71	1.02	0.37	0.33
6. Rubber	1.79	1.35	—0.72	0.68
7. Chemicals	1.86	1.59	0.75	0.65
8. Basic Metals	1.29	0.32	0.53	0.52
9. Non-Metallic Minerals	1.64	—1.76	0.87	0.62
10. Printing and Publishing	1.73	1.52	0.81	0.87
11. Electrical Machinery	0.81	0.87	—0.62	0.45

Third, for both time series and cross section data consistently high estimates of σ are obtained for chemicals, printing and publishing, and rubber. However, the estimates for food, textiles, and leather are not significantly different from zero in both cases. For many of the remaining categories, e.g. basic metal, non-metallic minerals, and footwear, the elasticity parameter is extremely sensitive to the type of data used.

B. Comparison of Alternative Specifications for Cross Section Data

Appendix Table 2 gives the cross section regression results for equations (2) and (3). Addition of the output variable (V) in (eq. 3) improves the fit for all industries. For food, textiles, leather, and electrical machinery the R^2 increases from extremely low values to relatively high values of around 0.5 or more. The value of the elasticity parameter falls in all but two cases (textile and electrical machinery) which is to be expected in view of a positive correlation between wages and value added across firm sizes. Where in the first case there are a number of industries with values of σ greater than unity, in the second formulation all values are below unity. Furthermore, the number of positive and significant parameters drops from nine to four (non-metallic minerals, machinery except electrical, chemicals and metal products). In the case of σ being very small, variations in labour productivity are explained by changes in output levels rather than movement in wages.

The coefficient of the V variable, b_2 is highly significant in all cases except machinery and metal products.

C. Comparison of Alternative Specifications for Time Series Data

Results for equations (2′) and (3′) for time series data are summarised in Appendix Table 3. As in the previous case of the cross-section estimations the introduction of the V variable for the time series estimations improves the fit for all industries. However, the degree of improvement is much smaller than that obtained for cross-section regressions with the exception of the leather industry for which R^2 increases from 0.21 to 0.96. The comparatively smaller increments in R^2 for the time series estimation are largely due to the inclusion of the time trend variable (t) which, being highly correlated with value added (V), may incorporate the effect of V to a considerable degree in equation 2′. (Regressions run on equation 2′ and 3′ for time series data without the t variable show marked increases in R^2 for a number of cases. The R^2 increases for all industries from 0.14 to 0.96; in basic metals from 0.13 to 0.56, in tobacco from 0.0009 to 0.58, and in non-metallic minerals from 0.13 to 0.96).

As expected, equation (2′) yields larger numerical elasticity estimates than equation (3′). However, there are a few exceptions where the value of the parameter actually increases—printing and publishing, basic metals non-metallic minerals, paper and tobacco. Comparing estimates for the two equations we note that results for electrical machinery, food, tobacco, and textiles are about the same. The highest estimates of elasticities for both equations are obtained for printing and publishing, chemicals, rubber, and electrical machinery. Recall that relatively high estimates for these industries were also obtained for the cross section data.

The number of significant elasticity estimates drops from four [electrical machinery, printing and publishing, footwear, and rubber] to two [electrical machinery, printing and publishing] with the addition of the value added variable. In only seven out of the total of thirteen industries was the co-efficient of the V variable significant. Furthermore the time variable which is highly significant in equation (2′) for a large number of industries turns insignificant for nearly all cases in equation (3′). The presence of a large number of insignificant time series estimates of σ is primarily due to the multicollinearity among variables. A look at the next to last column of Appendix Table 3 confirms this: the correlation coefficient between V and t, r_{vt}, is extremely high in all cases thereby making it extremely difficult to disentangle their respective effects on the dependent variable.

D. Summary

The analysis is summarized as follows:

(1) The time series estimation yield comparatively lower elasticity values and a smaller number of significant estimates, the latter being attributable to a multicollinearity problem.

(2) The largest number of significant estimates of the elasticity parameter with high numerical values is obtained for the constant returns specification i.e. equation (2). The nonconstant returns to scale specification yields lower values of σ in the majority of cases for both time series and cross section data.

(3) For cross section data the V variable seems to have greater explanatory power relative to wages judging by the increase in R^2 and the highly significant t-statistic values in nearly all cases. For time series the effect of the V variable may have been underestimated due to the high correlation problem between the independent variables.

(4) In comparing results, the estimates of σ are highly sensitive to the data and specification used, with the exception of the estimates for printing and publishing, and chemicals which are fairly high (greater than 0.5) for all four regressions, and the estimates for leather and textiles which are low and insignificant for all regressions.

E. International Comparison of Elasticity Estimates

Table 2 gives cross section estimates of elasticities from studies for various developing countries—Philippines by Sicat [18], Argentina by Katz [10], eight developing countries by Daniels [5] besides Pakistan and the United States. The results are all derived from the log-linear regression of labour productivity on the wage rate, and the level of aggregation is the two-digit categories of manufacturing.

Elasticity estimates for Pakistan and the Philippines are on the average larger than those derived by Katz and Daniels and compare reasonably well for a number of industries, e.g., footwear, rubber, basic metals, non-metallic minerals, metal products, and machinery except electrical. There is a tendency for the Pakistani elasticities to be higher: this is especially noticeable in the case of printing and publishing and chemicals. Gaude explains the higher values of Sicat's estimates as compared to those obtained by Katz in terms of differences in capacity utilization in the two countries. The Philippine economy was operating at a relatively low level of capacity utilization due to a slight recession in the time period considered. This might be a possible explanation for high elasticties derived in our study since low capital utilization rates are common in Pakistan's manufacturing sector as well.

Table 2

Industry	Pakistan	Philippines	Developing Countries	Argentina	U.S.A.
1. Textiles	N.S.	0.44	1.61	0.98	0.63
2. Food	—0.3	1.37	0.75	1.35	0.91
3. Leather	N.S.	1.01	0.53	0.87	
4. Footwear	0.71	0.61	0.78		1.17
5. Rubber	1.79	1.58	1.3	0.92	0.9
6. Chemicals	1.86	1.09	1.09	0.9	1.16
7. Basic Metals	1.29	0.94	1.8		1.2
8. Non-Metallic Minerals	1.64	1.35	1.11	1.19	2.37
9. Metal Products	1.02	1.36	0.97	0.87	2.00
10. Printing and Publishing	1.73	0.79	0.82	0.87	1.29
11. Electrical Machinery	N.S.	0.87	0.38	0.45	0.93
12. Machinery except Electrical	0.97	1.06		0.46	

Source: Philippines [18], Developing Countries [5], Argentina [10], and USA [4].
Note: N.S.=Not significant at 0.05 level of significance 1.

Estimates by Katz and Daniels, although comparatively lower, also indicate a considerable degree of flexibility in the industrial sector-with values of σ averaging around unity. As pointed out earlier use of cross section data for estimating equation 2 imparts an upward bias to the elasticity parameter. This is borne out further by lower estimates of σ for equation 3 which allows for effects on labour productivity of higher levels of output. Katz's estimates based on the specification incorporating scale economics also lead to lower value of σ.

Finally looking at the estimates for the United States, these are considerably higher for non-metallic minerals and metal products, and about the same for chemicals, basic metals, and electrical machinery. The value of the elasticity parameter on the average is unity indicating not much difference in substitution possibilities as compared to the other studies.

F. Returns to Scale

From Table 3 we find that with the exception of decreasing returns to scale in three industries (printing and publishing, metal products, and chemicals) and constant returns to scale in textiles, the scale factor is considerably greater than unity. For machinery the estimate is unrealistically high.

Table 3

Returns to Scale by Industry 1969-70

Industry	Equation 3 v	Katz's estimates of v
1. Chemicals and Chemical Products	—6.2	1.18
2. Basic Metals	1.55	1.60
3. Electrical Machinery	1.28	1.45
4. Food	1.35	1.50
5. Printing and Publishing	0.53	0.77
6. Non-Metallic Minerals	1.37	1.25
7. Textiles	1.02	1.45
8. Metal Products	0.88	
9. Leather	1.66	
10. Rubber Products	1.89	
11. Footwear	1.59	
12. Machinery	10.00	

The estimates also seem to be quite comparable with those derived by Katz [10] for Argentina's manufacturing sector. The lowest values for the scale parameter are for printing and publishing, and the highest, within the industries being compared, are for basic metals in both cases.

It is important to note that the level of capacity utilization has important implications for estimates of economies of scale. As Guade [6] has pointed out, if most firms are producing below capacity, which is likely to be true for Pakistan [12], cross section estimates would tend to show increasing returns to scale.

Conclusion

The policy importance of the scale and elasticity parameters necessitated an attempt to obtain at leastos me preliminary evidence regarding their magnitudes. However, any conclusion based on these estimates can at best be tentative and should be viewed in the light of the limitations imposed by unrealistic models and poor quality of data.

The data constraint is specially binding for time series estimation since there is a considerable amount of inconsistency in the definition of variables over time [9]. Furthermore there are several other difficulties in fitting production functions for time series data—cyclical conditions, misspecification of adjustment lags, multi-collinearities, etc. For cross section data there is considerable variation in estimates for the two specifications used. Results for equation 2 indicate a high degree of flexibility in the economy in response to changes in factor prices. As mentioned earlier in the paper, this specification may over estimate σ due to exclusion of factors other than changes in the capital-labour ratio affecting labour productivity. Evidence for increasing returns to scale and comparatively high values of R^2 suggest that most industries conform to the formulation presented in equation (3). Looking at results for equation (3) the general conclusion that emerges is that the elasticity of substitution in most industries is low, increase in labour productivity being explained to a large extent by factors associated with increases in output levels—economies of scale, technological change, etc. Incorporating a variable for market imperfections, if it is positively correlated with wages, would impart a further downward bias.

Furthermore, as pointed out by France Stewart [19] the presence of scale economics has important implications for the range of techniques available. "Historically the typical scale of output per unit of production has tended to grow over time, and so has the level of output for which successive machines were designed. The consequence has been that late technical development tend to be associated with larger scales of output. The results has been that scale is in many cases of decisive importance in determining choice, other more labour intensive methods remain efficient at low scale production levels".

Appendix

Table 1

Estimates of the Elasticity of Substitution from Equation (2) and (2′)

	Equation (2)				
	Estimate of σ	t Value	Level of significance	R^2	No. of observations
1. All Industries	1.17	2.35	0.05	0.18	26
2. Textiles	0.18	0.52	Insig.	0.01	25
3. Food	—0.30	—0.53	—	0.01	25
4. Leather	0.46	0.48	Insig.	0.02	13
5. Footwear	0.71	2.46	0.05	0.32	14
5. Rubber	1.79	1.85	0.05	0.32	9
7. Chemicals	1.86	7.45	0.001	0.71	25
8. Basic Metals	1.29	3.58	0.01	0.49	15
9. Non-Metallic Minerals	1.64	4.54	0.001	0.60	16
10. Printing and Publishing	1.73	3.56	0.01	0.44	18
11. Electrical Machinery	0.81	1.29	Insig.	0.09	17

—Continued

Appendix Table 1—*Continued*

	Equation (2′)							
	Estimate of σ	t Value	Level of significance	Coefficient of time	t Value	R^2	r_{wt}	No. of observations
1. All Industries	—0.22	—0.97	—	0.07	11.42	0.94	0.46	10
2. Textiles	0.46	1.31	Insig.	0.05	5.28	0.96	0.87	10
3. Food	0.26	0.43	Insig.	0.07	2.37	0.70	0.76	10
4. Leather	0.49	0.51	Insig.	0.04	1.41	0.21	0.014	12
5. Footwear	1.02	3.51	0.01	0.02	2.49	0.67	0.05	12
6. Rubber	1.35	3.02	0.01	0.05	0.65	0.81	0.81	11
7. Chemicals	1.59	1.43	Insig.	0.03	0.45	0.90	0.97	10
8. Basic Metals	0.32	0.67	Insig.	0.03	2.4	0.53	0.30	10
9. Non-Metallic Minerals	—1.76	—1.35	—	0.09	5.7	0.84	0.60	10
10. Printing and Publishing	1.52	5.25	0.01	0.02	2.42	0.88	0.45	10
11. Electrical Machinery	0.87	4.11	0.01	0.03	3.24	0.82	0.30	11

Appendix

Table 2

Estimates of the Elasticity of Substitution and Returns to Scale from the Cross Section Data

	Equation (2)				
	(a) Intercept	Estimate of σ	t Value	Level of significance	R^2
1. All Industries	1.19	1.17	2.35	0.05	0.18
2. Textiles	1.64	0.18	0.52	Insig.	0.01
3. Food	2.83	—0.30	—0.53	Insig.	0.01
4. Leather	1.38	0.46	0.48	Insig.	0.02
5. Footwear	0.71	0.71	2.46	0.05	0.32
6. Rubber	2.8	1.79	1.85	0.05	0.32
7. Chemicals	0.29	1.86	7.45	0.001	0.71
8. Basic Metals	0.93	1.29	3.58	0.01	0.49
9. Non-Metallic Minerals	0.41	1.64	4.54	0.001	0.60
10. Metal Products	0.88	1.02	4.35	0.001	0.53
11. Printing and Publishing	0.08	1.73	3.56	0.01	0.44
12. Electrical Machinery	1.23	0.81	1.29	Insig.	0.09
13. Machinery except Electrical	0.77	0.97	2.82	0.05	0.33

—Continued

Appendix Table 2—*Continued*

	Equation (3)									
	(a) Intercept	Estimate of σ	t Value	Level of significance	Coefficient of V	t Value	v	R^2	r_{vw}	No. of observations
1. All Industries	—1.3	0.72	1.55	Insig.	0.25	2.81	2.79	0.39	0.34	26
2. Textiles	0.18	0.35	1.25	Insig.	0.14	4.02	1.02	0.43	0.14	25
3. Food	—1.11	—0.96	—2.19	—	0.50	4.78	1.35	0.51	0.31	25
4. Leather	—0.82	—0.01	—0.03	—	0.40	5.36	1.66	0.73	0.17	13
5. Footwear	—0.59	0.37	1.66	Insig.	0.23	3.5	1.59	0.67	0.41	14
6. Rubber	—1.12	—0.72	—1.81	—	0.81	8.84	1.89	0.94	0.71	9
7. Chemicals	—1.66	0.75	2.02	0.1	0.36	3.55	—6.20	0.81	0.83	25
8. Basic Metals	—0.21	0.53	1.23	Insig.	0.22	2.46	1.55	0.66	0.69	15
9. Non-Metallic Minerals	—0.66	0.87	2.16	0.05	0.20	2.80	1.37	0.74	0.67	16
10. Metal Products	—0.25	0.93	3.80	0.01	0.15	1.22	0.88	0.53	0.31	21
11. Printing and Publishing	—1.9	0.81	1.53	Insig.	0.37	2.78	0.53	0.63	0.62	18
12. Electrical Machinery	—0.67	—0.62	—0.92	—	0.39	3.37	1.28	0.50	0.66	17
13. Machinery except Electrical	0.13	0.90	2.61	0.05	0.09	1.17	10.00	0.39	0.17	17

Appendix

Table 3

Estimates of the Elasticity of Substitution from the Time Series Data

	Equation (2′)						
	(a) Intercept	Estimate of σ	t Value	Level of Significance	Coefficient of time	t Value	R^2
1. All Industries	1.15	—0.22	—0.97	—	0.07	11.42	0.94
2. Textlies	0.9	0.46	1.31	Insig.	0.05	5.27	0.96
3. Food	1.45	0.26	0.43	Insig.	0.06	2.37	0.70
4. Leather	1.48	0.49	0.51	Insig.	0.03	1.41	0.21
5. Footwear	0.82	1.02	3.51	0.01	0.02	2.49	0.67
6. Rubber	1.02	1.36	3.05	0.01	0.02	0.64	0.83
7. Chemicals	0.9	1.59	1.43	Insig.	0.03	0.45	0.90
8. Basic Metals	1.01	0.32	0.67	Insig.	0.03	2.40	0.53
9. Non-Metallic Minerals	1.73	—1.76	—1.35	—	0.09	5.70	0.84
10. Printing and Publishing	0.53	1.52	5.25	0.01	0.02	2.42	0.88
11. Electrical Machinery	0.91	0.87	4.11	0.01	0.03	3.24	0.82
12. Tobacco	2.28	0.42	1.68	Insig.	0.05	3.30	0.58
13. Paper	1.9	0.33	0.36	Insig.	0.003	0.07	0.09

—*Continued*

Appendix Table 3—*Continued*

	Equation (3′)										
	(a) Intercept	Estimate of σ	t Value	Level of Significance	Coefficient of V	t Value	Coefficient of time	t Value	R^2	r_{vt}	No. of observations
1. All Industries	—5.75	—0.13	—0.63	—	0.50	1.79	0.02	0.65	0.96	0.98	10
2. Textiles	—4.34	0.35	1.19	Insig	0.41	2.11	0.02	0.86	0.96	0.97	10
3. Food	—9.29	0.25	0.60	Insig	0.96	3.06	—0.07	1.50	0.88	0.97	10
4. Leather	—7.51	—0.13	—0.57	—	0.99	12.42	—0.05	—5.47	0.96	0.76	12
5. Footwear	—6.52	0.33	1.36	Insig	0.77	4.14	—0.02	—1.59	0.88	0.80	12
6. Rubber	—3.27	0.68	1.6	Insig	0.53	2.65	—0.02	—0.98	0.92	0.89	11
7. Chemicals	—6.03	0.65	1.30	Insig	0.67	5.71	—0.04	—1.38	0.98	0.95	10
8. Basic Metals	—1.88	0.52	0.86	Insig	0.29	0.65	0.002	0.04	0.56	0.94	10
9. Non-Metallic Minerals	—7.52	0.62	0.75	Insig	0.83	4.67	—0.02	—0.95	0.96	0.93	10
10. Printing and Publishing	—3.15	1.85	4.4	0.01	0.34	1.07	0.003	0.18	0.90	0.74	10
11. Electrical Machinery	2.81	0.87	3.93	0.01	—0.19	—0.62	0.06	1.48	0.84	0.96	10
12. Tobacco	0.93	0.45	1.51	Insig	0.13	0.25	0.02	0.25	0.58	0.98	11
13. Paper	—1.19	0.53	0.54	Insig	0.32	0.9	—0.03	—0.54	0.22	0.76	9

References

1. Ahmed, M. "Employment Aspects of Industrial Growth: A Correction." *Pakistan Development Review*. Vol. XIV, No. 1. Spring 1975.

2. Arow, K., H. Chenery, B. Minhas and R. Solow. "Capital Labour Substitution and Economic Efficiency." *Review of Economics and Statistics*. Vol. 43, 3. August 1961.

3. Behrman, J.R. "Sectoral Elasticities of Substitution Between Capital and Labour in a Developing Economy: Time Series Analysis in the Case of Post War Chile." *Econometrica*. Vol. 40, No. 2.

4. Bruton, H.J. *Elasticity of Substitution in Developing Countries*. Research Memorandum No. 45. Centre for Development Economics, Williams College, Massachuetts. April 1972.

5. Daniels, M.R. "Differences in Efficiency Among Industries in Developing Countries". *American Economic Review*. 59(1). March 1969.

6. Gaude J.S. "Capital Labour Substitution Possibilities. A Review of Empirical Evidence." In A.S. Bhalla (ed.) *Technology and Employment in Industry*.

7. Guisinger, S.E. and Mohammad Irfan. "Inter-Industry Differentials in Wages and Earnings in Pakistan's Manufacturing Sector." *Pakistan Development Review*. Vol. XIV, No. 3. Autumn 1975.

8. Hussain, I. "Employment Aspects of Industrial Growth in West Pakistan." *Pakistan Development Review*. Vol XIII, No. 2. Summer 1974.

9. Irfan, M. *Problems in the Compilation of Industrial Time Series Data in Pakistan*. (Mimeographed—Discussion Paper No. 2).

10. Katz, Jorge, M. *Production Functions, Foreign Investment and Growth*. North Holland Publishing Company. Amsterdam and London, 1969.

11. Kemal, A.R. "Consistent Time Series Data relating to Pakistan's Large-Scale Manufacturing Industries." *The Pakistan Development Review*. Vol. XV, No. 1. Spring 1976.

12. ————and Talat Allauddin. "Capacity Utilization in the Manufacturing Industries of Pakistan." *Pakistan Development Review*. Vol. XIII, No. 3. Autumn 1974.

13. Khan, A.R. *Capital Labour Ratios and Labour Requirement in the Pakistan Economy*. Pakistan Institute of Development Economics. April 1970.

14. O' Herlihy, C. St. J. "Capital Labour Substitution and the Developing Countries: A Problem of Measurement." *Oxford Bulletin of Economics and Statistics*.

15. Pakistan. Statistical Division. *Census of Manufacturing Industries*. 1954-55 to 1969-70.

16. Pakistan. Central Statistics Office. 25 *Years of Pakistan in Statistics* 1947-1972. Karachi. 1972.

17. Rehman, A.N.M. "Elasticities of Substitution in Manufacturing Industries of Bangladesh: An International Comparison." *Bangladesh Economics Review*. Vol. 1, No. 2. April 1973.

18. Sieat, G.P. "Capital Labour Substitution in Manufacturing in Developing Economy: The Philippines." *The Developing Economies*. Vol. VIII, No. 1. March 1970.

19. Stewart, Frances. "Choice of Technique in Developing Countries." *Journal of Development Studies*. Vol. IX, No. 1. October 1972.