

## **Short-Term Employment Functions in Manufacturing Industries: An Empirical Analysis for Pakistan**

KHALID HAMEED SHEIKH and ZAFAR IQBAL

### **I. INTRODUCTION**

The most challenging issue facing Pakistan today is the high rate of growth of population and labour force which is a major obstacle to the development of the country. The current problem of unemployment is becoming serious and is deeply rooted in the economic, social and political conditions of the economy. The consequences of rapid industrialisation on employment generation in Pakistan has also been very disappointing.

The manufacturing sector in Pakistan has grown at an average annual rate of around 6.0 percent during the 1970s and 8.7 percent during the 1980s. Manufacturing output has risen from 16.5 percent of the GDP during the 1970s to 19.1 percent during the 1980s. The manufacturing sector has failed to generate sufficient employment for new entrants in the labour force. Over a period of 18 years from 1969-70 to 1986-87, only 14.0 percent of the total labour force could get employment in the manufacturing sector. A low creation of employment opportunities is also manifest in the fact that the growth rate of employment in the manufacturing sector has declined considerably from 2.4 percent during the 1970s to 1.0 percent during the 1980s.

In view of such a wide gap between employment growth and output growth, it becomes important to investigate the determinants of employment in the manufacturing industries in a more disaggregated way. The relationship between output and employment in the manufacturing sector has been studied in Pakistan by various authors. Ali (1978) estimates the impact of output, wages, lagged-employment and time trend on employment using time-series data for the period 1954 to 1970 for the manufacturing sector as a whole. He finds that output is positively, and technology, is negatively related to employment in the manufacturing sector in Pakistan. He also finds that the elasticity of employment with respect

Khalid Hameed Sheikh and Zafar Iqbal are Research Demographer and Research Economist, respectively, at the Pakistan Institute of Development Economics, Islamabad.

*Authors' Note:* We bear responsibility for any errors remaining.

to wages is negative. Ahmed (1981) estimates the employment functions for 16 manufacturing industry groups using the time-series data for the period 1959-60 to 1969-70. He finds that output is only the relevant and significant variable in explaining the movements of employment in these industries. The other two variables i.e. technology and lagged employment do not emerge to be very important explanatory variables.

Kemal and Irfan (1983) estimate the employment elasticity with respect to output 0.32, Government of Pakistan (1983) 0.39, ARTEP (1983) 0.45 and Khan (1988) 0.43 for the manufacturing sector as a whole. However they ignored to estimate the employment elasticity with respect to output for individual industries except for Ahmed (1981) and Malik *et al.* (1987). These studies suffer from some basic shortcomings as none of these studies include employment cost per employment in the employment function. Since it is well known that the rapidly increasing employment cost in developing countries like Pakistan is one of the major obstacles for generating further employment in the large-scale manufacturing sector. Therefore, the omission of such an important variable can profoundly bias the estimated coefficients. The purpose of this study is the following.

First, we estimate the basic structural employment function of 13 major manufacturing industries using the latest available time-series data for the period 1969-70 to 1986-87 assuming that the observed level of employment in each industry is demand determined.

Second, we estimate employment elasticities with respect to the output of 13 manufacturing industries as these provide us important information about the labour absorptive capacity of each industry.

Third, we estimate the employment elasticity with respect to employment cost which gives us the important information about percentage change in employment as a result of one percent change in employment cost in each industry.

Finally, in estimating the employment function, we take into account the weaknesses of the earlier studies, thereby improving the reliability of the estimated coefficients.

## II. MODEL

In order to estimate the employment function, the basic model has been described by Brechling (1965), Ball and St. Cyr (1966), Brechling and O' Brien (1967), and Smyth and Ireland (1967). This model has been applied to estimate

the relationship between employment and its determinants in the manufacturing sector of developed and developing countries. Following Brechling and O'Brien (1967)<sup>1</sup>, the extended model we present:

$$\log E^*_t = \beta_0 + \beta_1 \log Q_t + \beta_2 T + e_t \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad (1)$$

where:

$E^*_t$  = Desired level of employment in each industry.

$Q_t$  = Value added of each industry.

$T$  = Time trend.

$e_t$  = Stochastic error term.

We are including another important explanatory variable that is employment cost per employment (including wages salaries plus other cash and non-cash benefits) in the above basic model which has never been treated as an important determinant in any one of the above studies except Malik *et al.* (1987). Including employment cost ( $EC$ ), the basic model is expressed as:

$$\log E^*_t = \beta_0 + \beta_1 \log Q_t + \beta_2 T + \beta_3 \log EC_t + e_t \quad \dots \quad \dots \quad \dots \quad (2)$$

Since the desired level of employment ( $E^*_t$ ) is not directly observable so it has been transformed into observable form using Marc Nerlove's (1958) well-known partial adjustment process to overcome this problem. The partial adjustment process is expressed as:

$$\log E_t - \log E_{t-1} = \lambda (\log E^*_t - \log E_{t-1}) \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad (3)$$

where  $\lambda$ , (such that  $0 < \lambda < 1$ ) is known as the coefficient of adjustment. Equation (3) postulates that the actual change in the level of employment in any given time period ( $t$ ) is some fraction  $\lambda$  of the desired change in the level of employment for that period. Rearranging Equation (3), the adjustment mechanism can be written as:

$$\log E_t = \lambda \log E^*_t + (1-\lambda) \log E_{t-1} \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad (4)$$

substituting Equation (2) into Equation (4). We get

$$\begin{aligned} \log E_t &= \lambda \beta_0 + \lambda \beta_1 \log Q_t + \lambda \beta_2 T + \lambda \beta_3 \log EC_t \\ &+ (1-\lambda) \log E_{t-1} + \lambda e_t \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad (5) \end{aligned}$$

For simplicity the Equation (5) can be written as:

<sup>1</sup>The main features and assumptions of the model are well summarised in Brechling and O'Brien (1967).

$$\log E_t = a_0 + a_1 \log Q_t + a_2 T + a_3 \log EC_t + a_4 \log E_{t-1} + U_t \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad (6)$$

where:

$$a_0 = \lambda \beta_0$$

$$a_1 = \lambda \beta_1$$

$$a_2 = \lambda \beta_2$$

$$a_3 = \lambda \beta_3$$

$$a_4 = (1 - \lambda)$$

$$U_t = \lambda e_t$$

The final Equation (6) is our basic structural model which has been estimated by applying ordinary least squares (OLS) estimation techniques.

### III. THE DATA

The basic data used in the statistical estimation are time-series from 1969-70 to 1986-87 of 13 manufacturing industries. The data regarding employment (numbers employed), current price value-added and employment cost per employment in manufacturing industries are obtained from Pakistan Economic Survey, 1990-91 which is based on the annual Census of Manufacturing Industries (CMI). A GDP deflator of the manufacturing sector is used to deflate the current price value-added and employment cost in order to get the constant price value-added and employment cost.

### IV. THE EMPIRICAL RESULTS

The estimated results of the structural employment function based on Equation (6) are reported in Table 1. There seem to fit the data satisfactorily together with a reasonable adjusted  $R^2$  and tolerable  $t$ -statistics.

The coefficient of  $\log Q_t$  is the employment elasticity of output which gives the percentage change in employment as a result of an one percent change in output. The employment elasticities of 10 out of 13 manufacturing industries reported in Table 1 are positive and statistically significant. The employment elasticity for Paper is maximum i.e. 1.11 which is greater than unity. The estimated employment elasticities for other industries are also reasonably high but less than unity, which indicate that less than proportionate increase in employment is brought about as a result of an increase in output. The size of employment elasticity for Drugs and Pharmaceutical is 0.74, Ginning & Pressing 0.69, Rubber 0.58, Electrical

Machinery 0.53, Other Chemical 0.49, Beverages 0.26, Machinery 0.22, Tobacco 0.20 and Transport Equipment 0.19. The lowest employment elasticity is for Textiles which is 0.16. Although the elasticity of Non-Metallic Mineral Products is lowest i.e. -0.03 but it is statistically insignificant. These employment elasticities with respect to output provide us important information about the labour absorptive capacity of each industry. The estimated employment elasticities almost

Table 1  
Regression Results of Employment Functions

Industries	Constant	$\log Q_t$	$\log EC_t$	$T$	$\log E_{t-1}$	adj. $R^2$	D.W.	(Coeff. of Adjustment) $\lambda$
Beverages	2.56 (1.32)	0.26 (1.18)	-0.39 (1.31)	0.06*** (1.71)	0.01 (0.03)	0.92	2.00	0.99
Tobacco	7.00* (4.82)	0.20*** (1.73)	-0.82* (4.13)	0.007 (0.37)	0.27 (1.06)	0.59	1.43	0.73
Textile	0.10 (0.05)	0.16 (1.16)	-0.10 (0.35)	-0.003 (0.28)	0.91* (3.84)	0.83	2.51	0.09
Ginning, Pressing and Bailing of Fibre	1.33 (0.59)	0.69* (4.31)	-0.40 (1.12)	0.01 (1.08)	0.20*** (1.46)	0.91	2.00	0.80
Paper and Paper Products	7.97** (2.31)	1.11* (3.07)	-1.46* (3.32)	0.02 (0.79)	0.45*** (1.68)	0.59	2.27	0.55
Drugs and Pharmaceuticals	7.11 (5.56)	0.74* (3.70)	-1.08* (8.30)	0.02*** (1.44)	0.11 (0.79)	0.84	1.14	0.89
Industrial Chemicals	4.13* (3.34)	0.14** (2.21)	-0.48* (3.32)	0.03** (1.97)	0.59* (2.87)	0.98	2.10	0.41
Other Chemical Products	7.76* (7.01)	0.49*** (1.67)	-1.01* (8.49)	0.02 (0.74)	0.02 (0.21)	0.86	1.41	0.98
Rubber	3.01*** (1.37)	0.58* (2.68)	-0.42*** (1.57)	-0.03*** (1.47)	0.11 (0.60)	0.30	1.78	0.89
Non-Metallic Minerals	8.81* (5.13)	-0.03 (0.15)	-0.83* (6.02)	0.09* (3.24)	0.08 (0.37)	0.77	1.41	0.92
Machinery	-0.30 (0.07)	0.22*** (1.49)	0.09 (0.19)	-0.01 (0.38)	0.47 (1.26)	0.83	2.19	0.53
Electrical Machinery	7.08* (2.93)	0.53* (2.93)	-1.03* (4.67)	-0.005 (0.33)	0.56 (1.26)	0.71	2.10	0.44
Transport Equipment	1.39 (0.85)	0.19* (2.71)	-0.21 (1.08)	0.002 (0.13)	0.77* (4.52)	0.65	2.26	0.23

Note:  $t$ -statistics are in parentheses. (\*\*\*) indicates statistical significance at 0.10 level; (\*\*) the 0.05 level; and (\*) the 0.01 level.

in all the industries (except paper industry) are less than unity which seem to confirm the argument that capital augmenting technology inhibits the further demand for labour in the manufacturing sector of Pakistan. It is a fact that employment elasticities tend to fall as capital intensities increase.

The time trend variable is taken as a proxy for the capital stock and techniques of production. The *a priori* expectation for the trend variable is to be negatively related with the level of employment. But the estimated coefficients of the trend variable are not according to expectation. The results indicate that the trend variable possesses a negative sign in the case of four industries. But the negative coefficient of the trend variable in the case of the Rubber industry is statistically significant. The time trend variable possesses a positive sign and is statistically significant in the case of four industries (i.e. Beverages, Industrial Chemicals, Non-Metal Minerals and Drugs) reported in Table 1. For the remaining industries, the coefficients of the time trend variable (T) is positive but statistically insignificant. The estimated coefficients of the trend variable which is used as a proxy for technology must be treated with some caution as it may not show the real impact of technology.

Another important finding of this paper shows the negative relationship between the employment cost per employment and the level of employment in the manufacturing industries. The results are as expected. The employment elasticity with respect to employment cost per employment is negative and highly significant almost in all the cases except Machinery. The elasticity of employment is greater than unity for Paper and Paper Products  $-1.46$ , Drugs and Pharmaceuticals  $-1.08$ , Electrical Machinery  $-1.03$ , and Other Chemical Products  $-1.01$ . For the remaining industries, the estimated employment elasticity with respect to cost is less than unity that is for Non-Mineral  $-0.83$ , Tobacco  $-0.82$ , Industrial Chemicals  $-0.48$ , Rubber  $-0.42$ , Ginning and Pressing  $-0.40$ , Beverages  $-0.39$ , and Transport Equipment  $-0.21$ . The lowest employment elasticity is for Textiles  $-0.10$ . The employment elasticity for Machinery is positive but statistically insignificant. The negative and strong significant impact of employment cost per employment on the level of employment seems to confirm our main hypothesis that rapidly increasing employment cost is the main hindrance for generating further employment in the manufacturing sector of Pakistan.

The estimated coefficients of the lagged dependent variable  $\log E_{t-1}$  are positive, as expected, in all the cases. The estimated coefficients lie between zero and unity which indicate that the level of previous year's employment raises the present year's employment but this increase is less than proportionate. The positive relationship between lagged employment and current employment employs

that as these industries earn profits and the demand for the products of these industries rises, the output also expands which results in the creation of more jobs in the manufacturing sector.

The regression coefficients of  $\log E_{t-1}$  are consistent with the implication of equation (3) that the coefficient of adjustment  $\lambda$  should lie between zero and unity.  $\lambda$  indicates the speed of adjustment of employment to its desired level. The estimated adjustment coefficients ( $\lambda$ 's) suggest that comparatively fast adjustment of employment to desired employment takes place in Beverages (0.99), Other Chemicals (0.98), Non-Metallic Minerals (0.92), Rubber (0.89), Drugs and Pharmaceutical Products (0.89), Ginning and Pressing and Bailing of Fibre (0.80), and Tobacco (0.73). Adjustment seems to be slow relatively in the following industries: Paper and Paper Products (0.55), Machinery (0.53), Electrical Machinery (0.44), Industrial Chemicals (0.41), Transport Equipment (0.23), and Textiles (0.09).

## V. CONCLUSION

The employment function that we have fitted to the manufacturing sector in Pakistan appears to produce reasonably sensible results. In general, the coefficients have the anticipated values and signs and they are quite significant. The empirical results which have been reported in this paper have led us to the following conclusions: First, the output elasticities of employment of 10 out of 13 manufacturing industries are positive and statistically significant. The output elasticity for the Paper and Paper Products industry is maximum i.e. (1.1) which is greater than unity and the lowest output elasticity is for textile industry i.e. (0.16). For the remaining 11 industries the output elasticities lie between zero and unity. Second, the time trend variable which is taken as a proxy variable for the capital stock and techniques of production possesses a negative sign in the case of 5 industries. Third, the important and interesting finding of our paper is the negative and highly significant impact of employment cost on employment in the case of 12 out of 13 manufacturing industries. It seems to confirm our main hypothesis that rapidly increasing employment cost is the main obstacle for generating further employment in the manufacturing sector in Pakistan. Lastly, the coefficient of adjustment lies between zero and unity in case of all industries. It is found that the speed of adjustment of employment to its desired level is highest (0.99) in case of the Beverages industry and lowest (0.09) in case of the Textile industry.

## REFERENCES

- Ahmed, Masood (1981) Short Term Employment Functions in Manufacturing Industries in Pakistan – A Disaggregated View. *Pakistan Manpower Review* 8.
- Ali, Karamat (1978) Short-Term Employment Functions in Manufacturing Industries of Pakistan. *The Pakistan Development Review* 17: 3.
- ARTEP (1983) *Employment and Structural Change in Pakistan – Issues for the Eighties*. Bangkok.
- Ball, R. J., and E. B. A. St. Cyr. (1966) Short Term Employment Functions in British Manufacturing Industry. *The Review of Economic Studies* 33:3 95.
- Breachling, F. P. R. (1965) The Relationship between Output and Employment in British Manufacturing Industries. *The Review of Economic Studies* July.
- Brechling, Frank, and Peter O' Brien (1967) Short-Run Employment Functions in Manufacturing Industries : An International Comparison. *The Review of Economic and Statistics* 49:3.
- Gujarati, Damodar (1987) *Basic Econometrics*. McGraw- Hill International Book Company.
- Kemal, A. R., and M. Irfan (1983) Employment and Manpower Projections for the Sixth Plan Period. Paper Presented to ARTEP – PIDE Seminar on Employment and Structural Changes in Pakistan's Economy, Islamabad.
- Khan, Ashfaq H. (1988) Factor Demand in Pakistan's Manufacturing Sector. *International Economic Journal* 2:3.
- Malik, S. J., N. Bilquis and Zafar M. Nasir (1987) Employment Elasticities in Selected Large-Scale Manufacturing Industries of Pakistan. Islamabad: Manpower Institute.
- Nerlove, Marc (1958) Distributed Lags and Demand Analysis for Agricultural and Other Commodities. *Agricultural Handbook* 141: U.S. Department of Agriculture.
- Pakistan, Government of (1983) *The Sixth Five Year Plan: 1983–88*. Islamabad: Planning Commission.
- Pakistan, Government of (1986) *Economic Survey 1985-86*. Islamabad: Economic Advisor's Wing, Finance Division.
- Pakistan, Government of (1991) *Economic Survey 1990-91*. Islamabad: Economic Advisor's Wing, Finance Division.
- Smyth, D. J., and N. J. Ireland (1967) Short-Term Employment Function in Australian Manufacturing. *The Review of Economics and Statistics* 49: 4. November.



**Comments on**  
**“Short-Term Employment Functions in Manufacturing**  
**Industries: An Empirical Analysis for Pakistan”**

The main hypothesis of the paper investigates the relationship between the level of employment and employment cost in the manufacturing sector. The hypothesis argues that rising employment cost has been a major inhibiting factor for the growth of employment in this sector. The average annual growth rate of employment relative to the growth of output has considerably declined over time i.e., from 2.4 percent to 1.0 percent during the 1970s and 1980s; whereas manufacturing output has risen from 16.5 percent, to 19.1 percent of GDP during the same period. The analysis presented in the paper to testify the hypothesis lacks rigor and depth. I list some of the obvious shortcomings of the paper with a view to provoking further discussion and possibly a review of the paper in future.

*First*, the claim of the paper that this hypothesis has not been examined before is incorrect. Karamat's paper (1978) has already evaluated it in the context of aggregate data of the sector. His model included real wages as a regressor and obtained a reasonably good result.

*Second*, the authors entitle their model as short-term employment functions whereas it contains long-term features. The presence of time trend,  $t$ , adjustment parameter  $\lambda$ , and the case of lagged dependent variable are indicative of this. There is no need to restrict the scope of the paper to the short-run because the model can generate both short and long-run parameter estimates. The estimate of  $\beta$  in Equation (6) measures long-run effects and  $\lambda\beta$  measures short-run effects. The paper could easily have generated long-run estimates. Then by comparing short and long-run elasticities it could have obtained important insights for the explanation of its hypothesis.

*Thirdly*, the authors do not provide adequate motivation for the connection between the level of employment and employment cost. They seem to suggest two notions of the employment cost, the fixed capital cost and wage/and non-wage compensation. Substantiating the first notion, they cite the number that at current market price, it costs about Rs 1.5 million to create just one job. For the second,

they make just a qualitative statement. The reader is thus left bewildered. The paper does not make use of economic theory to motivate its point of view. For instance, why is the employment cost posing a problem in the event of staggering unemployment? As a matter of fact, what is needed here is to cite the evidence regarding labour substitution possibilities in the group of industries under consideration. Then working with the relative price of labour, the paper can convince the existence of the hypothesis. Because, the increase in the wage rate relative to the interest rate, for example, can lead to the substitution of labour for machinery and hence the fall in employment could occur at each level of manufacturing output. But then as the industries becomes more capital intensive, the marginal product of labour rises which tends to neutralise the depressive effects of the higher relative wage rate. Therefore, capital intensities may be offsetting the employment contractionary effects of the higher employment cost over time.

*Fourth*, the underlying assumptions of the model are quite restrictive. For instance, the supply conditions in the labour market, availability of scarce inputs and raw materials are assumed away. These factors have important implications for employment.

*Fifth*, the survey of literature seems incomplete. In selecting their basic model, the authors refer to 1960s literature.

*Sixth*, the specification of the model is unsatisfactory. The authors do not give any reason for the preference of the functional form chosen. Why, in particular is a variant of the stock adjustment model employed? Some variables like the desired level of employment is not defined. Moreover, the unit of measurement of some variables like employment cost is not specified. Also, the expected signs of the parameters are not noted under the estimating equation. Furthermore, one dummy variable could have been added to capture the effect of the structural break in the data around 1971-72.

*Finally*, the regression results in Table 2 present a discouraging situation. The coefficient of employment cost variable, testifying the validity of the main hypothesis, is statistically insignificant (at 5 percent level) in six industries. Moreover, it has a wrong sign in one industry. Similarly, the variables, output, time trend and lagged dependent variables are found to be statistically insignificant in 6, 9 and 8 industries respectively out of the sample of 13 industries. Furthermore, the output variable gets one sign wrong and time trend variable gets nine signs wrong.

The regression results are suggestive of the presence of multicollinearity. Again, looking at Table 2, the results for the Beverage industry show that none of the explanatory variables are significant at 5 percent and  $\bar{R}^2$  is 92. In the Textile industry, excepting the lagged dependent variable, none of the explanatory

variables show up although  $\bar{R}^2$  is .83. Similar is the case in the Machinery industry. These results suggest that, perhaps, multicollinearity is causing this situation. It would have been useful if the authors had tested for it and found some way out.

International Islamic University,  
Islamabad.

**Muhammad Ramzan Akhtar**