The Economic Journal of Nepal Vol.8, No.3, Issue 31, July-September 1985

Covariance Analysis of Manufacturing Establishments of Some Countries

G. S. MONGA*

Introduction

In this paper a production function analysis of manufacturing establishments of five countries: France, India, Israel, Japan and Yugoslavia has been carried out with the help of fourteen selected forms of production function models.

The Models and the Notations

1. The models used are: Cobb Douglas Production function with the inputs (K,L) and with three inputs (K,L M).
2. Cobb Douglas function with three inputs (K,L_D,L_I) and also with there inputs (K,L_E,L_O)
3 Kmenta approximation
4. CES and VES function (2 modifications) a. with L as divisor and b. with K as divisor.
5. Other forms.

The notations are as follows:

V,K,L,M stand for value added, capital labours and raw materials respectively.
L_D,L_I,L_E and L_O stand for direct and indirect, educated and other labour respectively.
w stands for the wage rate and r for the rate of return.
Y stands for gross output in money terms.

Other models and several variants of the variables L and K were also tried but it was found that no significant improvement in the results obtained from the above models was possible.

Data and the Coverage

The data consist of 64 manufacturing establishments of France, 117 of India, 69 of Israel 63 of Japan and 145 of Yugoslavia. The SIC numbers were not used but different criteria were utilised to rearrange the establishments in a suitable order to form possibly homogeneous

* *Dr. Monga is a Professor of Economics at the University of Bombay, India.*

Table 6

Balance of Payments Summary

(In Million Rs.)

Description	1974/75	1979/80	1980/81	1981/82	1982/83	1983/84	First Nine Months	
							1983/84	1984/85*
Exports F.O.B.	884.8	1152.7	1612.7	1496.0	1135.8	1709.9	1262.1	1965.6
Imports of C.I.F.	2057.2	3569.3	4442.9	4948.0	6332.8	6533.5	4761.6	5810.8
Trade Balance	–1182.4	–2416.6	–2830.2	–3452.0	–5197.0	–4823.6	–3499.5	–3845.2
Services, Net	280.8	873.2	1117.0	1378.0	1634.9	1406.8	1038.2	1064.5
Receipts	(693.3)	(1719.0)	(2070.1)	(2292.5)	(2521.8)	(2580.4)	(1863.6)	(1999.2)
Trael	170.6	636.8	773.4	841.5	844.2	561.0	402.2	510.2
Investment Income	108.7	190.3	159.9	197.0	203.0	94.6	52.5	50.1
Others	414.0	891.9	1136.8	1254.0	1474.6	1924.8	1408.9	1438.9
Payments	(412.5)	(845.8)	(953.1)	(914.5)	(886.9)	(1273.6)	(825.4)	(934.7)
Transfers, Net	564.7	1188.2	1417.3	1681.7	1890.7	2073.4	1597.7	1730.5
Receipts	(598.7)	(1201.3)	(1435.5)	(1705.4)	(1923.8)	(2111.3)	(1628.3)	(1751.5)
Private Remittance	204.3	357.3	484.2	477.1	549.7	614.1	422.9	432.1
Official Grants	282.8	762.7	860.8	1157.0	1315.0	1381.2	1128.2	1220.6
Indian Excise Refund	108.2	36.9	57.3	40.3	8.6	59.5	43.1	77.4
Others	3.4	45.4	33.2	31.0	50.5	56.5	34.1	21.4
Payments	(34.0)	(13.1)	(18.2)	(23.7)	(33.1)	(37.9)	(30.6)	(21.0)
Current Acc. Balance	–336.9	–355.2	–295.9	–392.3	–1671.4	–1343.4	–863.6	–1050.2
Official Capital Net	86.7	577.3	633.8	774.1	924.4	1203.5	736.2	723.9
Foreign Loans	(104.0)	(598.0)	(664.9)	(806.5)	(963.9)	(1274.3)	(803.1)	(807.0)
Amortization	(–17.3)	(–20.7)	(–31.1)	(–32.4)	(–39.5)	(–70.8)	(–66.9)	(–83.1)
Miscellaneous Capital	–168.7	–195.7	–143.8	–119.7	72.0	13.9	168.8	–18.7
Change in Reserves, Net	–418.9	26.4	194.1	262.1	–675.0	–126.0	41.4	–345.0

*Provisional.

Source: *Nepal Rastra Bank.*

Foot notes

1. The Rising Nepal, January 8, 1986.
2. HMG/N, Ministry of Finance, *Economic Survery*, 1984–85(Kathmandu: Ministry of Finance,1985), p. 45.
3. HMG/N,Budget Speech of the Fiscal Year 1978–79 by the Finance Minister (Kathmandu:Ministry of Finance, 1978), p. 16.
4. HMG/N,Budget Speech of the Fiscal Year 1980-81 (Kathmandu: Ministry of Finance, 1980), p.16.
5. HMG/N, Budget Speech, 1979-80, *Op. Cit.*, p. 4.
6. *Ibid.*, p. 4
7. Nepal Rastra Bank, *Twenty Five Years of the Working of Nepal Rastra Bank* (Kathmandu: NRB, 1981 ,)p.47.

groups whose characteristics could be studied by analysis of covariance. The data obtained from UNIDO are cross sectional for the year 1964 and thereabouts for individual establishments of the countries under consideration. Nearly 40 variables were elicited from the data though only a few were ultimately employed after the appropriate trial and error processes.

Production relations used in the Empirical Analysis.

CD2 (1a) $V = A K^{\alpha} L^{\beta}$

CD3A (1b) $Y = A_M K^{\alpha M} L^{\beta M} M^{\gamma M}$

CD3B (2a) $V = A_{DI} K^{\alpha DI} L_D^{\beta D} L_I^{\beta I}$

CD3C (2b) $V = A_{EO} K^{\alpha EO} L_E^{\beta E} L_O^{O}$

Kmenta (3a) $\ln V = A_K + \alpha_K \ln K + \beta_K \ln L + \delta_K (\ln K/L)^2$

CESL (4a) $\ln V/L = a_L + b_L \ln w$

CESL1 (4b) $\ln V/L = a_{L1} + b_{L1} \ln w + C_{L1} \ln K/L$

CESL2 (4c) $\ln V/L = a_{L2} + b_{L2} \ln w + c_{L2} \ln K/L + d_{L2} \ln L$

VESK (5a) $\ln V/K = a_K + b_K \ln r$

VESK1 (5b) $\ln V/K = a_{K1} + b_{K1} \ln r + c_{K1} \ln L/K$

VESK2 (5c) $\ln V/K = a_{K2} + b_{K2} \ln r + c_{K2} \ln L/K + d_{K2} \ln K$

CESA (6a) $\ln K/L = a_D + b_D \ln w/r$

CESB (6b) $\ln wL/rk = a_s + \frac{1-b_s}{b_s} \ln K/L$

CESC (6c) $\ln L = a_v - b_v \ln w - c_r \ln V$

Results and their Interpretations

For the various production functions, the following results were obtained:

Constant returns to scale prevail for the manufacturing establishment data of all the countries under consideration.

Raw materials do play an important role as an explanatory factor in production function analysis.

The quality-wise break up of labour does not influence the capital coefficient in the production function.

The use of Kmenta approximation suffers from multicollinearity problem and does not give reliable results.

In the case of the CES function, Pederson's hypothesis that b_L should be less than b_K is consistently satisfied. The value of elasticity of substitution is almost always less than unity.

The VES function does not improve the results significantly. Also the results obtained by using VESK functions are superior to those from VESL functions.

The CES and VES results are generally an improvement over the Cobb Douglas results.

The first two variants CESA and CESB of the CES production function gave very poor fits but the last one CESC gave good fits and values of elasticity of substitution comparable with those of the CES function. The shares of capital and labour are obtained as follows. For France and Israel 20:80. For Yugoslavia 35:65. For India and Japan 45:55.

On the whole the values of the parameters obtained from different countries from any production model do suggest some uniformity in results. The Cobb Douglas and CES fuuction give particularly good results in this regard. Certain differences in results can be explained in terms of the differences in the nature and pace of the economies under consideration.

It is concluded that the explanatory power of a production model is improved if both economic as well as technical variables are used as explanatory factors.

Group regression analysis helps to examine in detail the results of pool regressions. If the data are arranged appropriately, it is possible to study the variations in the values of the parameters as we move from small size to large size establishments.

For the results of each production models, the establishment data were divided into three parts consisting of small, medium and large size establishments on the basis of various criteria like K, L, K/L etc.

The parameters of each group were estimated separately and covariance analysis applied to them to discover the presence of uniformity in them and also to find if the returns to scale are the same for all sizes of establishments.

It is found that if full utilisation of resources may be regarded as an aspect of economies of scale, the increasing returns to scale in the case of developing countries, as noticed here are not surprising. With reference to the data under consideration (years 1964–65) this tendency is noticed in the case of India, Israel and Japan. It can be due to a greater emphasis on capital intensive methods, keeping upto date and selection of appropriate industrial activity. In the case of Japan, multishift system, capital depending and squeezing the maximum output out of every input unit are some of the noteworthy factors.

In the case of France, beyond the medium size establishments, diseconomies of scale are noticed. The result finds support in *Carre, Dubois and Malinvand (1976)*.

In she Socialist Yugolsav economy, even the small enterprises are suficiently large and show constant returns to scale. According to a World Bank report, the units here function rathere like division with separate accounts within a decentralised concern. The Yogoslav establishments have a unique size structure. They are not autonomous and are often grouped with other enterprises under a variety of arrangements and for a number of reasons.

The discrepancies in the returns to scale in various sizes of establishments are concealed in the case of pool regressions.

The CES results for the elasticity of substituion for different sizes of establishments were not as reliable as those of pool regressions. The use of VES relations improved matters and suggest the variability of elasticity of substitution for different size groups. No major improvements over VES1 results were obtained from the use of VES2 function. Other prodution relations also pointed in the same direction.

It is noticed that the pooled data on the whole, provide a better representation of and constitute a more complete set of observations from the manufacturing sector of the countries under study. This is not to imply that the quality of group regressions is poor. The explanation may be in the smaller number of observations in groups and the criteria used to group the establishments, *Monga (1982)*. The nature and extent of variations in the results of pool and group regressions become evident from an analysis of covariane for which the Chow Test of regression coeffiicients was used.

It is likely that the groups under consideration may be in the form of continuing segments having the same parameter values or there may be enough variation within the groups and that levelling effect makes these values equal. However the fact remains that the variations within the groups represent a wide variety of experience. We test the hypothesis that there is homogeneity between different groups if the same country so far as the production parameters are concerned and that the pooled data suggest an underlying stable structure.

The hypothesis is fully confirmed in the case of input Cobb Douglas function, with two inputs when the grouping criterion used is K, the capital assets of maufacturing establishments. This establishes the stability of the pool data of each country. The hypothesis is further supported by similarly subjecting the data to a covariance analysis using several variants of the three input Cobb Douglas production function. The use of Kmenta approximation also leads to si rmilaresults. But the CES function does not suggest stability in all the cases. This may be explained by noticing that the grouping variable is related to the dependent variable. It may also be due to the nature of the grouping variable K which basically has a technical character while the CES relation unlike the Cobb Douglas and Kmenta relations involved an economic variable w. We thus find that the choice of the grouping variable is essential to reveal the presence of homogeneity.

The second point noted above, viz. the presence of an economic variable in the production relation leading to heterogeneity with a technical grouping criterion, is supported later when other grouping criteria like L, K/L, w, r etc. were used. Even in the above case of K grouping, it was found that the results in favour of stability improved with the use of VES functions which involved technical explanatory factors besides economic factors. The use of other production relations supported this point on similar lines.

Use was made of several grouping criteria like L, K/L, w. r, V, age of establishment, capacity utilisation etc.

Conclusion

It is observed that the presence of both the technical and economic variables in a production relation helps to capture the prominent features of a realistic production process more vividly than otherwise. The use of too many of either of the variables does not improve the matters much. The stability of pool data depends on the choice of the grouping criterion whose nature and connection with the dependent variable in the production relation play important role in the process of determining the presence of homogeneity. In general, the parameters of production relations of various countries show striking resemblance with one another, and that there is considerable uniformity in the nature of industrialisation across nations. Finally, there is evidence of a unitary elasticity of substitution as well as constancy of returns to scale in most cases.

References

1. Carre, J.J.; P.Dubois and E Malinvand, *French Economic Growth* (Oxford University Press, 1976)
2. Monga G.S., "Some Aspects of the Neo-Classical Producton Functions," *Udyog Pragati* Vol.3, 1979, pp. 17-22.
3. —— "Some Variants of the CES Function", *Vishleshan*, Vol. 6, 1980, pp.73-98.
4. —— "Some Producivity Relations and Production Functions", *Udyog Pragati*, Vol.4, 1980, pp. 12-17.
5. —— "A generalised VES Production Function". *The Economic Journal of Nepal* Vol 4, 1981 pp. 27-49.
6. —— "Size and Grouping of Establishment Data", *Economic Analyst*. Vol 3, 1983, pp. 19-29.
7. Pederson, P.J. "Note on the Estimation of Aggregate CES Prodution Function with the Use of Capital Data", *Review of Economics and Statistics*, 1972, pp. 3336--333.