NOTES

A NOTE ON PRODUCTION FUNCTION OF HOUSEHOLD MANUFACTURING ENTERPRISES*

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SUMMARY. Bulk of the work on production functions in India and abroad relates to large scale manufacturing industries. In contrast, an attempt has been made in this note to see how far production functions of the Cobb-Douglas type explain the relation between output and factor inputs in the Indian household manufacturing enterprises. The estimates of the parameters obtained from the National Sample Survey cross section data, their errors and their sub-sample variations indicate that the form of function found suitable for large scale industries may apply also to small scale household industries at least as a first approximation.

1. Bulk of the work on fitting production functions to empirical data has been done for large-scale manufacturing industries. Both time series and cross-section data have been used to estimate parameters of production functions for individual industries as well as for the manufacturing industries sector taken as a whole. When such estimates are based on cross-section information, data relating to individual firms of a particular industry are needed for obtaining the production function for the industry. Second, cross-section data relating to individual industries have also been used to obtain production functions for the industry sector as a whole. It has to be admitted that the latter procedure is not a satisfactory one because this involves the assumption that different industries have the same production function. Obviously a more satisfactory way to obtain an inter-industry production function would be to make use of time series data relating to the manufacturing industries sector as a whole. But in the absence of time series data, it becomes necessary to fall back upon this procedure to obtain the inter-industry production function. In spite of the various defects, the parameters of the production function obtained in this manner should give a rough indication of the relation between output and factor inputs for the sector as a whole. For example, the procedure may give significantly different parameters for two classes of industries chosen according to some *a priori* consideration.

2. Value added (X) is usually taken as the measure of output in production functions, and the factor inputs considered are labour (L) and capital (K). A physical measure of labour is usually employed such as the number of man-hours or man-days employed. Capital is, on the other hand, measured in value units. All the snags which attach to valuation of capital thus affect the estimates of parameters of production functions. Inputs other than labour and capital have sometimes been used in the construction of production functions; we have not, however, done this in the present note.

3. The most fashionable form of production function, which has been used very widely, is due to Cobb and Douglas. The Cobb-Douglas form is given by

$$X = A.L^{\alpha}K^{\beta} \qquad \dots \quad (1)$$

or

$$X = A.L^{\alpha}K^{1-\alpha} \qquad \dots \quad (2)$$

where $0 > \alpha, \beta, > 1$. This form is linear homogeneous in the logarithms of the variables. The coefficients α and β respectively give the elasticities of labour and capital in respect of production. Empirical studies have frequently shown that $\alpha+\beta$ approximates unity,

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showing constant return to scale. In the Cobb-Douglas case, the elasticity of substitution between the two factor inputs is unity. We have used equation (1) for our subsequent analysis.

4. The object of the present note is to see how far production functions of the Cobb-Douglas type explain the relation between output and factor inputs in the Indian household manufacturing enterprises sector taken as a whole. Availability of data does not permit either a time series analysis or an inter-firm cross section analysis and we have to fall back upon fitting inter-industry functions on the basis of cross section data. The basic data are collected through the National Sample Survey (NSS). NSS Report No. 94 (1965) gives some data on household enterprises smaller than registered factories. The data were collected during the 14th round of the survey (July 1958–June 1959). Estimates of added value are given for last month and last year; we have used the latter estimate. Data on capital relate to fixed capital only, and the average value used can be taken to relate to the middle of the year. In so far as labour input is concerned, the report gives number of working persons and number of working days last month. Working persons include both household and hired labour. From this, it is possible to obtain an estimate of annual labour input. All estimates are given as averages per manufacturing household. The figures relate to 15 industry groups separately for rural and urban areas, and for each industry in each area, two estimates are given based on two independent interpenetrating sub-samples. Thus for an inter-industry estimate of the production function, 60 observations are available relating to 15 industry groups, each industry group having four observations, two urban and two rural. Each of these 60 composite observations, however, are based on a large number of primary observations. In fact, as many as 29392 households out of an estimated number of 134.56 lakhs of households engaged in small scale manufactures and handicrafts in the country comprised the NSS sample. Of this, the urban sample was smaller (5977) than the rural sample (23415). It is probably because of this that larger margin of uncertainty attaches to the estimates of coefficients of production function for the urban area. While we have used urban data for the all-India function, we have refrained from giving any separate estimate of urban production function. Also one urban industry in one sub-sample gives a large negative figure as added value and has to be neglected at the outset. Thus, altogether 59 composite observations form the basis of our analysis. The variables ultimately used are value added per manufacturing household per year (X), number of man-days worked per manufacturing household per year (L) and value of fixed capital per manufacturing household roughly during the middle of the year (K).

5. To start with we have obtained production function for the country as a whole, as well as for rural India making use of the 59 observations for the country and 30 observations for rural India. The estimates are presented below :

	N	α(labour)	β(capital)	A	R
rural	30	0.6518 ± 0.1331	0.1875 ± 0.1090	4.1803	0.75
all-India	59	0.7792 ± 0.0752	0.1863 ± 0.1008	2.5125	0.82

While the estimates of the coefficients are plausible, we note that relative standard errors are large, particularly for the exponent of capital. Also the multiple correlation coefficient is small in both cases. At the national level, the identity $\alpha+\beta = 1$ is approximately satisfied but there appears to be diminishing return to scale for rural industries, taken as a whole.

6. Generally, the data used, particularly those relating to urban areas, are extremely heterogeneous, and we have accordingly screened the data, rejecting some of the extreme values, with an aim to obtain better estimates of the parameters. For this purpose, we have computed the ratios $\frac{X}{K}$, $\frac{X}{L}$ and $\frac{K}{L}$ for all the composite observations. For rural areas, we have rejected observations having $\frac{X}{L}$ ratio above 10 and below 0.5 and $\frac{K}{L}$ ratio above 3. The first criterion leads to four rejections while the second, only one, thus leading altogether to 5 rejections. For urban areas, the rule used in rejecting observations for which $\frac{X}{K}$ is above 15, $\frac{K}{L}$ below 0.10 and $\frac{X}{L}$ above 8. The first criterion leads to 4 rejections and the second and third criteria to one rejection each. Thus we are left with 23 urban observations. While the rules used may appear arbitrary, the rejected values are by and large out of run with general observations. For example, $\frac{X}{L}$ ratio in urban areas ranges from Rs. 0.69 to Rs. 3.31 leaving aside the extreme value, Rs. 8.21.

7. Estimates based on the accepted observations are presented below :

	N	α(labour)	β(capital)	A	R
rural	25	0.4526±0.0954	0.4261±0.0896	4.0560	0.88
all-India	48	0.5796±0.0797	0.3753±0.0687	2.8821	0.91

These values appear to be more plausible to us, particularly at the all-India level. The exponent of labour is of the order of 0.6 while that of capital is only slightly below 0.4. The standard errors of the coefficients show that both are significant and the coefficient of labour is almost significantly larger than that of capital. Also, the multiple correlation is large showing a reasonable fit of the regression equation. Coming to the rural parameters, they are individually significant, but α and β are not significantly different, both being of the order of 0.45. The multiple correlation is large, though slightly smaller than that at the all-India level.

8. As we have already pointed out, the observations used by us are given in two indepndent interpenetrating sub-samples. It is, therefore, possible to work out production functions separately for the two sub-samples. We have done this only at the all-India level and the results are given below :

	N	α(labour)	β(capital)	A	R
sub-sample 1	26	0.5530±0.0968	0.3141±0.0789	4.5709	0.92
sub-sample 2	22	0.5960±0.1344	0.4953±0.1269	1.6121	0.93

These figures show that the estimate of α is better because the sub-sample estimates here demarcate a narrow range, 0.55 to 0.60. The estimate of β is subject to larger margin of uncertainty because here the range between sub-sample estimates is wider. The fact that

α is greater than β is borne out by both the sub-sample estimates, and thus it may be reasonable to believe that $\alpha > \beta$ for Indian household industries. The sum, $\alpha+\beta$, however, differ widely from sub-sample to sub-sample, being 0.86 in sub-sample 1 to 1.08 in sub-sample 2, the pooled value being 0.96. But the evidence generally indicates that $\alpha+\beta$ is probably near unity, under Indian conditions, for household industries.

9. We do not propose to draw any conclusion from the above analysis apart from pointing out that Cobb-Douglas production functions could probably be tried for studying Indian household industries. Nothing in the results we have presented militates against this contention. The coefficients obtained by us also tally approximately with those relating to Indian large scale manufacturing industries as the following figures (Walters, 1963) show :

	α labour	β capital	$\alpha+\beta$	reference year
Tewari (1954)	0.66	0.31	0.97	1946
Dutta (1955)	0.57	0.50	1.07	1947
Murti and Sastry (1951)	0.59	0.40	0.99	1951
Ours (1966)	0.58	0.38	0.96	1958-59

Much further study, however, is needed before one could definitely assert that Cobb-Douglas type of production functions are, in fact, useful for analysis of Indian household industries. The most important work which could immediately be undertaken is a study of inter-firm production functions for household industries on the basis of NSS data.

REFERENCES

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