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UNIVERSITY OF WOLLONGONG

DEPARTMENT OF ACCOUNTANCY

**DETERMINANTS OF FACTOR PROPORTIONS
IN MANUFACTURING IN A DEVELOPING
COUNTRY**

- Evidence from Sri Lanka

by

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ABSTRACT

Employment generation is a main objective of a developing country's industrialisation policy. The realisation of this objective depends largely on the nature of factor intensity in its manufacturing industry. This has generated a considerable amount of academic discussion on the determinants of factor intensity. However, most of these studies have arrived at differing conclusions, creating a necessity for more extensive empirical investigation into a wider range of developing country situations.

This paper presents results from an analysis of factor intensity in the Sri Lankan manufacturing industry. The results indicate that large firms tend to be more capital intensive than small firms. There is also evidence that locally owned firms are more labour intensive than foreign owned firms. Further, high-wage firms seem to use relatively more capital intensive production techniques than low-wage firms.

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I. INTRODUCTION

Employment generation is a main objective of a developing country's industrialisation policy. Contrary to this objective, the industrial structure in those countries is said to be characterised by an in-built capital intensity bias (Weiss, 1988:10). This has generated a considerable amount of academic discussion on the determinants of factor intensity. However, most of these studies have arrived at differing conclusions, particularly in respect of the relationship of capital intensity to firm size and ownership variables. For example, the widely held notion that small firms are more labour intensive than large firms has been challenged by some studies.¹ Therefore, much more extensive empirical investigation covering a wider range of developing country situations are needed before any meaningful generalisation on this issue can be made.

The purpose of this paper is to contribute to this debate by presenting results from an analysis of factor intensity in the Sri Lankan manufacturing industry. The remainder of the paper is organised as follows: The relevant empirical literature is briefly surveyed in Section II. In Section III, the trends and patterns of development in the Sri Lankan manufacturing industry are outlined to provide groundwork for the empirical analysis. Section IV sets out the methodology and describes the data base. The results are presented and analysed in Section V. The main conclusions are presented in Section VI.

II. REVIEW OF PREVIOUS WORK

In a pioneering study of interrelations among scale, technology and other economic characteristics in 10 industries in India, Sandesara (1966) finds no positive association between firm size and capital intensity. His investigation reveals that small firms very often employ fewer persons per each unit of capital than large ones.

¹ See Sandesara, (1966), Little, et al.(1987) and Cortes, et al.(1987)

Interestingly, in another study based on 32 industries in the same country for the period 1960-63 Metha (1966) strongly disagrees with the findings of Sandesara. He presents statistical evidence to show that smaller units have smaller capital/labour ratio than both medium and large units and also capital per worker increases with size. This evidence of a positive correlation between capital intensity and firm size is strongly supported by Lim (1983) with evidence from a study of Malaysian manufacturing. Results somewhat contrary to this have been found in a comparative ILO study of Malaysia, Thailand and the Philippines (Amjad, 1981:25). According to this study, except in the case of the Philippines, capital intensity does not vary significantly between different size classes of firms as is generally believed to be the case. In the case of Thailand, the study comes with a surprising result that firms employing less than 10 workers are more capital intensive as compared to firms employing between 10-49 and that the capital intensity of firms employing more than 200 workers is almost double that of the smaller sized firms.

In a more recent study on India, Columbia and ten other developing countries including Taiwan and Korea, Little, Mazumdar and Page (1987) have cast doubts about the labour intensity of small firms. They report that their survey has not provided evidence to assert that small firms (employing less than 10 workers) are reliably more labour intensive than large ones.

Another well known argument on the factor proportions issue is that the technology used by foreign firms (popularly known as Multinational Enterprises or MNEs) operating in developing countries is highly capital intensive and, therefore, tends to reduce the employment potential of industrialisation (Agarwal, 1976; Sen, 1980; Balasubramanyam, 1984). Testing of this hypothesis deserves serious consideration because the degree of involvement of MNEs from both developed and neighbouring developing countries in the manufacturing sector of developing countries has considerably increased in recent years (Lall, 1983; Nixon, 1984). Not all studies, however, have produced convincing evidence of a greater capital intensity bias in MNEs.

For example, some studies based on export-oriented industries in Taiwan, Hongkong and Malaysia show little systematic difference in capital intensity between foreign and indigenous firms (quoted in Casson and Pearce, 1987:100). According to an ILO study on Kenya, in sectors where both foreign and indigenous enterprises operate it is the latter that apparently indicates a greater degree of capital intensity (ILO, 1972).

III. THE SRI LANKAN SETTING

The economy of Sri Lanka, which was heavily dependent on a limited range of primary export commodities at the time of independence in 1948 (Snodgrass, 1966:16), has gone through significant structural transformation over the past three decades. The most discernible of this transformation has been the expansion of manufacturing. In early 1960s, in response to a severe balance of payments crisis the government placed heavy emphasis on an import substitution industrialisation strategy which provided the initial impetus for the growth of the industrial sector (Kanesalingam, 1967:228). As a result of this emphasis, the first half of the 1960s witnessed the emergence of a sizeable number of import substituting consumer goods industries. Industrial growth in the private sector, particularly in the large-scale sector, was supplemented by expansion of government industrial ventures. In view of the stringent import and exchange restrictions imposed in the 1960s, many foreign firms which upto then had been exporting goods to Sri Lanka from their overseas production centers set up subsidiaries and/or joint ventures with local partners to undertake production for a largely captive domestic market (Athukorala and Jayasuriya, 1988:411).

In the 1970s, dissatisfaction with the pattern of growth of the industrial sector in the sixties, the commitment to socialism of the United Front Government, and the scarcity of foreign exchange led to the introduction of a new industrialisation policy aimed at expanding the public sector by setting up new large-scale industrial ventures and nationalising some of the privately owned enterprises (Betancourt, 1981:33).

The change in political leadership in 1977 brought about a liberalised economic environment through a series of policy reforms including an export-oriented industrialisation strategy. The heavy emphasis of this new strategy was placed on large-scale industries in the private sector, those with foreign capital participation in particular (Wijewardena, 1988:228). Setting up of an export processing zone (the Katunayake Investment Promotion Zone) in 1978 was one of the major steps taken in this direction. Numerous incentives were offered mostly for the promotion of export-oriented industries. As a response to the incentives offered and the favourable political environment created, participation of MNEs in manufacturing increased substantially over the post-liberalisation period.

Despite recent emphasis on export-oriented manufacturing, the industrialisation pattern has continued to be characterised by high capital intensity (Lakshman, 1986:33). The manufacturing contribution to GDP increased from about 6 per cent in the early 1960 to 15 per cent in the mid-1980s. The share of employment, however, increased only from 9.2 to about 13 per cent during this period (Cuthbertson and Athukorala, 1990). The survey data available from the Ministry of Industries and Scientific Affairs (1975-76) and the Department of Census and Statistics (1981) has shown a sizeable upward trend in the capital intensity bias in the manufacturing sector. The capital/labour ratio increased from 9.21 in 1974 to 26.32 in 1981².

IV. METHODOLOGY AND DATA

The Model

In order to examine the determinants of the factor intensity, we develop a model drawing upon the literature on the nature and determinants of industrial structure in developing countries (Bhalla, 1981; Lim, 1984; Athukorala and Jayasuriya, 1988). Depending on the availability of data, three industry characteristics (firm size, ownership

² For details see Table 2.13 in Cuthbertson and Athukorala, (1990)

and wage rate of manufacturing firms) are taken into account in our model. The model is presented below:

$$(1) \quad KL_i = a SZ_i^{b_1} FW_i^{b_2} WGR_i^{b_3} e_i$$

OR

$$(2) \quad \text{Log } KL_i = \text{log } a + b_1 \text{ log } SZ_i + b_2 \text{ log } FW_i + b_3 \text{ log } WGR_i + e_i$$

$$b_1 > 0, \quad b_2 < 0, \quad b_3 > 0$$

$$i = 1 \dots n$$

Where

KL = Capital intensity defined as the value of machinery and equipment per worker),

SZ = Firm size represented by gross output

FW = Firm ownership dummy which is 1 if the firm is locally owned and 0 otherwise.

WGR = Wage rate measured as average wage per production worker

i = Firm subscript

n = Number of firms (111)

Firm size is included as an explanatory variable in order to capture the role of scale of production in the determination of factor intensity. A test of the effect of this variable (SZ) on the factor intensity is important since the industrialisation policy of a developing country generally places emphasis on the promotion of small-scale industry as a means of generating employment (Bhalla, 1981:23). This policy emphasis on small-scale industry is based on a number of advantages which are generally believed to be associated with the small-scale. Small industry is not seen only as providing a remedy for unemployment, but also as spreading the benefit of economic development more widely (Elkan, 1989: 234). The low import dependence is also considered a favourable feature of small industry from the view point of balance of payments and backward linkage relationships (Wijewardena, 1988: 229). Another argument put forward in favour of small-scale industry is that it makes use of resources that may otherwise not be

drawn into the development process (Marsden, 1981:23). In essence, the main argument in favour of a policy for promoting small-scale industry stems from the hypothesis that large firms are more capital intensive than small firms. If this were so, the sign of the coefficient of SZ in our model should be positive.

The conventional wisdom on the involvement of foreign firms (MNEs) in developing countries holds that their subsidiaries tend to be more capital intensive than purely locally owned firms (Wells, 1973; Agarwal, 1976; Balasubramanyam, 1984). In the light of this, we include ownership dummy in the model in order to test if MNE involvement leads to greater capital intensity.

As pointed out earlier, it is generally believed that in developing countries firms paying higher wages tend to be more capital intensive (Lim, 1983; Amjad, 1981; Agarwal, 1976). The wage rate variable (WGR) is included in the model to test if this feature of higher wages is a symptom of capital intensity. Thus, the expected sign of WGR is positive.

Data

The data for the study comes from the Sri Lankan Survey of Manufacturing industries in 1981 (DCS, 1985). The identification of MNE affiliates for the purpose of data extraction from unpublished returns was done using the list of firms prepared by Lakshman and Athukorala (1985). The list identifies a firm as 'foreign' if at least 30 per cent of the share capital is foreign owned and gives information on the parentage and the date of commencement of operations in Sri Lanka. Accordingly, a sample of 111 firms were used for the study.

The survey data contained information on the value of total fixed capital as well as that of plant and machinery in fixed capital. In measuring the capital intensity variable (KL), we used the latter for the following reasons: Firstly, employment is likely to be

more closely related with outlay on plant and machinery than with outlay on land and buildings. Secondly, the literature suggests that MNEs tend to spend relatively more on buildings compared with local firms (Agarwal, 1976: 593). Hence, the use of total fixed assets as the measure of capital intensity may lead to misleading results.

Capital intensity was measured by dividing the value of plant and machinery by the number of employees. As an alternative variable of capital intensity, we also tested a variable derived as total capital in firms divided by the number of employees. Out of these two, the former was chosen on empirical grounds.³

V. RESULTS

The model was estimated using the ordinary least squares method (OLS). Both linear and log linear forms of the model were estimated to find that the results for both functional forms are generally comparable. The results for the log linear form are reported in Table 1.⁴

All regressions pass the F-test for overall statistical significance at the 1 per cent level. They also pass the Ramsey's RESET (using the squares of the fitted values) for the appropriateness of the functional form chosen.⁵ The normality assumption and the heteroscedasticity assumptions relating to the OLS error process are overwhelmingly supported by the relevant tests.

³ Alternative estimates based on this variable (total capital per worker) are available with request from the author.

⁴ The log linear form had the added advantage that the regression coefficients can directly be interpreted as elasticities.

⁵ For details of various statistical tests used here see Maddala (1988).

Table 1
Determinants of Factor Intensity (KL) in Sri Lankan Manufacturing - Regression Results^a

Log equation: $\log KL_i = \log a + b_1 \log SZ_i + b_2 \log FW_i + b_3 \log WGR_i + e_i$					
	(1)	(2)	(3)	(4)	(5)
a	1.27 (2.51)*	0.61 (1.75)**	1.68 (9.02)*	2.70 (12.07)*	0.64 (1.81)**
b ₁	0.09 (1.09)	0.14 (1.82)**	0.26 (2.90)*		
b ₂	-0.58 (1.78)**			-1.10 (3.85)	
b ₃	0.49 (2.70)*	0.60 (3.52)*			0.70 (4.24)*
Test statistics:					
F	8.44*	10.87*	8.43*	14.84*	18.02*
SE	1.42	1.43	1.50	1.46	1.45
JBN ^b	0.25#	0.17#	0.53#	2.20#	0.09#
RESET ^c	0.97#	1.31#	0.49#	(n.a.)	0.61#
ARCH ^d	0.67#	1.38#	0.03#	0.90#	1.69#

Notes:

- a. T-ratios are given in parentheses. Significance levels are denoted as: * = 1%, ** = 5%, # = the relevant null hypothesis is not rejected at 1 per cent level.
- b. Jarque-Bera test for the normality of residuals
- c. Ramsey's RESET test for functional form mis-specification using square of the fitted values, F version.
- d. Engle's autoregressive conditional heteroscedasticity test of residuals.

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Table 2

Correlation Matrix

	<u>WGR</u>	<u>KL</u>	<u>SZ</u>	<u>FW</u>
WGR	1.00			
KL	0.23	1.00		
SZ	0.24	0.20	1.00	
FW	-0.41	-0.31	-0.30	1.00

All the coefficients in the full model (equation 1) have the expected signs. The coefficient of the wage rate variable (WGR) is statistically significant at 1 per cent level, suggesting that high-wage firms are characterised by greater capital intensity. The ownership dummy variable (FW) is significant at 5 per cent level. Thus, there is empirical support for the hypothesis that production operation of purely locally owned firms are less capital intensive than subsidiaries of multinational corporations. The coefficient of firm-size variable (SZ), though with the expected sign, is not statistically significant. The inspection of the correlation matrix (Table 2) showed that the FW is correlated with both SZ and WGR. Therefore, it may be that the insignificance of SZ coefficient is due to multicollinearity. To allow for this possibility, we re-estimated the model after dropping FW (equation). In this equation, the coefficient of SZ is significant at the 5 per cent level. Bivariate regressions for the three explanatory variables are also reported in the table. In all the three equations, the relevant coefficients carry the expected signs and are significant at 1 per cent level.

VI. CONCLUSIONS

The following conclusions can be derived: Firstly, large-scale firms tend to be more capital intensive than small-scale firms. These results provide empirical support for

the policy emphasis on the promotion of small-scale ventures. There is also evidence that locally owned firms tend to be more labour intensive than foreign owned firms. Finally, firms operating in high-wage industries seem to use relatively more capital intensive production techniques than those operating in low-wage industries.

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