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ECONOMIC EFFICIENCY, CAPITAL-INTENSITY AND CAPITAL-LABOUR SUBSTITUTION IN RETAIL TRADE

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I. Introduction

The problems of factor proportions, capital-intensity and technological change are quite familiar. Yet, in the measurement of capital-intensity, inclusion of working capital is rarely seen. This is likely to introduce serious biases in the estimates of both capital-intensity and the elasticity of substitution between capital and labour. The situation is likely to become worse in the case of distributive trades where the importance of fixed capital alone is rather limited.

One of the purposes of the present paper is to examine the economic position of retail trades by taking account of the requirements of working capital (or inventory stocks). The choice of retail trades is guided by various reasons. First, it is felt that this category of services is a suitable example of non-material production. Second, it is often assumed that the small retail shops are highly labour-intensive. It would be interesting to explore whether this hypothesis remains valid if one considers inventory-sales ratios as a measure of capital-intensity. Justification for the use of inventory-sales ratio or inventory-labour ratio lies in the fact that the conventional indicators such as per capita availability of horsepower or "tons of steel" or value of equipment used for material production are not very relevant. Besides, the stocks reflect more accurately the annual flow of capital services than the fixed capital in the measurement of relationship between output and capital input. Finally, the variations in size of inventory-sales ratios may also throw light on the relative economic efficiency of small and large establishments in retailing.

The degree of capital-intensity depends on the elasticity of substitution between capital and labour. A priori, one might expect that this elasticity is low in non-material production where by and large, labour is the end-product and quality of services is judged in terms of the amount of labour. The empirical observation of a rise in the share of labour in retail trades,and also in other services, without a corresponding rise in the share of output also suggests a low elasticity of substitution. However, contrary to expectations, the authors of the CES production function (Arrow et al.) obtained rather high estimates of this elasticity for trade (1.12) and transport services (1.74)[1] from the data for Japan and the USA.

We shall explore whether retail trades indicate a high or low elasticity and whether the high estimates obtained by Arrow et al. are in fact, due to the exclusion of working capital. The CES estimated aggregate elasticity is for the trade sector as a whole. One may also expect that the large-scale department stores have a greater elasticity (due to easier credit facilities and capital accessibility) than the small-scale stores. If the former predominate in the sample, the elasticity estimate may turn out to be high. Besides, the CES production function may not be as applicable to individual service industries as to manufacturing which is perhaps the only sector that

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[1]K. Arrow, H. B. Chenery, R. Solow, and B. Minhas,"Capital-Labour Substitution and Economic Efficiency," Review of Economics and Statistics, August 1961.

has so far been considered for testing the CES function.[1] This function has been hailed as one of the most 'generalised' versions of a production function since it can be easily extended to an n-factor case à la Uzawa. At least, empirically, there can be another interpretation of its generality; viz. that the derivation of the elasticity of substitution via the indirect behaviourial equation(regressing labour productivity on the wage-rate) or the direct method is equally valid for all economic sectors. A test is made of the indirect behaviourial equation with the aid of cross-country data of six retail industry groups to determine whether this assumption and interpretation of generality holds. The behaviourial equation measures the elasticity of substitution under restrictive assumptions of constant returns to scale and perfect competition in factor and product markets. The empirical validity of these assumptions for retail industries is also examined. For the measurement of elasticity of substitution directly,[2] we employ a three-level Uzawa version of a four-factor CES function. Assuming separability of components of variables, fixed and working capital are considered separate inputs, as are wage-labour and own-account labour.

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[1] Most authors have so far concentrated on manufacturing for lack of data of good quality for agriculture and service sectors. For a recent review, see Marc Nerlove, "Recent Empirical Studies of the CES and Related Production Functions," in Murray Brown (ed.), The Theory and Empirical Analysis of Production, NBER, New York, 1967.

[2] In the words of Bagicha Minhas, ". . .any estimates of the elasticities of substitution between capital and labour in these sectors (i.e. agriculture and services) which further research may produce would be very useful." (B. Minhas, An International Comparison of Factor Cost and Factor Use, North-Holland Publishing Co., 1963, p. 97.) The present attempt should be treated as only a modest exercise which is undertaken in full recognition of the inadequacy and poor quality of comparable data. One of the objectives of the present study is to make a beginning with the processing of requisite data.

II. Indices of Capital-Intensity and Economic Efficiency

In economic literature, capital-labour as well as capital-output ratio have been frequently used as indicators of capital-intensity. Assuming that fixed capital is relatively insignificant in retailing, stock-sales ratio[1] becomes analogous to the capital-output ratio (K/O) and inventory-labour ratio to the capital-labour (K/L) ratio. The fixed capital stock measures only a static relationship in an average capital-output ratio. On the other hand, inventory measures the flow of capital services and thus has a better economic meaning as a numerator in the capital-output or capital-labour ratio. In the following pages, we consider both inventory-labour and inventory-sales ratios as indices of capital-intensity.

A few limitations in the use of inventory-sales ratio as an index of capital-intensity are worth noting however. First, the stock-sales ratio, strictly speaking, is not the inverse of stock investment turnover, because the element of gross profit is included in each increment of stock investment. Neither is it identical to the rate of turnover of working capital which may also be affected by the promptness with which the customers settle their accounts.[2] Second, we have assumed that all stocks held by

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[1] In general, the stock-sales ratio presents a relationship between stocks at a given point of time and sales during a given period. However, we consider the ratio as a ratio of the average stocks over the year (average of the beginning-of-the-year and end-of-the-year stocks) to the sales for that year. Some writers have argued that the stock-sales ratio based on the beginning-of-the-year stocks is more valuable since the size of the stocks held depended on the amount of sales the businessmen expected to make in future. End-of-the-year ratio is less reliable for setting ideal stocks during periods when sales are declining or increasing at below normal rates. See Carl N. Schmalz, Indexes of the Stock-Sales Relationship in Retail Stores, Harvard Business Review, Vol. 6, 1928, pp. 433-442.

[2] Cf. M. P. McNair, Significance of Stock-turn in Retail and Wholesale Merchandising, Harvard Business Review, Vol. 1, 1922-23, pp. 87-96.

retailers represent "productive" investment. In underdeveloped countries, this need not necessarily be true. Apart from technical requirements, the size of inventory stocks may also be influenced by the nature of economic organisation. In retailing, for instance, household and the bulk of family labour provides the basis for economic operations. Working capital requirements in terms of final consumer goods may be reduced to some extent since the remuneration to additional self-employed labour does not accrue until the fruits of labour materialize.[1] A fall in the family-based retailing may partly explain a rise in the working capital requirements since larger stocks held by traders reflect both "investment" and "consumption".

Despite the above limitations, under conditions of capital scarcity (that is almost proverbial in the LDCs), inventory-sales ratio can be an appropriate index of dynamic economic efficiency. The lower the inventory-sales ratio, for instance, the shorter the average length of time for which the retail stores have to hold their stocks. This would imply a reduction of costs and rise in profits when the reorder costs of more frequent purchases is less than the carrying costs. Although a low inventory-sales ratio need not be a cause of high economic efficiency, the latter being a function also of such factors as ability and foresight of good management, it does at least reflect economies of scale and superior management.

There is, as yet, no unanimous view regarding the optimum level of stocks in relation to sales. One can at best cite a number of prevailing

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[1] See Amartya Kumar Sen, "Working Capital in the Indian Economy: A Conceptual Framework and Some Estimates," in P. N. Rosenstein-Rodan (editor), "Pricing and Fiscal Policies" -- Studies in the Economic Development of India, Series No. 3, MIT.

hypotheses, viz:

(a) Businessmen maintain a constant proportion of sales in stocks;

(b) Rational entrepreneur should vary his inventory stocks with the square root of sales rather than with sales; . . .

(c) According to Boulding,"the optimum inventory is not independent of the amount of capital with which the firm starts. The more capital a firm has, the larger will be its inventory."[1] Although Boulding does not provide any explanations for this relationship, it may be that the greater the capital the firm has, the more it pays to invest it in inventory stocks especially under conditions of expectations of price rises. This would be true if the returns to capital were greater in the larger firms than the smaller ones.

III. Some Evidence of Inventory-Sales Ratios, Economies of Scale and Market Imperfections

In general, the diseconomies of small-scale would suggest higher ratio of stock to sales for smaller shops than those for larger shops. This hypothesis of an inverse correlation is borne out by the position of seven retail industry groups of Colombia (1954) as illustrated by the following graphs. On the vertical axis, we plot the inventory-sales ratios whereas the horizontal axis measures the size of stores in the ascending order of

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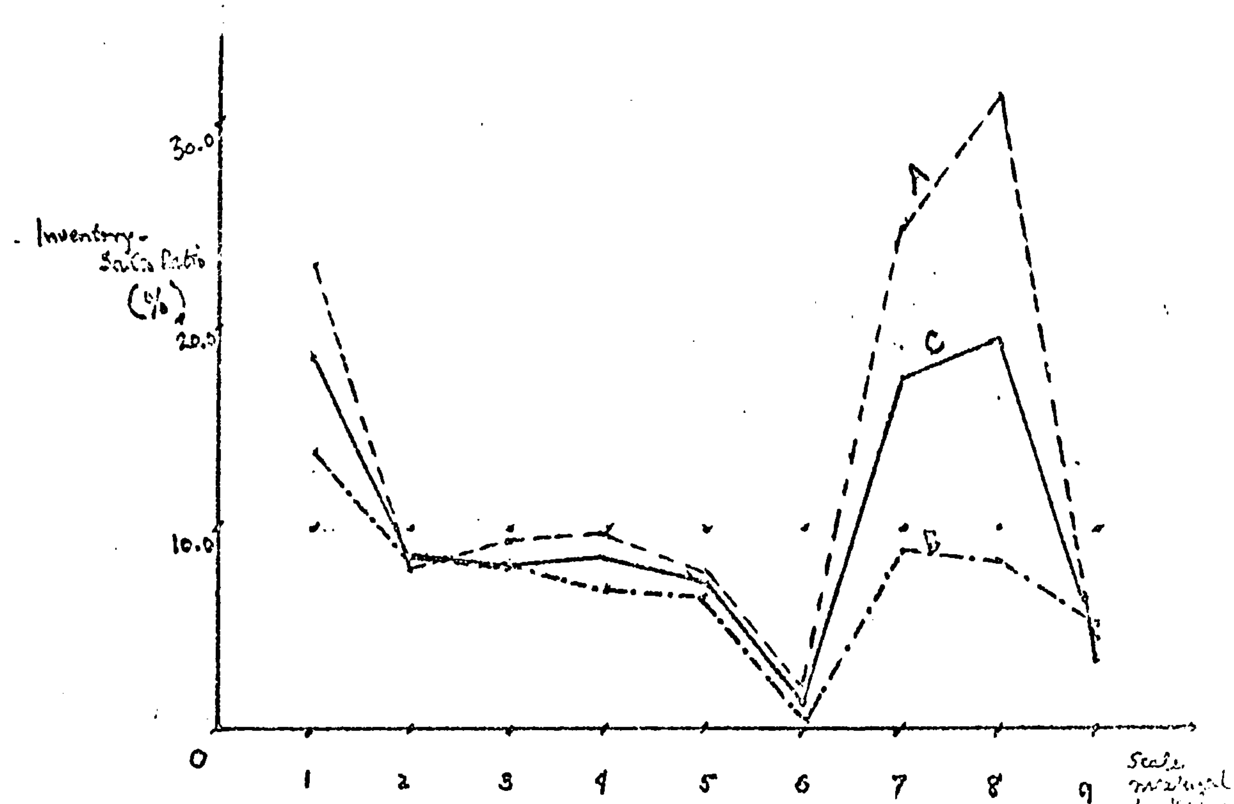
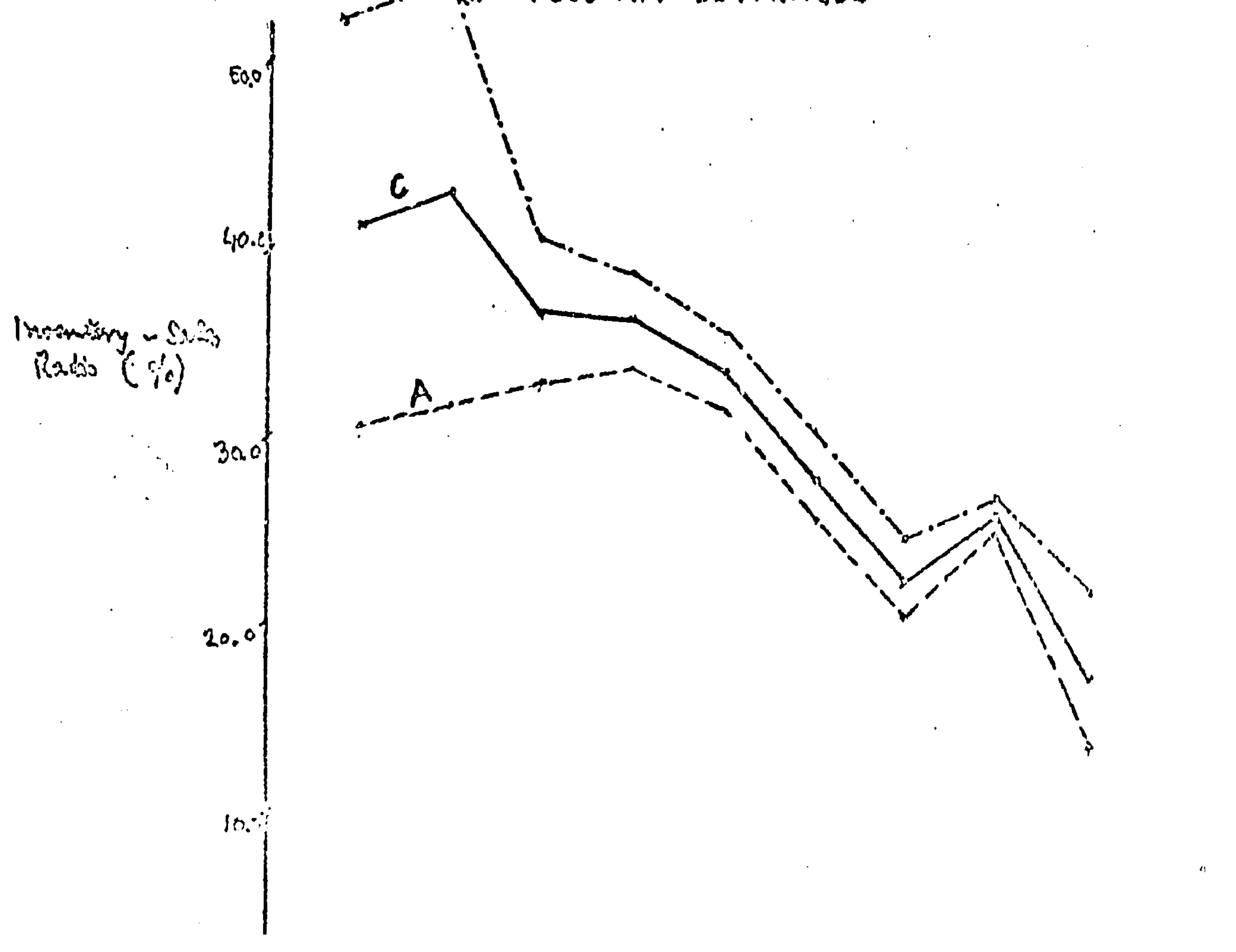
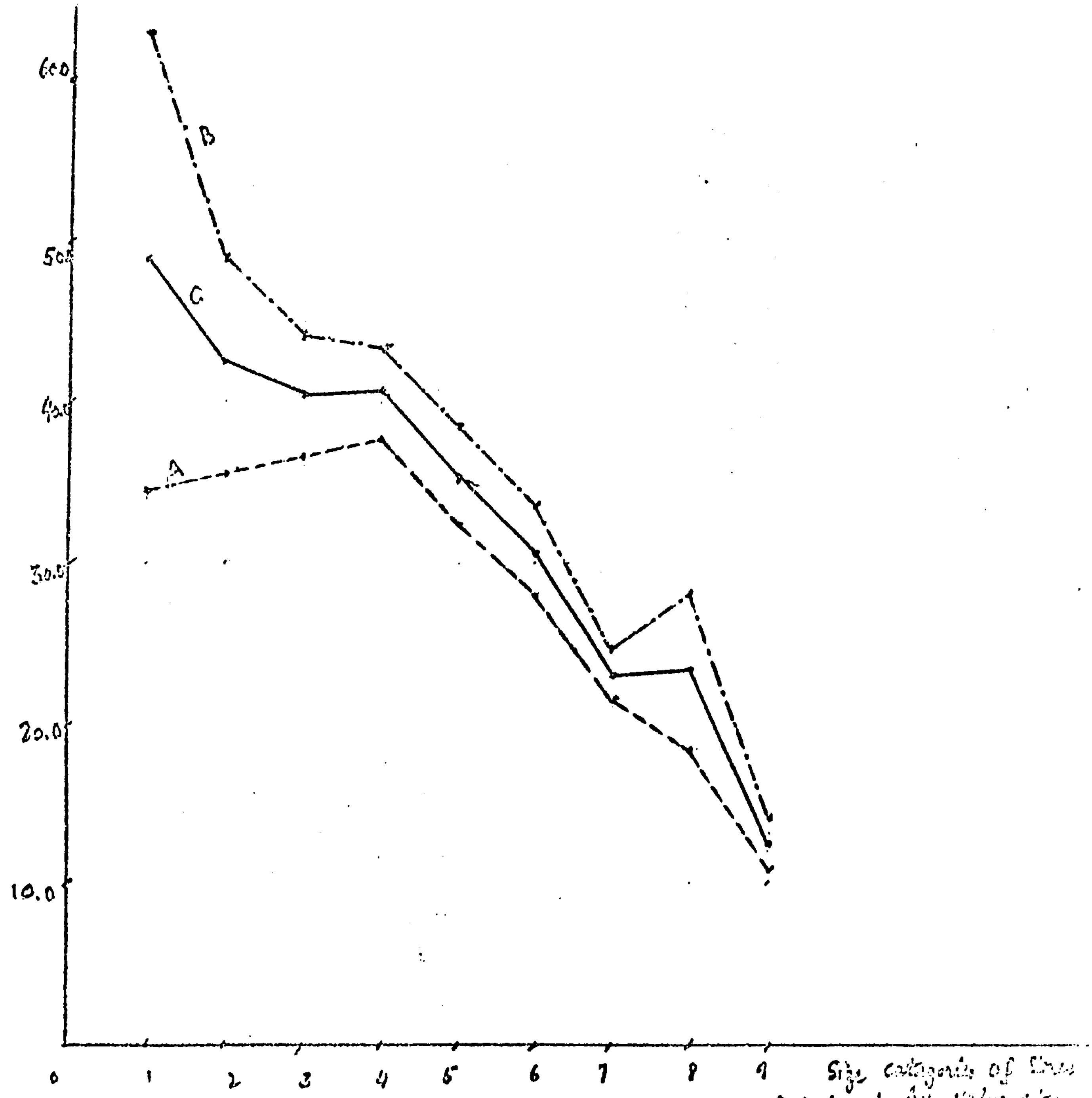
[1] Kenneth Boulding: A Reconstruction of Economics, 1950, p. 113. This situation obtains when the indifference curves facing a firm are not parallel but circular. If the curves are parallel, i.e. they are separated by a constant vertical distance so that slopes of all curves are constant, then for any given amount of inventory, the inventory does not change with the change in capital since the whole profit is added to the liquid stock of the firm.

COLOMBIA ([illegible])

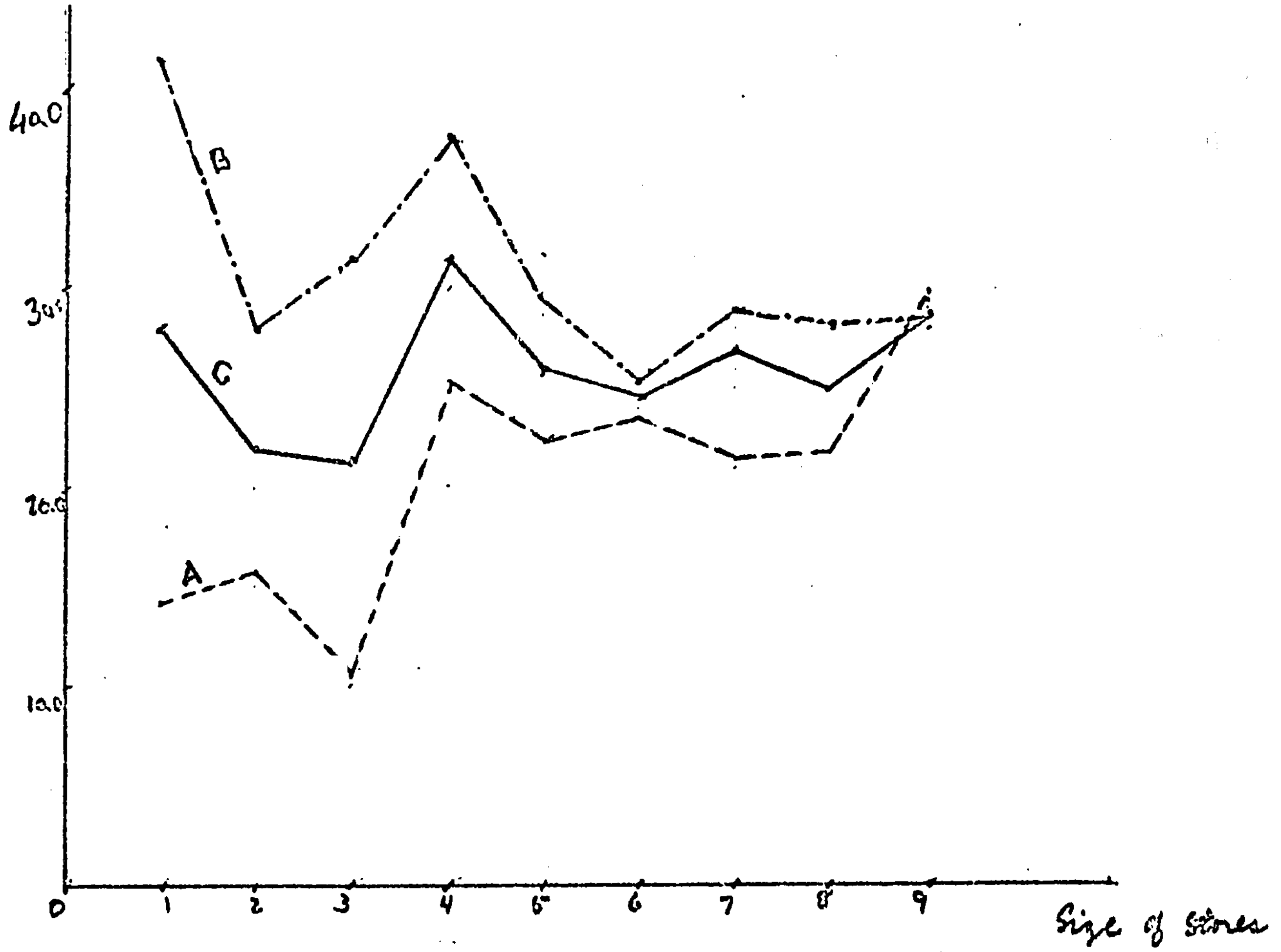


(ii) FOOD AND BEVERAGES

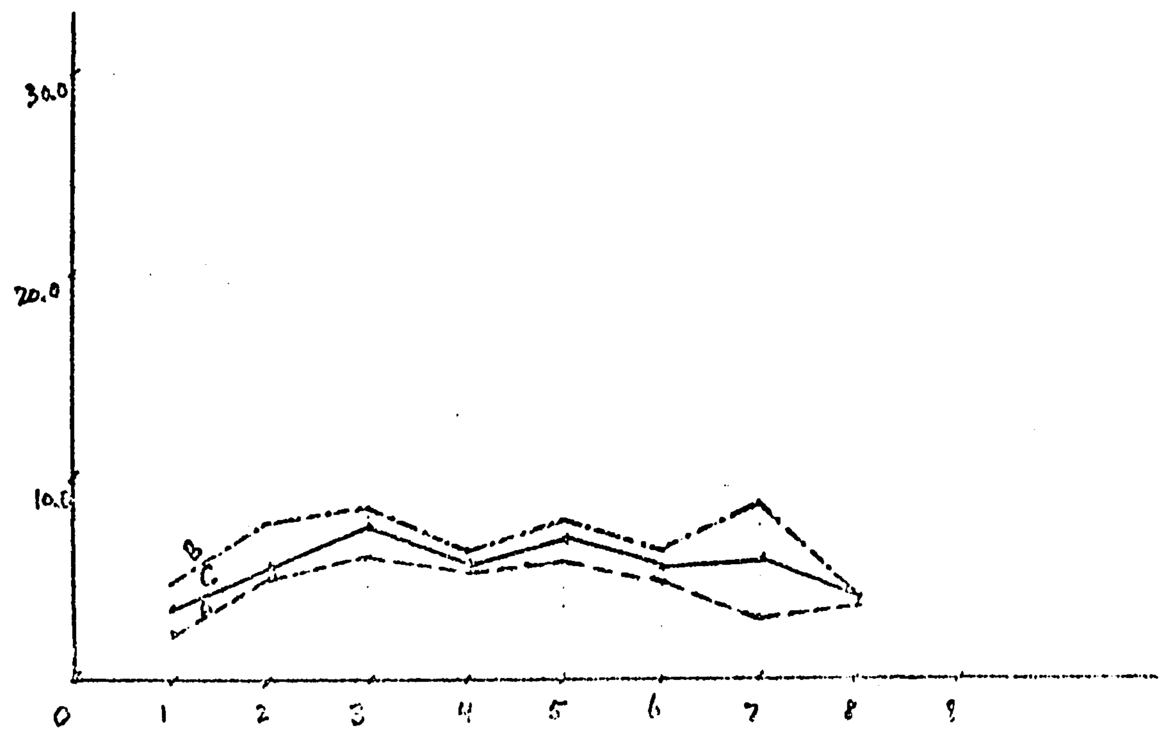




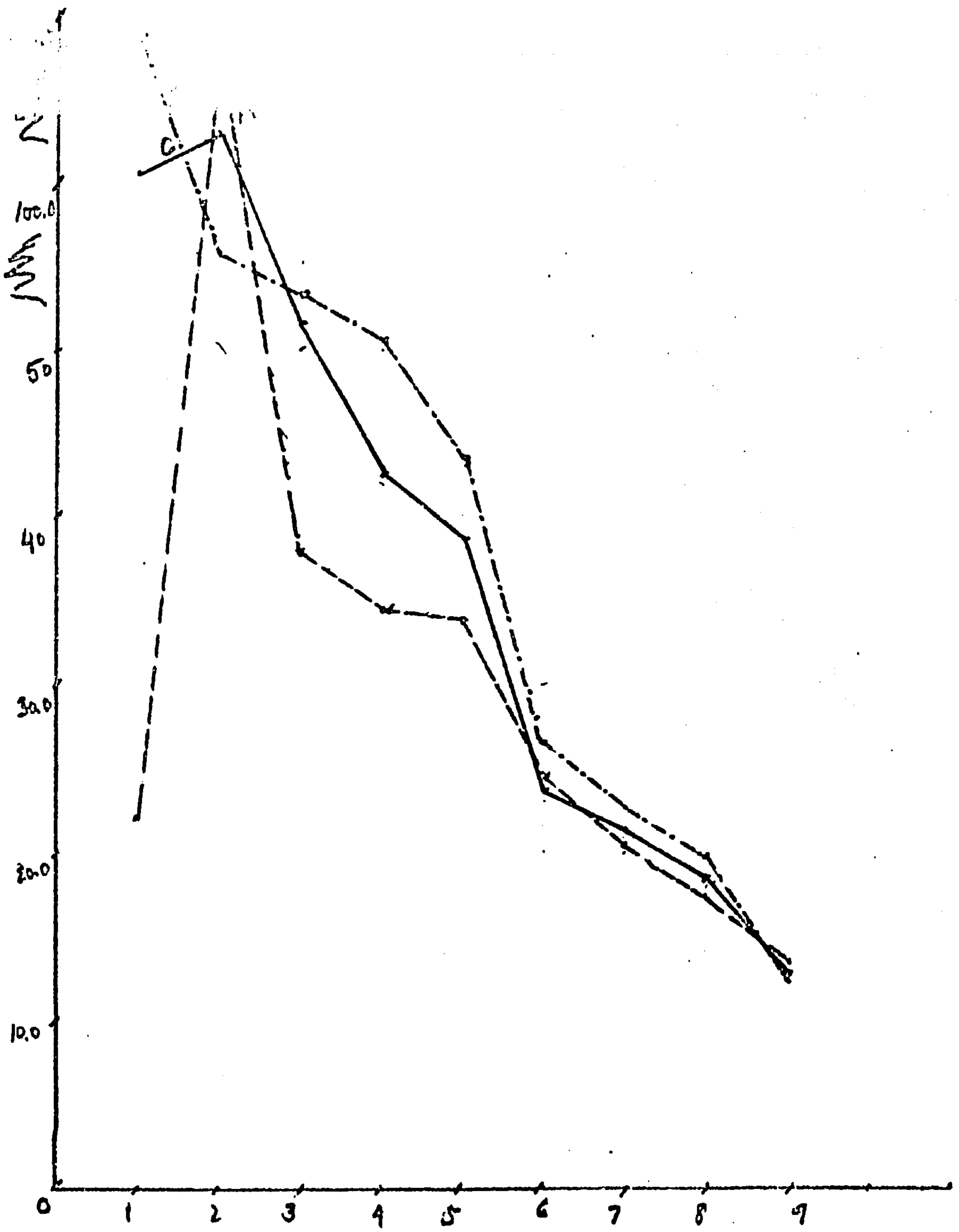
(3). TEXTILES AND CLOTHING



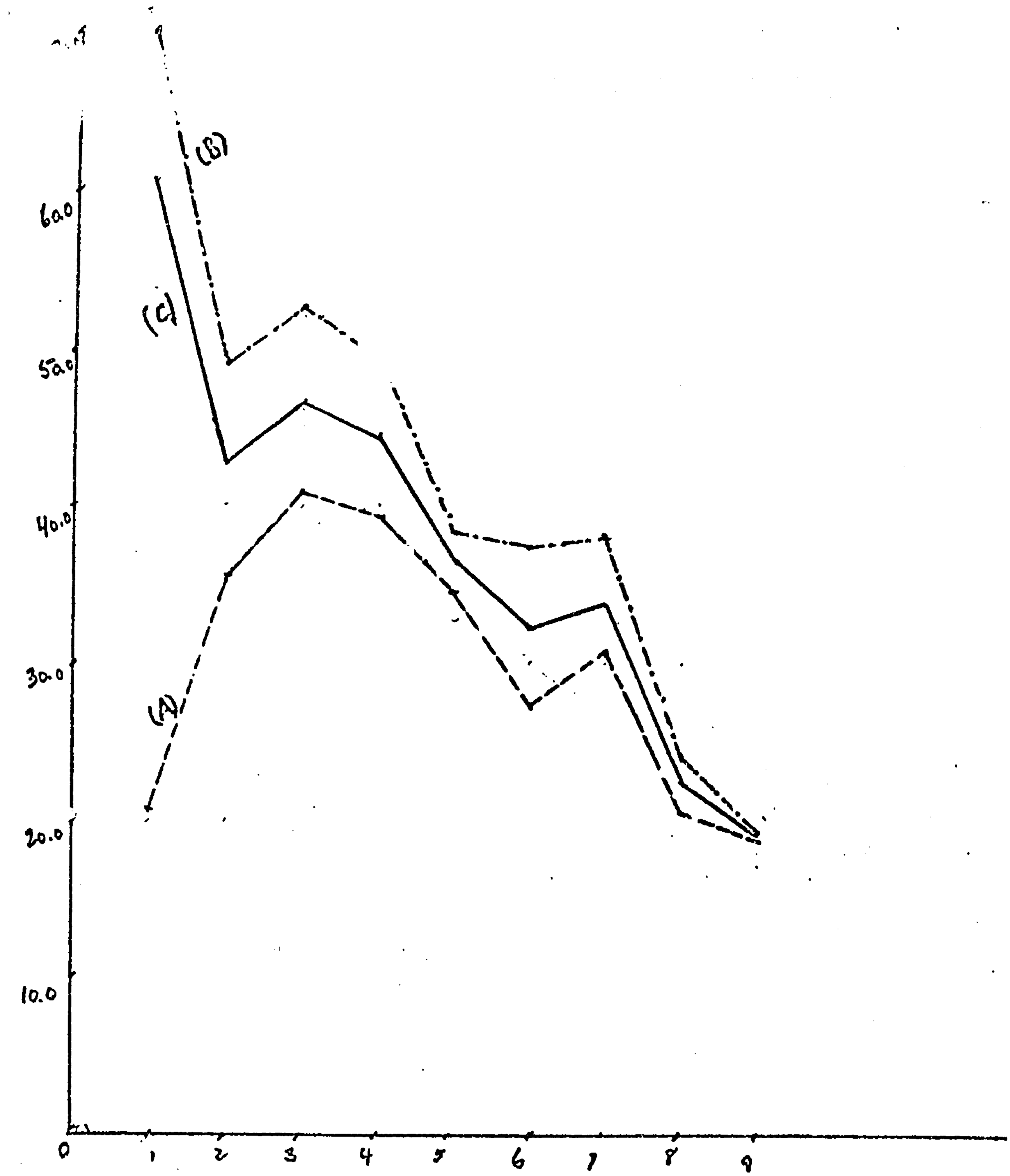
(4). FURNITURE AND DOMESTIC APPLIANCES



(5) FUELS



(6). AUTOMOBILES AND ACCESSORIES



(D). HARDWARE AND CONSTRUCTION MATERIALS

Note: (A) = represents Inventory at the end of the year.

(B) - " " " beginning of the year

(C) - " " as average for the whole year.

the value of sales. There are nine size-classes. In four cases out of seven, viz. general merchandise, textiles and clothing, automobiles and accessories, and hardware and construction materials, as the size of stores increases, the inventory-sales ratio (K_1/S) continues to fall until it reaches the lowest level in the largest stores. In the case of food and beverages, the ratio declines until it reaches the lowest level in the medium-sized stores and then rises sharply again. For fuels, the size of stores seems to bear little influence on the magnitude of the ratio which is fairly stable across different size-classes. For furniture and domestic appliances, the medium-scale as well as large-scale stores indicate ratios which are almost as large as those for the small-scale stores. In general, the beginning-of-the-year inventory and end-of-the-year inventory move parallel to the average inventory for the whole year. Thus, the fact that the end-of-the-year stocks are more closely related to the last year's sales rather than those of the coming year does not seem to make any significant difference.

The above observations seem to contradict a number of commonly held hypotheses, viz. (a) that the inventory-sales ratios for the small stores would tend to be low since they often buy in small bulk and more frequently in order to lower carrying costs; (b) that the ratio will tend to be low for such perishable products as food, fruits and vegetables and high for durables like ornaments, watches and automobiles typical of erratic demand resulting from the caprice of consumers; and (c) the poor liquid and credit position of the small businessmen forces them to lower stock-sales ratio in order to save on carrying and storage costs. We notice that at least in the Colombian case, even the stocks held by small retailers in food and beverages which would generally qualify as perishables, are quite large in relation to sales. Thus, even though there are savings in carrying costs, the more frequent the ordering of merchandise the greater are the reorder costs of delivery. If the sellers charge a higher price for smaller orders and a lower price for larger orders, the reorder costs will be still higher for the small shops.

It is also interesting to note that inventory labour ratio (K_i/L) and inventory-sales ratio (K_i/S) both decline with an increase in the sales-size of the firms;[1] sales labour productivity rises and so does the wage per employee (see Table I, Appendix I). This implies that the larger 'shops' make more economical use of both labour and capital resources than the smaller shops. However, this observation is inconsistent with the traditional neo-classical theory of production according to which, given constant returns to scale, all firms irrespective of their size, are on the same production function. Therefore, theoretically, an increase in capital-labour ratio should be associated with an increase in capital-output ratio, and an increase in output-labour ratio. This inconsistency between received theory and empirical facts of the retail trades can be reconciled by assuming increasing returns to scale and superior management in the large shops.[2]

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[1]Ranking of shops according to size may vary depending on the criteria of 'scale' used. The two most popular criteria are the number of persons engaged and the volume of sales. Our choice of the latter is governed partly by the availability of data in this form, and partly for its greater economic significance in measuring the efficiency and economies arising from increase in sales.

[2]There is plenty of empirical evidence for the manufacturing sector that suggests a positive correlation between capital productivity and labour productivity. See J. C. Sandesara, Scale and Technology in Indian Industry, Bulletin of the Oxford University Institute of Economics and Statistics, August 1966; and H. Shinohara and D. Fisher, The Role of Small Industry in the Process of Economic Growth, The Hague, 1968.

It may seem that in retail distribution, the economies of scale are insignificant since the size of stores in general is quite small and the growth of total sales merely reflects the growth of commodity production. Yet, in practice the situation in retailing need not be any different from what prevails in manufacturing establishments. Large retail stores, e.g. supermarkets and chain stores, can use advanced techniques of distribution more economically at higher volume of sales. Similarly, expansion of sales enables fuller utilisation of existing equipment and staff.[1]

In order to verify the existence of economies of scale in the seven sub-groups of retail industries of Colombia, we fitted the following logarithmic equations:

$$\log (S/L_p) = \alpha_0 + \beta_0 \log (S) + \Sigma_0 \qquad (1.a)$$

$$\log (S/L_e) = \alpha_1 + \beta_1 \log (S) + \Sigma_1 \qquad (1.b)$$

$$\log (S/L_e) = \alpha_2 + \beta_2 \log (S) + \gamma_2 \log (W_e) + \Sigma_2 \qquad (1.c)$$

where S/L_p - is sales per person engaged, S/L_e - sales per employee, S - total sales, and W_e - wage per employee. The β-coefficient in these equations gives what is well-known as the "Verdoorn coefficient."[2] This coefficient roughly indicates the size of economies of scale on the assumption that the productivity increase in response to expansions in total output

[1] For fuller details of the types of economies associated with expansion of output of retail distribution, see Margaret Hall, John Knapp, and Christopher Winsten, Distribution in Great Britain and North America, Oxford University Press, 1961, Chapter Seven on "Economies of Scale."

[2] Cf. J. P. Verdoorn, Complementarity and Long-range Projections, Econometrica, 1956. According to Verdoorn, a stable, long-run relationship exists between labour productivity and the level of output. The statistical basis of the relation was shown by the logaritnmic regression of output per man on output. The regression coefficient was significant and varied from 0.45 to 0.60.

is explained by these economies. Inclusion of (W_e) as an additional independent variable was made in order to examine any biases in the β-coefficient due to the omission of other explanatory variables. The results of these regressions are presented in Table I. In almost all cases, equation (1.c) with (W_e) as one of the variables provides the best fit. The correlation between sales[1] and sales per employee is positive and statistically significant for general merchandise, furniture and domestic appliances, automobiles and hardware and construction materials. Of these industry groups, it is significant to note that general merchandise, automobiles and hardware and construction materials also showed a decline in the inventory-sales ratios with a rise in the scale of shops. One can therefore conclude that at least in these cases, the decline in the ratio can be attributed to economies of scale.

At present, there is however no satisfactory method of separating economies of scale from imperfections in the product market which are typical of retail trades. The identical articles often sell at very different prices in the same neighborhood. Small-sized shops are protected from the competition from large shops by the "loyalty of their clientele." Competition is imperfect and tends to operate not so much through a reduction of prices or distributive margins as through the multiplication of shops and elimination of abnormal profits.

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[1]The limitations of sales as an indicator of output need to be borne in mind. For instance, sales do not respond to a change in size of transactions or to a deepening of operations (e.g. greater performance of service per week).

Table I
Colombia: Retail Industries
"Verdoorn Coefficients"

Industry and Dependent Variables	α	β	γ	$\bar{R}^2$	N = Number of Observations
I. Food & Beverages					
log (S/L_e)	6.534	-0.335 (0.129)		0.489	9
log (S/L_e)	5.956	-0.234 (0.147)	+0.234 (0.186)	0.595	9
log (S/L_p)	7.437	-0.790* (0.610)		0.193	9
II. General Merchandise					
log (S/L_e)	4.384	-0.118 (0.112)		0.137	9
log (S/L_e)	3.372	0.230 (0.141)	-0.580 (0.196)	0.648	9
log (S/L_p)	-1.240	1.151 (0.234)		0.775	9
III. Textiles & Clothing					
log (S/L_e)	4.150	-0.0008 (0.210)		0.000	9
log (S/L_e)	4.176	-0.181 (0.088)	0.833 (0.133)	0.866	9
log (S/L_p)	0.672	0.629 (0.286)		0.407	9
IV. Furniture and Domestic Appliances					
log (S/L_e)	2.735	0.289 (0.049)		0.832	9
log (S/L_e)	2.774	0.257 (0.132)	0.059* (0.223)	0.834	9
log (S/L_p)	5.73	0.862 (0.056)		0.970	9
V. Fuels					
log (S/L_e)	3.122	0.216 (0.154)		0.219	9
log (S/L_e)	3.664	0.193** (0.137)	0.863 (0.220)	0.780	9
log (S/L_p)	0.875	0.967 (0.309)		0.582	9

Table I, continued

Industry and Dependent Variables	α	β	γ	$\bar{R}^2$	N = Number of Observations
VI. Automobiles					
log (S/L_e)	2.763	0.422 (0.030)		0.964	9
log (S/L_e)	2.795	0.454 (0.087)	-0.098* (0.249)	0.965	9
log (S/L_p)	1.867	0.639 (0.032)		0.982	9
VII. Hardware					
log (S/L_e)	3.628	0.329** (0.229)		0.227	9
log (S/L_e)	2.886	0.129 (0.057)	0.918 (0.084)	0.963	9
log (S/L_p)	1.866	0.913 (0.265)		0.628	9

* - not significant at 5% level of confidence.
** - significant at 10% level of confidence.

N.b. Figures in parentheses represent standard errors.

Factor markets in retail trade appear to be no less imperfect. Shops of different sizes pay different wage-rates to the hired employees. In all the Colombian retail trades considered, the wage-rate rises continually with the size of shops. With the exception of general merchandise, these wage-differentials by size of shops are positively correlated with the sales per employee (see Table I, Appendix I). Besides, although information on returns to capital is not available, a strong possibility of differential accessibility to capital and finance would suggest that the price of capital is relatively low for large stores,[1] which show larger size of owned capital.

IV. Capital-Labour Substitution

In order to estimate the elasticity of substitution between capital and labour in retail trades, we assume the CES production function of the following form:

$$V = (\beta K^{-\rho} + \alpha L^{-\rho})^{-1/\rho} \qquad (2.a)$$

where V is value added, K - capital and L - labour; and the elasticity of substitution $\sigma = (\frac{1}{1 + \rho})$. Arrow et al., the authors of this CES function provided its empirical basis with the following behaviourial equation which they tested with the cross-country data on manufacturing:

$$\log (\frac{V}{L})_i = \log A_i + b \log W_i + \Sigma \qquad (2.b)$$

where $\frac{V}{L}$ - is value added per unit of labour, W - wage-rate per man-year,

[1] For the purpose of illustration, it may be worth noting that in Japan in 1958, small enterprises with a capitalization of ¥ 5 million and less were charged an average interest rate of 17 per cent, whereas the large enterprises with a capitalization of ¥ 100 million and over borrowed at a relatively low average interest rate of 11 per cent. See Kenichi Miyazawa, The Dual Structure of the Japanese Economy and Its Growth Pattern, The Developing Economies, June 1964.

A - constant term and subscript i denotes individual industries. Given the assumptions of perfect competition in product and factor markets and constant returns to scale, it was shown that the relationship (2.b) was independent of the capital stock and that b-coefficient measured the Hicksian elasticity of substitution. However, for lack of data on capital stock the authors of the CES did not test the following equation:

$$\log \left(\frac{V}{L}\right)_i = \log A_i + b \log (W)_i + c \log \left(\frac{K}{L}\right) + \Sigma \qquad (2.c)$$

where $\frac{K}{L}$ is capital-labour ratio, and its coefficient c is assumed to be equal to zero, and $b>0$ measures elasticity of substitution. We estimated equations (2.b) and (2.c) with the aid of cross-country data for all those LDCs for which comparable information were available. In equation (2.c) we use inventory-labour ratio as a measure of annual flow of capital services. The data for six major groups of retail industries (presented in Appendix II) were converted into U.S. dollars by using official exchange rates. Wherever multiple rates prevailed, the free rate of exchange was used. No allowance was made for changes in the purchasing power of the dollar over the different years of the sample. Unfortunately, data limitations did not permit the use of the same sample size for the two equations. Besides, sales per employee had to be used as an index of labour productivity in the absence of cross-country data suitable for estimation of "gross margin" (i.e. total sales minus cost of goods sold) which serves as a rough measure of value added. We feel however that it is illegitimate to exclude self-employment (e.g. owner-operators and unpaid family labour) which constitutes the bulk of total work-force in retailing. In order to use the concept of "total number of persons engaged," it is necessary to obtain information on labour income from self-employment which could not be found in any of the country economic censuses reviewed. Resort was made to fit the data of twenty retail industries of Taiwan (1961) to our equations in order to examine whether the use of value added and total number of persons engaged makes any significant difference to the results. The estimates of labour income from self-employment in this case were improvised by assuming that 90 per cent of the owner-disbursements represent labour income.[1] The results of these regressions are presented in Tables II and IIA below.

The coefficient of determination ($\bar{R}^2$) between the sales per employee (S/L_e) and average wage and salary per employee (W_e) is very low with only one exception. Thus, in general the "goodness of fit" of this relation is very poor. The introduction of capital variable in the relationship, improves the goodness of fit in all cases except one. Although the sample size in the two equations is not identical (in view of a small number of observations, it was decided not to sacrifice any information), the results suggest that the three-variable relationship is more significant. Exclusion of capital variable, whose coefficient is significantly different from zero in almost all industries, is likely to give biased estimates of β-coefficient. However, in this latter relationship, many of the β-coefficients become non-significant at 5% level of confidence. On the other hand, with the two-variable behavioural equation of the original CES formulation, the relation between sales per employee (S/L_e) and the wage-rate (W_e) is significant at any level of confidence, with only one exception.

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[1]For a similar assumption, see Victor Fuchs, The Service Economy, 1968, p. 237, Appendix G, and Irving Leveson, "Non-farm Self-employment in the U.S.," unpublished Ph.D. dissertation, Columbia University, 1967, Chapter 4.

A. Inter-Country Cross-Section

Table II
Empirical Test of the CES with Retail Trade Data: Cross-Country Regressions

Industry	α	β	γ	$\bar{R}^2$	N=Number of Observations
A. Estimating Equation $\log(S/L_e) = \alpha + \beta \log(W_e) + \Sigma$					
1. Food & Beverages	6.861	0.491 (0.185)		0.303	18
2. Textiles & Clothing	-0.453	1.455 (0.028)		0.055	17
3. Furniture & domestic appliances	7.734	0.250* (0.176)		0.143	14
4. Pharmacies	6.601	0.414 (0.161)		0.320	16
5. Automobiles & vehicles	-0.462	1.462 (0.021)		0.611	18
6. Gas & fuels	-0.541	1.541 (0.023)		0.116	16
B. Estimating Equation $\log(S/L_e) = \alpha + \beta \log(W_e) + \gamma \log(K_i/L_e) + \Sigma$					
1. Food & beverages	5.478	0.015* (0.261)	0.585 (0.202)	0.584	14
2. Textiles & clothing	-0.184	0.261* (0.195)	0.922 (0.149)	0.924	13
3. Furniture and domestic appliances	6.198	-0.214* (0.116)	0.581 (0.129)	0.794	9
4. Pharmacies	3.020	0.223* (0.175)	0.605 (0.174)	0.740	10
5. Automobiles & vehicles	-0.357	0.851 (0.248)	0.505 (0.195)	0.542	14
6. Gas and fuels	-0.549	1.207 (0.316)	0.342* (0.308)	0.533	12

Source: For basic data, see Appendix II. For reasons of non-comparability, certain observations had to be sacrificed.

N.B. Figures in brackets indicate standard errors of the coefficients.

* - not significant at 5% level of confidence. All other coefficients are statistically significant at this level.

B. Intra-Country Cross-Section

Table II.A
Retail Industries of Taiwan (1961)

	Dependent Variable	α	β	γ	$\bar{R}^2$	N
1.	Sales per employee (log S/L_e)	10.000	-2.177 (0.623)		0.403	20
2.	Sales per employee (log S/L_e)	11.316	-2.351 (0.598)	-0.306 (0.174)	0.495	20
3.	Sales per person (log S/L_p)	2.250	+1.116 (0.210)		0.609	20
4.	Sales per person (log S/L_p)	1.990	1.329 (0.232)	-0.079 (0.045)	0.670	20
5.	Value added per employee (log V/L_e)	9.498	-2.964 (0.472)		0.685	20
6.	Value added per employee (log V/L_e)	8.496	-2.832 (0.453)	+0.234 (0.131)	0.735	20
7.	Value added per person (log V/L_p)	1.906	+0.214* (0.496)		0.010	20
8.	Value added per person (log V/L_p)	3.147	-0.801 (0.358)	+0.381 (0.069)	0.643	20

N.B. Figures in parentheses represent standard errors.
* - not significant at 5% or 10% level of significance. All other coefficients are statistically significant at 5% level.

The intra-country regression estimates in Table 11A further support our contention that the inclusion of capital variable considerably improves the goodness of fit. Also the substitution of "value added" per employee for sales per employee leads to a better fit. However, the use of value added per person leads to no gains.

Thus, one can conclude that the basic relation used by Arrow et al. is not independent of capital. Besides, the observations on Colombian retail industries suggest that the key assumptions of constant returns to scale and perfect competition in product and factor markets are also inconsistent with facts. In order to test the economies of scale hypothesis further with the cross-country sample, we relax for the moment, the popular and convenient assumption of constant returns to scale and assume the following Brown-de Cani version[1] of the CES function:

$$V = (\beta K^{-\rho} + \alpha L^{-\rho})^{-\nu/\rho} \qquad (2.d)$$

or

$$V = (K^{-\rho} + \frac{\alpha}{\beta} L^{-\rho})^{-\nu/\rho} \qquad (2.e)$$

where ν- economies of scale parameter has a value of $\nu \gtrless 1$. By assuming competition in factor markets and not necessarily in product market, we consider the following side relation which states that the ratio of the factor prices (i.e. w/r) is equal to the marginal rate of substitution:

$$\left(\frac{w}{r}\right) = \frac{\partial V/\partial L}{\partial V/\partial K} =$$

$$= \left(\frac{\alpha}{\beta}\right) \left(\frac{K}{L}\right)^{1/\sigma} \qquad (2.f)^{2}$$

From (2.f) values of $(\frac{\alpha}{\beta})$ and σ were obtained by converting it into loga-

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[1]See Murray Brown and John S. de Cani, Technological Change and the Distribution of Income, International Economic Review, September 1963.

[2]In the absence of any data on fixed capital, K - represented working capital only. r - its rate of return was assumed to be equal to the short-term interest rate. The data on these interest rates were taken from the IMF International Financial Statistics.

rithmic form. These values were inserted into (2.e) and a second use of linear least-squares gave us the value of ν - the economies of scale parameter. The estimated values of σ, ρ, and ν, for three of the six industries in the cross-country sample, viz. food and beverages, textiles and clothing and automobiles, are presented in Table III. For the remaining three industries, viz. pharmacies, furniture and domestic appliances, and gas and fuel, the minimum number of observations could not be gathered.

The standard errors of ν - alone could not be estimated. No other estimates are available with which these could be compared. The estimates of the elasticity of substitution are quite significant and suggest that the elasticity in retail trades is not necessarily low if account is taken of working capital. It is less than unity only in the case of automobiles.

The preceding methods of estimation of the elasticity of substitution no doubt have an appeal of simplicity. Yet, they fail to measure the elasticity of substitution between components of aggregate variables. If this elasticity of substitution is less than infinite, it is more logical to treat components of capital and labour, e.g. fixed and working capital (or inventory stocks) and wage-labour and self-employed labour as separate factor inputs. Although there may be a tendency for the private employers to increase the use of family labour in response to a rise in wage-costs, this substitution may or may not be limited. Also, there may be qualitative barriers between wage-labour and own-account labour. Intuitively, one might expect that the substitution of wage-labour for self-supporting labour, at least up to a point, reduces underemployment and raises productivity in services such as retailing. It would therefore be interesting to examine the elasticity of substitution between these two categories, not only as a theoretical exercise but also as a useful guide-line in the determination of employment policy. In view of

Table III
Elasticity of Substitution and Economies of Scale: Cross-country Regressions

Industry	Elasticity of Substitution σ	Standard Error of σ S_σ	Substitution Parameter ρ	Ratio of K and L-coefficients $\frac{\alpha}{\beta}$	Economies of Scale ν/ρ	Economies of Scale ν	Standard Error of ν/ρ $S_{\nu/\rho}$	Goodness of Fit of Equation (2.[illegible]) $\bar{R}^2$	Number of Observations N
1. Food & beverages	0.662	0.281	0.510	1.300	[illegible]	[illegible]	0.270	[illegible]	9
2. Textiles and clothing	0.739	0.321	0.353	0.620	2.404	9.810	0.286	0.909	9
3. Automobiles	1.327	0.333	0.246	0.173	4.462	18.130	0.679	0.860	9

differences in durability and response to economic fluctuations, among other techno-economic characteristics, working and fixed capital also deserve a separate treatment.

In the light of the above considerations, we assume a generalized version of a four-factor CES production function of the following form:

$$V = \beta \quad (\alpha K_1^{-\beta 12} + \phi K_2^{-\beta 12})^{-\rho_1/\beta_{12}} \quad (\gamma L_1^{-\beta 34} + \delta L_2^{-\beta 34})^{-\rho_2/\beta_{34}} \tag{3.a}$$

where K_1 - is fixed capital, K_2, working capital or stocks, and $K_1 + K_2 = K$; L_1 - wage-labour and L_2 - self-employed labour including family workers, $L_1 + L_2 = L$; $\rho_1 + \rho_2 = 1$, i.e. constant returns to scale. The relative factor prices are assumed to be equal to the relative marginal products, so that:

$$(\frac{r_1}{r_2}) = (\frac{\alpha}{\phi}) \quad (\frac{K_2}{K_1})^{1/\sigma} \tag{3.b}$$

and
$$(\frac{w_1}{w_2}) = (\frac{\gamma}{\delta}) \quad (\frac{L_2}{L_1})^{1/\sigma_1} \tag{3.c}$$

r_1 - is rate of return to K_1 and r_2, rate of return to K_2, w_1 - labour compensation to L_1 and w_2 - labour compensation to L_2.

The production function (3.a) is treated at three different levels each of which is considered one by one below:

A. <u>First Level</u>

In the first stage, we specify an aggregate function for total capital:

$$K^* = f \ (K_1 \ . \ . \ . \ . \ . \ K_n) \tag{4.a}$$

which is based essentially on the assumption of functional separability of variables. Thus, under this stringent condition, the production function could be written in the following form:

$$V = F \{L, g (K_1 \ . \ . \ . \ . \ . \ K_n)\} \qquad (4.b)^1$$

Then the aggregate function for K* which has CES properties can be written as:

$$K^* = (\alpha K_1^{-\beta} + \phi K_2^{-\beta})^{-1/\beta} \qquad (4.c)$$

or $$K^* = (K_1^{-\beta} + \frac{\phi}{\alpha} K_2^{-\beta})^{-1/\beta} \qquad (4.c.1)$$

In order to estimate K* from (4.c), we need prior information on β - the substitution parameter and on α and ϕ - the distribution parameters. Such information can be obtained by fitting the following logarithmic form of equation (3.b):

$$\log (\frac{r_1}{r_2}) = (\frac{\alpha}{\phi}) + {}^1/\sigma \log (\frac{K_2}{K_1}) + \Sigma \qquad (3.b.1)$$

where Σ - is the stochastic term, and $_\beta = (\frac{1 - \sigma}{\sigma})$. In order to be able to estimate (3.b.1), we need $(\frac{r_1}{r_2})$, the ratio of the rates of return from K_1 and K_2.

In both wholesale and retail business, net profit on total investment is affected, to a large extent, by the percentage of net profit on capital invested in stocks of merchandise. It is therefore desirable to estimate rates of return separately since they are unlikely to be identical due to differences in durability and the range of alternative uses of K_1 and K_2. In the absence of any better recourse, we assume that the stocks of retailers (K_2) which have a short life-cycle, earn short-term interest rate

[1] The separation of L in this equation, it must be borne in mind, implies a rather unrealistic assumption that the relative marginal productivities of different types of capital goods remain unaffected by labour.

and the residual of total profits accrues to fixed capital (K_1). Thus, if P is total profits, r_1 - rate of return from K_1 and r_2 - rate of return from K_2, V - value added or "gross margin," w - wage-rate, and L, labour, then,

$$P = V - w.L = r_1K_1 + r_2K_2$$

and $r_1K_1 = P - r_2K_2$. Under competitive conditions, $r_1 = \frac{\partial V}{\partial K_1}$ and $r_2 = \frac{\partial V}{\partial K_2}$, so that

$$P = \frac{\partial V}{\partial K_1} K_1 + \frac{\partial V}{\partial K_2} K_2.$$

For lack of adequate number of observations, and the data on fixed capital, our cross-country sample could not be used to estimate equations (3.b.1) and (4.c). As Taiwan is one of the very few less developed countries with fairly detailed statistics on retail trades, we used information on twenty retail industries for 1961. The estimated equation (3.b.1) is as follows:

$$\log \left(\frac{r_1}{r_2}\right) = -1.349 - \underset{(0.201)}{0.533} \log \left(\frac{K_2}{K_1}\right) \qquad (3.b.1)^1$$

$$\bar{R}^2 = 0.281; \text{ since } {}^1/\sigma = 0.533, \ \beta = \frac{1 - \sigma}{\sigma} = 0.467$$

Thus, given the β parameter the aggregate K* function (4.c.1) was solved as:

$$K^* = (K_1^{.467} + 0.741 \ K_2^{.467})^{1/.467} \qquad (4.c.1)$$

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[1] For 1961, r_1 for Taiwan (central bank call loan rate) is estimated at 16.2%. (Cf. IMF, International Financial Statistics). K_2 represents book-value of fixed capital assets, and K_1, average inventory stocks.

B. Second Level

Having estimated the aggregate K*, we specify the aggregate labour function as:

$$L^* = f\ (L_1\ .\ .\ .\ .\ .\ L_n) \tag{5.a}$$

where the underlying production function is of the form:

$$V = F\{K,\ g\ (L_1\ .\ .\ .\ .\ L_n)\} \tag{5.b}$$

This stringent condition (5.b) need not be as unrealistic as (4.b) at least in retail trades. After all, if fixed capital plays a minor role in the growth of output in non-material production, it must be the quality of labour ("human capital") that mainly accounts for it. It may therefore be assumed that the relative marginal productivities of different types of labour remain unaffected by capital.

The function (5.a) with CES properties takes the following form:

$$L^* = (\gamma L_1^{-\beta} + \delta L_2^{-\beta})^{-1/\beta} \tag{5.c}$$

The elasticity of substitution between L_1 and L_2 was estimated by transforming equation (3.c) into logarithmic form. The estimate of this equation is:

$$\log\ (\frac{W_1}{W_2}) = -0.345 - \underset{(0.038)}{0.037}\ \log\ (\frac{L_2}{L_1}) \tag{3.c.1}$$

$$\bar{R}^2 = 0.049$$

As there is no relationship between ratio of earnings and the marginal rate of substitution,[1] for convenience, we assume an infinite elasticity

[1]The equation (3.c.1) was run twice taking L_2, first inclusive of family workers and then exclusive of them. No significant difference was made to the results. In the estimate presented above, L_2 refers to owner-operators only.

of substitution (σ) between L_1 and L_2. When $\sigma = \infty$, $\beta = -1$. Therefore the aggregate function (5.c) simplifies as follows:

$$L^* = (\gamma L_1 + \delta L_2) \quad (5.d)$$

$$L^* = (\frac{\gamma}{\delta}L_1 + L_2) \quad (5.e)$$

$$= (.702\ L_1 + L_2),$$

where ($\frac{\gamma}{\delta} = .702$) is the mean relative earnings of the two types of labour.

C. Third Level

Given the values of K* and L*, the aggregate CES production function can be estimated by assuming that:

$$V = (\alpha K^{*-\rho} + \beta L^{*-\rho})^{-1/\rho} \quad (6.a)$$

If the elasticity of substitution between K* and L* is unity, as assumed by Uzawa,[1] the above CES function simply reduces to the familiar Cobb-Douglas form:

$$V = K^{*\alpha} \cdot L^{*\beta}$$

In order to examine whether the restrictive assumption of unit elasticity holds, we invoke the side relation (2.f) again so that,

$$(\frac{w}{r}) = (\frac{\alpha}{\beta}) \quad (\frac{K^*}{L^*})^{1/\sigma} \quad (2.f)$$

By transforming this relation into logarithms we obtained the following regression equation:

$$\log (\frac{w}{r}) = 1.072 + \underset{0.257}{0.429} \log(\frac{K^*}{L^*}) \quad (2.f.1)$$

$$\bar{R}^2 = 0.134 \qquad 1/\sigma = 0.429 \qquad \therefore \sigma = 2.331$$

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[1] Cf. H. Uzawa, Production Functions with Constant Elasticities of Substitution, Review of Economic Studies 29 (1962) pp. 291-99. Also Murray Brown, On the Theory and Measurement of Technological Change, 1966, Appendix B.

Although the $\bar{R}^2$ adjusted for degrees of freedom is too low for comfort, σ - coefficient is quite significant. Admittedly, our estimates are very preliminary and may well be quite fortuitous. Yet it may be worth mentioning that another estimate[1] of the elasticity of substitution for "commerce" as a whole also turned out to be quite high. The use of time series data for Uganda resulted in an elasticity estimate greater than 2. Our estimate is based on cross-sectional data instead and may therefore have an upward bias. As Marc Nerlove has shown[2], the empirical estimates based on time-series data are invariably lower than those based on cross-sectional data.

Conclusions:

We have attempted to traverse a rather uncharted territory purely in the spirit of a preliminary exploration. The inadequacies of data and the small size of our sample do not warrant any conclusive generalisations. Also our use of some coefficients in spite of discomforting $\bar{R}^2$ may be open to question. However, one of the explanations for the low $\bar{R}^2$ may be found in the wrong specification of the side relation with which

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[1]See J.B. Knight, Earnings, Employment, Education and Income-Distribution in Uganda, Bulletin of the Oxford University Institute of Economics and Statistics, November 1968. The author tested the well-known CES equation of the following form:

> $\dot{y} = a + b\dot{w}$, where $\dot{y}$ is change in the natural logarithm of productivity and $\dot{w}$ change in the natural logarithm of average earnings.

[2]Marc Nerlove, Recent Empirical Studies of the CES and Related Production Functions, in "The Theory and Empirical Analysis of Production" (ed. Murray Brown), National Bureau of Economic Research, New York, 1967.

the CES elasticity of substitution if measured. Logically, the use of empirical facts of retailing which is typical of imperfect competition may not be expected to generate an estimate of elasticity of substitution which corresponds to the world of perfect factor and product markets.

Nevertheless, interest in exploring the elasticity of substitution between capital and labour is not merely theoretical. It bears a great policy significance which is often overlooked in the discussion on choice of techniques. Under conditions of low elasticity of substitution and low employment elasticity of output in manufacturing, the LDCs are planning for much of labour absorption to occur in the tertiary sector. A knowledge of the elasticity of substitution in different tertiary sub-sectors would provide a useful guideline for such employment planning.

Appendix

Output-Labour, Capital-Labour and Wage Rates, etc. in Different Types of Retail Trades: Intra-Country and Cross-Country Data

Any information on economic indicators for retail distribution in the LDCs is, in our knowledge, very rare. We therefore decided to produce the basic data which were used in the text. Six main sub-categories of retail trades were considered. Most of the statistics are computed from national census reports. In certain cases, data had to be grouped into these categories somewhat arbitrarily. Since the LDCs do not follow any standard international classification for compiling retail trade statistics, full comparability cannot be guaranteed. The following notations are used in the tables:

- S: total sales
- r: total rate of return to aggregate capital (K)
- r_1: rate of return to fixed K_1
- r_2: rate of return to working K_2
- S/L_e: sales per employee
- S/L_p: sales per person engaged
- V/L_e: value added ("gross margin") per employee
- V/L_p: value added ("gross margin") per person engaged
- K/L_e: total capital per employee
- K/L_p: total capital per person engaged
- K_2/L_e: inventory stocks per employee
- K_2/L_p: inventory stocks per person engaged
- K_2/S: inventory-sales ratio

W/L_e: annual wage per employee

K_2/K_1: ratio of working capital to fixed capital

L_2/L_1: ratio of self-employed (excluding family labour) to wage-labour

K/L: total capital-labour ratio

r_1/r_2: ratio of rates of return from K_1 and K_2

W_1/W_2: ratio of earnings of L_1 and L_2

W/r: ratio of wage-rate to total rate of return

N.B. Data on fixed capital represent undeflated book-values of fixed capital assets.[1] Data on working capital represent average inventory stocks for the whole year.

[1] For a similar use of undeflated book value census data in a cross-sectional analysis, see Phoebus J. Dhrymes, Some Extensions and Tests for the CES Class of Production Functions, Review of Economics and Statistics, November 1965. Also for a defence of the use of such data, see T. C. Liu and G. H. Hildebrand, Manufacturing Production Functions in the United States, 1957 (1965), Cornell Univ. Press, pp. 133-135.

Appendix I

Table I: COLOMBIA (1954) Data on Retail Industries

Industry units and size of firms ↓ / Ratios →	S (000 pesos)	S/L_e (pesos)	S/L_p (pesos)	K_2/L_e (pesos)	K_2/L_p (pesos)	K_2/S (%)	W/L_e (000 pesos)
I. Food & Beverages							
Sales less than 5,000 pesos	65.77	113.79	1.86	20.961	0.34	18.41	0.45
5,000-24,999 pesos	356.05	124.10	7.74	10.48	0.65	8.45	0.74
25,000-49,999 "	263.95	108.00	20.2	9.00	1.67	8.28	0.98
50,000-99,999 "	249.09	108.4	34.2	9.12	2.87	8.40	1.27
100,000-249,999 "	239.37	115.2	56.9	8.58	4.23	7.45	1.66
250,000-499,999 "	118.86	115.1	77.5	13.01	8.76	1.13	2.07
500,000-999,999 "	75.37	140.1	106.6	24.54	18.67	17.51	2.30
1,000,000-2,499,999 "	44.11	154.2	132.5	30.54	26.2	19.80	2.98
2,500,000 & above	30.80	410.6	342.2	18.08	15.0	4.40	4.09
II. General Merchandise							
Sales less than 5,000 pesos	5.12	60.97	1.77	25.21	0.75	41.35	0.51
5,000-24,999 pesos	37.73	70.92	7.20	30.49	3.09	42.99	0.82
25,000-49,999 "	39.02	60.59	15.80	22.23	5.80	36.69	1.25
50,000-99,999 "	43.90	61.75	25.8	22.35	9.35	36.19	1.46
100,000-249,999 "	70.28	59.31	37.7	19.71	12.54	33.23	2.01
250,000-499,999 "	46.64	54.30	44.6	15.09	12.42	27.80	2.47
500,000-999,999 "	36.95	39.73	36.8	8.89	8.24	22.37	2.12
1,000,000-2,499,999 "	53.21	35.76	34.8	9.25	9.01	25.87	2.55
2,500,000 & above	90.22	35.97	35.6	6.14	6.07	17.07	3.02
III. Textiles & Clothing							
Sales less than 5,000 pesos	4.71	28.03	2.34	13.71	1.06	48.92	0.70
5,000-24,999 pesos	40.27	42.26	7.20	18.00	3.27	42.59	0.92
25,000-49,999 "	52.10	49.67	11.25	20.09	6.68	40.44	1.69
50,000-99,999 "	78.16	50.10	25.85	20.35	10.16	40.62	1.53
100,000-249,999 "	132.13	55.52	37.72	19.75	13.32	35.58	3.31
250,000-499,999 "	78.19	66.10	44.67	20.41	16.38	30.88	2.96
500,000-999,999 "	54.51	71.92	36.34	16.17	14.45	23.04	3.15
1,000,000-2,499,999 "	27.29	101.84	34.85	23.78	21.24	23.26	3.19
2,500,000 & above	13.74	205.07	35.57	25.36	22.65	12.37	5.45
IV. Furniture and Domestic Appliances							
Sales less than 5,000 pesos	1.00	17.03	1.82	4.76	0.51	27.96	0.675
5,000-24,999 pesos	6.62	23.32	7.04	5.12	1.54	21.95	1.12
25,000-49,999 "	10.13	27.84	14.97	5.89	3.16	21.17	1.43
50,000-99,999 "	15.39	35.23	22.94	11.15	7.27	31.66	1.87

Table I, Appendix I, cont.

Industry units and size of firms ↓ / Ratios →	S (000 pesos)	S/L_e (pesos)	S/L_p (pesos)	K_2/L_e (pesos)	K_2/L_p (pesos)	K_2/S (%)	W/L_e (000 pesos)
IV. Continued							
100,000-249,999 pesos	40.91	45.87	35.15	11.93	9.14	26.02	2.61
250,000-499,999 "	41.35	43.72	39.05	10.78	9.63	24.67	3.68
500,000-999,999 "	40.43	51.77	49.49	13.32	12.74	26.97	4.79
1,000,000-2,499,999 pesos	39.78	58.07	54.27	14.53	13.58	25.03	5.04
2,500,000 & above	33.65	31.60	31.48	9.11	9.07	28.88	5.35
V. Fuels							
Sales less than 5,000 pesos	1.41	23.56	1.51	0.82	0.05	3.47	0.42
5,000-24,999 pesos	5.68	22.84	6.80	1.44	0.43	6.31	1.04
25,000-49,999 "	5.37	22.38	12.60	1.18	0.90	7.15	1.17
50,000-99,999 "	9.53	28.29	19.90	1.65	1.16	5.84	1.32
100,000-249,999 "	28.17	36.58	30.82	2.53	2.13	6.91	1.78
250,000-499,999 "	29.48	38.28	35.56	2.18	1.96	5.52	2.02
500,000-999,999 "	21.80	64.51	59.09	3.80	3.48	5.89	2.84
1,000,000-2,499,999 "	7.89	62.16	58.91	2.48	2.35	3.99	2.56
2,500,000 & above	-	-	-	-	-	-	-
VI. Automobiles & Accessories							
Sales less than 5,000 pesos	0.10	6.66	1.61	6.76	1.63	101.00	0.66
5,000-24,999 pesos	1.67	17.61	7.58	21.37	7.80	121.40	1.27
25,000-49,999 "	3.11	26.35	14.46	13.59	7.46	51.56	1.79
50,000-99,999 "	7.15	30.06	20.92	12.87	8.95	42.80	4.94
100,000-249,999 "	21.36	44.69	33.54	17.28	12.97	38.68	2.88
250,000-499,999 "	20.85	71.45	56.70	16.43	13.04	23.48	3.30
500,000-999,999 "	29.87	76.41	68.06	16.45	14.65	21.36	4.61
1,000,000-2,499,999 "	55.47	80.05	75.58	14.88	14.05	18.60	5.17
2,500,000 & above	62.61	105.34	102.15	13.49	13.09	12.82	4.76
VII. Hardware and Construction							
Sales less than 5,000 pesos	0.32	26.75	2.00	12.12	0.90	60.75	1.84
5,000-24,999 pesos	2.01	34.11	8.28	14.42	3.50	42.28	1.43
25,000-49,999 "	3.03	37.06	16.07	17.36	7.53	46.53	2.46
50,000-99,999 "	6.17	46.09	25.95	20.33	11.44	44.11	2.47
100,000-249,999 "	22.71	58.85	40.06	21.34	14.52	36.26	2.24
250,000-499,999 "	20.82	75.44	73.32	24.28	19.25	32.19	3.58
500,000-999,999 "	14.00	75.31	65.46	22.79	19.81	33.84	2.39
1,000,000-2,499,999 "	14.13	87.22	79.83	19.37	17.73	22.20	4.60
2,500,000 & above	8.74	673.00	546.81	127.61	103.68	18.96	33.97

Source: Colombia, Departamento Administrativo Nacional de Estadistica: Censo Nacional de Comercio y Servicios for 1954 (April 1957).

Appendix I

Table 2: TAIWAN
Data on Retail Trades

	Industry	(S/L_p)	(V/L_p)	(S/L_e)	(V/L_e)	(W_p)	(W_e)	(K_2/L_p)	(K_2/L_e)
		(000 NT $)							
1.	Staple food	97	9	686	68	5.6	5.9	3.50	24.8
2.	Fish, meat, vegetables	149	2	1,344	16	7.6	7.3	0.32	2.89
3.	Fruit	42	7	563	94	4.5	5.9	0.57	7.69
4.	Confectionery, bakery, canned food	51	8	600	97	4.7	5.9	2.30	26.94
5.	Sundries	65	9	1,715	248	4.9	4.9	2.53	66.88
6.	Home utensils	54	9	439	70	5.4	5.5	4.41	36.04
7.	Fuels	67	12	275	48	6.2	7.3	3.01	12.30
8.	Piece goods	77	9	438	52	5.7	6.1	9.24	52.39
9.	Shoes, hats apparel	74	16	252	53	6.3	6.8	7.27	24.92
10.	Daily necessities	63	9	478	69	4.9	6.4	5.32	40.34
11.	Educational, cultural, sports supplies	66	11	177	30	6.3	7.3	12.31	33.15
12.	Ornaments, watches	65	12	221	42	6.7	6.3	6.64	22.71
13.	Furniture	63	12	215	43	6.4	6.2	7.15	24.21
14.	Metals and electrical material	89	13	256	36	6.5	6.6	11.38	32.82
15.	Construction materials	76	13	211	36	6.9	6.9	7.94	22.15
16.	Drugs, medicines	57	16	412	118	5.7	5.4	4.95	35.51
17.	Scientific instruments, machines	107	17	174	28	9.3	10.2	16.97	27.42
18.	Industrial raw materials and supplies	96	12	173	21	8.1	8.1	13.42	24.18
19.	Agricultural, industrial and mining machinery	88	10	164	18	8.4	10.5	14.08	26.30
20.	Transport equipment and accessories	112	9	183	15	9.1	8.9	21.68	35.21

Source: Industrial and Commercial Census of Taiwan, Vol. IV.

N.B. Total number of persons engaged refers to regular employees, owner-operators and unpaid family workers.

Table III

Taiwan: Ratios of Capital to Labour, Capital to Capital, Labour to Labour, etc.

Industry	(K_2/K_1)	(L_2/L_1)	(K/L)	$(\frac{r_1}{r_2})$	$(\frac{W_1}{W_2})$	$(\frac{W}{r})$
1.	0.11	3.56	53.61	0.66	0.62	7.67
2.	0.03	5.17	13.92	-3.29	0.61	-1.81
3.	0.03	8.07	29.91	0.66	0.88	5.40
4.	0.09	6.37	43.65	0.73	0.77	5.74
5.	0.13	14.93	37.12	1.15	0.59	4.19
6.	0.12	4.12	65.28	0.45	0.58	11.20
7.	0.09	2.01	48.62	0.85	0.80	5.64
8.	0.29	2.63	63.43	0.58	0.62	10.16
9.	0.18	1.41	66.81	1.21	0.66	4.51
10.	0.18	3.56	56.41	0.74	0.74	6.72
11.	0.31	1.04	68.24	0.62	0.79	9.01
12.	0.16	0.61	63.10	0.68	0.60	7.70
13.	0.15	1.45	74.50	0.68	0.59	7.66
14.	0.31	1.15	64.83	0.85	0.63	6.93
15.	0.21	1.13	59.11	0.84	0.64	6.68
16.	0.14	4.11	55.05	1.60	0.62	2.97
17.	0.47	0.39	61.23	1.19	0.82	6.91
18.	0.29	0.55	68.19	0.42	0.70	14.89
19.	0.44	0.58	54.26	0.24	1.16	30.93
20.	0.55	0.41	70.63	0.05	0.63	166.49

Appendix II

Table I

1. Food & Beverages, Eating & Drinking Places

		(S/L_e) ($)	(K_2/L_e) ($)	(W/L_e) ($)	(r) (%)
Puerto Rico	1958	30328	n.a.	1179	
Kenya	1960	12448	(1) 1152	(2) 543	
Trinidad & Tobago	1957	(4) 23014	(3) 1365 x	805	
Philippines	1961	(4) 21556 x	(5) 1051 x	496 x	5.00
Ecuador (5)	1965	17288	1475	318	5.00
Costa Rica	1964	23812	2196	620	5.00
Colombia	1954	33811	3232	368	4.00
Chile	1967	26943	n.a.	674	15.84
Chile	1964	19184	n.a.	514	14.63
Argentina	1954	26930	3961	640	
Panama	1961	59521	6664	2798	n.a.
Peru	1963	10377	960	274	9.50
Cyprus	1956	38820	4371	407	
El Salvador	1956	23147	373	222	3.00
Taiwan	1961	19281	375	163	16.2
Puerto Rico	1963	(4) 30584	n.a.	1714	n.a.
Zambia	1962	5571	483	477	n.a.
Brazil	1959	4220	(1) 524	108	8.0
Paraguay	1963	52197	4939	531	6.0
Rhodesia	1962	11398	937	821	n.a.

(1) end of the year stock
(2) cash and non-cash
(3) data on stocks by types of business were only collected for firms employing 25 or more. These data were used as the basis for estimating the breakdown by types for firms employing 5-24 persons.
(4) gross receipts
(5) for large establishments only
x excluded from sample for regression
n.a. not available

Table II

2. Textiles and Clothing and Other Dry Goods

		(S/L_e) ($)	(K_2/L_e) ($)	(W/L_e) ($)
Puerto Rico	1958	17108	n.a.	1582
Kenya	1950	7994	(1) 2305	(2) 610
Trinidad	1957	11935	(4) 3515	1205
Philippines (3)	1961	(7) 12524 x	2373 x	749 x
Ecuador (3)	1965	14209 x	6518 x	389 x
Costa Rica	1964	15103	5114	859
Colombia	1954	16394	5706	701
Chile	1967	23015	n.a.	1048
Chile	1964	15577	n.a.	719
Argentina	1954	12520	6068	914
Panama	1961	56175	23230	4721
Peru	1963	7280	3368	721
Cyprus	1956	36945	18273	647
El Salvador (6)	1956	4306 x	499 x	118 x
Taiwan	1961	19493	1172	151
Puerto Rico	1963	(5) 20296	n.a.	2021
Zambia	1962	4021	1133	332
Brazil	1959	6821	(1) 2605	345
Paraguay	1963	19563	3844	567
Rhodesia	1962	10447	3423	990

(1) end of the year
(2) cash and non-cash
(3) large establishments only
(4) Data by type of business were only collected from firms employing 25 persons or more. These were used as the basis for estimating the breakdown by types for firms engaging 5-24 persons.
(5) gross receipt
(6) for total persons engaged
(7) sales and resales
x = excluded from the sample
n.a. = not available

Table III

3. Furniture and Domestic Appliances

		(S/L_e) ($)	(K_2/L_e) ($)	(W/L_e) ($)
Puerto Rico	1958	18838	n.a.	2202
Kenya (1)	1960	9542 x	(2) 2200 x	(7) 697 x
Trinidad & Tobago(1)	1957	18741 x	(6) 6139 x	1437 x
Philippines (3)	1961	(4) 15034 x	1449 x	1124 x
Ecuador (3)	1965	12846 x	8315 x	848 x
Costa Rica	1964	16517	5545	1329
Colombia	1954	12065	3117	1059
Chile	1967	26876	n.a.	1073
Chile	1964	14538	n.a.	879
Argentina	1954	16378	5693	981
Panama	1961	20267	n.a.	915
El Salvador	1961	10784	2722	1351
Taiwan	1961	7324	692	140
Puerto Rico	1963	(5) 21920	n.a.	2312
Zambia	1962	6485	1864	1210
Brazil	1959	7260	1935	1509
Paraguay	1963	9841	1279	864
Rhodesia	1962	11517	3051	1694

(1) included building materials & timber
(2) end of the year stock
(3) large establishments
(4) sales & resales
(5) gross receipts
(6) Data by types of business were only collected from firms employing 25 persons or more. These were used as the basis for estimating the breakdown by types for firms engaging 5-24.
(7) cash and non-cash

x = excluded from the sample
n.a. = not available

Table IV

4. Pharmacies and Drugstores

		(S/L_e) ($)	(K_2/L_e) ($)	(W/L_e) ($)
Puerto Rico	1958	16059	n.a.	1584
Kenya (1)	1960	10635 x	(2) 2471 x	(6) 1125 x
Trinidad	1957	9553	n.a.	677
Philippines (3)	1961	(5) 9846 x	6074 x	815 x
Ecuador (3)	1965	8236 x	9640 x	839 x
Costa Rica	1964	12758	2511	884
Colombia	1954	10820	n.a.	344
Chile	1967	13521	n.a.	762
Chile	1964	12991	n.a.	636
Argentina	1954	10021	3315	436
Panama	1961	38051	8859	3923
Peru	1963	6664	2069	592
Cyprus	1956	16607	6917	667
El Salvador	1961	10120	1193	514
Puerto Rico	1963	(4) 20406	n.a.	2002
Zambia	1962	7681	1419	1086
Brazil	1959	5822	(2) 1943	1000
Paraguay	1963	16589	4068	672
Rhodesia	1962	10257	2084	1652

(1) includes photographic goods
(2) end of the year stock
(3) large establishments
(4) gross receipts
(5) sales and resales
(6) cash and non-cash

x = excluded from sample for regression
n.a. = not available

Table V

5. Automobiles and Vehicles

		(S/L_e) ($)	(K_2/L_e) ($)	(W/L_e) ($)
Puerto Rico	1958	57843	n.a.	2766
Kenya	1960	10539	(1) 3361	(2) 1265
Trinidad & Tobago	1957	41725	(3) 6623	1891
Philippines	1961	25030 x	3541 x	897 x
Ecuador	1965	22197 x	5762 x	1264 x
Costa Rica	1964	23044	7916	1372
Colombia	1954	19823	4376	1185
Chile	1967	21029	n.a.	1920
Chile	1964	14187	n.a.	1034
Argentina	1959	19535	6574	890
Peru	1963	23008	4170	1275
Cyprus	1956	60536	6809	1033
El Salvador	1961	9478	8811	503
El Salvador	1956	21259	5438	1488
Taiwan	1961	4566	880	225
Puerto Rico	1963	68288	n.a.	3606
Zambia	1962	9884	1019	912
Brazil	1959	11962	2257	2119
Paraguay	1963	23425	4300	917
Rhodesia	1962	10928	1552	1128

(1) end of the year stock
(2) cash and non-cash
(3) Data by types of business were only collected from firms employing 25 or more persons. These were used as the basis for estimating the breakdown by types for firms engaging 5-24.

x = excluded from sample for regression
n.a. = not available

Table VI

6. Gas and Fuel

		(S/L_e) ($)	(K_2/L_e) ($)	(W/L_e) ($)
Puerto Rico	1958	20019	n.a.	1231
Kenya	1960	8783	(1) 291	(2) 527
Trinidad	1957	(3) 12781	(4) 1099	907
Philippines	1961	(3) 23265 x	(5) 315 x	711 x
Ecuador (5)	1965	1758 x	446 x	1263 x
Costa Rica	1964	12081	625	746
Colombia	1954	10906	651	516
Chile	1967	17497	n.a.	582
Chile	1964	14857	n.a.	516
Argentina	1954	19666	1499	718
Panama	1961	5341	354	375
Peru	1963	11323	842	530
Cyprus	1956	32180	834	698
Puerto Rico	1963	(3) 19648	n.a.	1574
Zambia	1962	4300	155	400
Brazil	1959	9480	(1) 761	382
Paraguay	1963	1596	581	651
Rhodesia	1962	12734	3051	1687

(1) end of the year stock
(2) cash and non-cash
(3) gross receipts
(4) Data on stocks by types of business were only collected for firms employing 25 persons or more. These data were used as the basis for estimating the breakdown for firms engaging 5-24 persons.
(5) large establishments only

x = excluded from sample for regression
n.a. = not available