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A DISAGGREGATIVE APPROACH TO LDCs TERTIARY SECTOR
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I. Introduction

This paper has two main objects. First, it is shown that the current aggregative explanations of growth in "tertiary" sector output and employment in the less developed countries (LDCs) are not satisfactory. It is argued that Colin Clark's celebrated hypothesis about the relationship between per capita income and occupational distribution, viz. that the percentage share of tertiary output and employment rises with increases in per capita incomes, has often been misinterpreted in the context of the LDCs economies. Assumptions and conditions under which Colin Clark's thesis is applicable to the labour surplus economies are briefly examined. Second, the paper proposes disaggregate employment functions for wage-labour, self-supporting labour (owner-operators) and family labour. This type of labor disaggregation is designed to examine whether the simple demand rationale which ignores "supply effects" is appropriate in the context of an hypothesis of unlimited supplies of labour.

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In Section II, as a rationale for our approach, limitations of traditional production theory are briefly reviewed. We demonstrate that "localisation" of technological change, and consumer quality as a factor input--the two significant characteristics of most services--are not allowed for in the conventional production function. Besides, estimation of production functions with single equation least-squares method is subject to the "simultaneous equation bias." The results thus obtained are invariably assumed as demand equations. We argue that the estimation of disaggregate employment functions reduces this identification problem. Section III outlines a theoretical basis for the disaggregate employment functions in the light of Colin Clark's hypothesis. Finally, in Section IV some tentative empirical illustrations are provided with the aid of Japanese data.

II. Limitationsoof Traditional Production Theory

In the application of production theory, different types of labour input have been distinguished on the basis of occupational categories and for educational attainments. An aggregate production function is specified in the following general form:

$$X = f(K, L_1, L_2 .... L_n) \quad \text{----------------------} \quad (1)$$

where X is output, K, capital, and L_j ($j = 1 ...... n$), various occupational categories. We adopt a different criterion, viz. the "status" of workers. Labour engaged is divided into wage-earners, self-employed owner-operators and family workers.[1] As will be demonstrated below,

[1] For an empirical analysis of employment in major service subsectors on the basis of this labour classification, see author's paper on "The Role of Services in Employment Expansion," International Labour Review, May 1970.

the differences between these three categories lie not so much in the "status" of workers as the fact of demand and/or supply accounting for their proportions. A high income-elasticity qualifies an economic activity and employment in it, to be considered as "modern," whereas a low one implies its "traditional" character.[1]

In principle, on the assumption of separability of components of variables, one could conceive of a two-stage production function for services, with wage-labour (L_W), self-supporting labour (L_S--which includes family labour as a subset) and capital (K) as three factor inputs.[2] However, on closer scrutiny, application of traditional production theory to services suffers from serious limitations. This can be illustrated by tracing the relationship between labour productivity (O/L) and the ratios of factor inputs (L_W/L_S) and (K/L) as depicted in Figure (1) below:

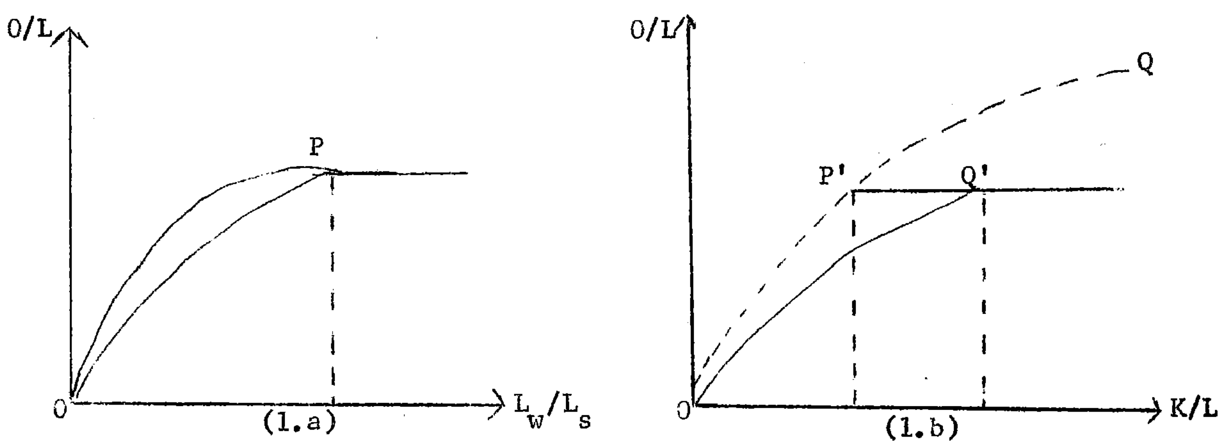

FIG. I

[1]The "status" of workers is used only as a convenient operational classification. The economic criterion of differential income-elasticity is the underlying principle which also facilitates separation of the "modern" from "traditional" types of employment.

[2]Wage-labour (L_W), for instance, can be considered analogous to Hicks' White Labour, and self-supporting labour (L_S) to his Black Labour. In the first stage, wage-labour is combined with self-supporting labour to produce aggregate labour L, (Hicks' Grey Labour). In the second stage, the latter intermediate product, L, is combined with capital to product final output. If the three-factor production function is linear homogeneous, the intermediate product can be defined so that both of the partial production functions will be linear homogeneous also. (Cf. J.R. Hicks, Marshall's Third Rule--A Further Comment, Oxford Economic Papers, October 1961.

Figure (1.a) shows that up to point P, a rise in the ratio (L_w/L_s) will correspond to a higher labour productivity beyond which any increase in this ratio will have no effect and the level of productivity will remain constant over the relevant range. This is a case where the two production functions merge at point P, thus suggesting that technological change is zero at point P and beyond. Figure (1.b) shows a case in which an increase in K/L will not reflect any increase in O/L after points P' and Q'. This situation is somewhat different from the traditional Cobb-Douglas type of production function under which if one factor (in our case, K) increases indefinitely while the other (i.e. L) remains constant, output or labour productivity also grows indefinitely, as is illustrated by the dotted curve P'Q in Figure (1.b).[1] However, the marginal product of the increasing factor K tends to disappear eventually.

In services, constant productivity or minor and sporadic increases in it may arise partly from "localisation" or "personalisation" of technical progress. Let us take the case of professionals such as physicians whose knowledge represents a labour-embodied technical change. 'Internal' human investment, experience (or "learning by doing") and knowledge, embodied in a few specialized surgeons, are also supplemented by natural aptitudes and innate abilities. If each physician and doctor is treated as a firm in the health industry, it is unlikely that the superior

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[1]In the Cobb-Douglas production function,

$$O = A\cdot K^a . L^b \qquad \text{or } O/L = A\left(\frac{K}{L}\right)^a \qquad \text{where } a+b = 1.$$

Differentiating (O/L) with respect to (K/L), we obtain:

$$\frac{d\left(\frac{O}{L}\right)}{d\left(\frac{K}{L}\right)} = A\cdot a\left(\frac{K}{L}\right)^{a-1} \quad \text{where } 1 > a > 0 \quad \text{and} \quad A > 0.$$

Thus, (O/L) is an increasing function of $\left(\frac{K}{L}\right)$.

qualities of a few will be spread throughout the industry. Entrepreneurial and organisational skills of businessmen may be cited as another example of non-transferable and 'internalised' knowledge.

Besides, in such services as commerce, and personal services, increase in K/L may result not so much from an increase of capital with a given amount of labour as from the consumer substituting its non-marketed labour for the marketed labour services of the producer. In self-service stores and supermarkets the former replaces the services of shop stewardesses and sales attendants.[1] Thus, it is possible that a given amount of fixed capital leads to a higher K/L ratio through a reduction in the denominator which is caused not so much by "capital-using" innovation as, paradoxically, a "labour-using" one. In Figure (1.b), after points P' and Q', the labour productivity of producers of services will cease to be a function of capital input. It will rise along the dotted path P'Q only under conditions in which the quality (education, knowledge, experience, etc.) of consumers' labour services is improving. It is a peculiar characteristic of the non-material production that consumer is a productive input which is not compensated for its services through the conventional market mechanism. The quality of the physician's services is partly determined by the 'external' human investment (or education) embodied in the consumer, and only partly by the 'internal' investment, ability and experience embodied in the physician. Similarly, teachers' productivity is also a function of the quality of his consumers (i.e.

[1]For a brief statement of this point, see Victor Fuchs, The Service Economy, Ch. 8, NBER, 1968.

students). Unless due account is taken of the productivity of consumer's labour services one may find an anomalous situation in which a higher K/L would correspond to a given or even lower efficiency of producers' services rendered to the consumer. On the other hand, in the case of material goods production, absence of "personalisation" between the consumer and the producer would suggest that a consumer's quality does not matter although his tastes do.

The traditional production theory does not allow for "localisation" of technical change or for consumer quality as input in the productive process. Besides, derivation of an aggregate labour demand function from the production function via the marginal product of labour implies that it is a pure demand relation. However, it remains unclear whether the derived employment function is a demand function, or a supply function or both. It is this problem of identification which justifies the treatment of employment function at a disaggregated level.

III. Disaggregate Employment Functions

The above problem of identification in an aggregate employment function has also led to an erroneous interpretation of Colin Clark who was perhaps one of the earliest economists to have extended Engel's Law to the tertiary sector. According to Clark, "the reason for the growth of the relative number of tertiary producers must largely be sought on the demand side";[1] (i.e. by the relatively greater income

[1] Colin Clark, The Conditions of Economic Progress, 1940, pp. 6-7.

elasticity of demand for services).[1]

Let us assume an aggregate employment function of the following form:

$$E_s = f\ (Y, K, N, W) \text{ ------------------------------ } (2)$$

where E_s is total employment in the tertiary sector, subscript s denoting services; Y, per capita income, N, total labour force, K, total capital stock or capital-labour ratio in the sector, and W, average wage rate in the sector, so that

$$\frac{\partial E_s}{\partial Y} > 0, \quad \frac{\partial E_s}{\partial N} > 0, \quad \frac{\partial E_s}{\partial W} < 0, \text{ and } \frac{\partial E_s}{\partial K} \gtrless 0.$$

depending on whether we def ne K, as capital-labour ratio or total capital accumulation in the economy. Then

$$d\ E_s = \left(\frac{\partial E_s}{\partial Y}\right) dY + \left(\frac{\partial E_s}{\partial N}\right) dN - \left(\frac{\partial E_s}{\partial K}\right) dK - \left(\frac{\partial E_s}{\partial W}\right) dW \qquad (2.a)$$

In order to test Colin Clark's hypothesis, it would be necessary to overcome the identification problem and determine the portion of observed tertiary employment that is demand-determined and in the case of which the "supply effects" are insignificant. In other words, in equation (2.a) above, the effect of Y on labour absorbed in the tertiary

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[1]It can be shown that the effect of income-elasticity of demand or marginal propensity to consume on labour demand in services is also combined with such other factors as labour productivity and employment in non-tertiary sectors. If Y is total income, L, labour, q, marginal propensity to consume and subscripts s, and g denote services and goods sectors, then:

$$Y_s = q\ Y \qquad\qquad Y = Y_g + Y_s$$

$$= \left(\frac{q}{1-q}\right) \cdot Y_g$$

$$\text{and} \quad L_s = \left(\frac{q}{1-q}\right) \cdot \left(\frac{Y_g}{Y_s}\right) \cdot L_g, \qquad \text{where} \quad Y_g = \frac{Y_g}{L_g}$$

$$\text{and} \quad Y_s = \frac{Y_s}{L_s}.$$

This point is due to Professor Kenichi Miyazawa of Hitotsubashi University, Tokyo.

sector, i.e. $\frac{\partial E_s}{\partial Y}$ dY, will have to be singled out holding all other explanatory variables constant. In the case of most labour surplus LDCs however, it is quite unrealistic to assume that $\frac{\partial E}{\partial N} = 0$, i.e. the elasticity of employment with respect to growth of labour supply is nil. In fact, the well-known phenomenon of "work-sharing," taken to extremes would instead suggest that at least a portion of E_s, say $E_{si} = f(N)$ with $\frac{\partial E_{si}}{\partial N} > 0$ and $\frac{\partial E_{si}}{\partial Y} = 0$. This portion may represent the bulk of employment in unorganised services such as shoe-shining, petty retail trades, e.g. activities of peddlers, hawkers and venders, whose services may have only an insignificant income-elasticity of demand.

A part of the identification problem can be overcome by disaggregating the employment function (2). As total employment is composed of paid employment (E_w), own-account employment (E_o), and family labour (E_f), the aggregate function can be decomposed into the following set of simultaneous equations in a structural form:

$$E_w = f_1 (W, K, Y) \quad \text{------------------------} \quad (2.a)$$

$$\hat{E}_w = f_2 (W, N) \quad \text{------------------------} \quad (2.b)$$

$$E_o = f_3 (Y, E_w) \quad \text{------------------------} \quad (2.c)$$

$$\hat{E}_o = f_4 (N, E_w) \quad \text{------------------------} \quad (2.d)$$

$$E_f = f_5 (N) \quad \text{------------------------} \quad (2.e)$$

$$E = E_w + E_o + E_f \quad \text{------------------------} \quad (2.f)$$

The hat (^) denotes supply equations. In the case of E_w, the wage-rate in the sector brings about equilibrium between demand and supply. On the other hand, in the case of owner-operators or workers on own-account, the magnitude of wage-employment and its fluctuations via wage-flexibility, is assumed as an equilibrating factor. Under conditions of slack wage-labour market, a high level of unemployment would tend to drive people into self-employment. Equation (2.e) for family labour is considered a residual. Excluding this equation, we are left with four equations (2.a to 2.d) and an identity (2.f). Since there are also five endogenous variables, viz. E, E_w, E_o, E_f, and W, the system is determinate. The solution of these simultaneous equations is provided in the following section.

Disaggregation of the elasticity of total service employment (E_s) with respect to different variables (e.g. income per capita as a measure of aggregate demand) is also desirable. The aggregate elasticity which is the average of the elasticities for wage-labour and self-supporting labour, tends to conceal differences in the components.

If η_1 is the partial elasticity of service employment (E_s), with respect to per capita income (Y), and η_2, the partial elasticity of a component of E_s, i.e. E_{ws}, with respect to per capita income, then:

$$\eta_1 = \left(\eta_2 + \eta_2 \cdot \frac{\partial E_{ss}}{\partial Y} \cdot \frac{\partial Y}{\partial E_{ws}}\right) \left(\frac{E_{ws}}{E_s}\right) \text{---------} \quad (3)$$

$$\eta_1 = \eta_2 \cdot \frac{E_{ws}}{E_s} \quad \text{if} \quad \frac{\partial E_{ss}}{\partial Y} \cdot \frac{\partial Y}{\partial E_{ws}} = 0 \quad \text{---------} \quad (3.a)$$

$$\text{or} \quad \frac{\partial E_{ss}}{\partial Y} = 0 \quad \text{and} \quad \frac{\partial Y}{\partial E_{ws}} = 0$$

where $E_{ss} = E_{os} + E_{fs}$

and $\eta_1 = \eta_2$ only when $\frac{E_{ws}}{E_s} = 1$ -------------------------- (3.b)

i.e. all service employment is wage-employment.

$\eta_1 < \eta_2$ when $\frac{E_{ws}}{E_s} < 1$ ----------------------------- (3.c)

Thus η_1 is likely to fall with a fall in the ratio of service wage-employment to total service employment i.e. (E_{ws}/E_s).

Similarly, the partial elasticity (η_3) of E_s with respect to supply of labour (N) is likely to fall with a fall in the ratio of self-supporting employment to total employment [i.e. E_{ss}/E_s or $(1 - E_{ws}/E_s)$].

$$\eta_3 (E_s, N) = \eta_4 (E_{ss}, N) \cdot \frac{E_{ss}}{E_s} \text{ ---------------------- } (3.d)$$

$$\text{or } \eta_3 (E_s,N) = \eta_4 (E_{ss}, N) \cdot \left(1 - \frac{E_{ws}}{E_s}\right) \text{ -------------- } (3.e)$$

It is only when condition (3.b), i.e. $E_{ws}/E_s = 1$, or when all service employment is wage-employment, holds that the Colin Clark-type arguments become truly relevant to the situations in the LDCs. So long as $E_{ws}/ E_s < 1$, and E_{ws} is small, $(1 - E_{ws}/E_s)$ which is the proportion of the self-employed, will be large. The latter also includes the "traditional" supply-induced element. It is therefore illogical to assume that all self-employment in the LDCs is demand-determined, or that the income elasticity of demand for self-employment is high.

Colin Clark's thesis is said to be inapplicable to the LDCs.[1] It is often acknowledged however that it fits well to the cases of the developed economies. Although it is very rarely made clear why this is so, two main reasons seem to explain this situation, (a) self-employment

[1]Cf. Alain Cotta, Analyse Quantitative de la Croissance des Pays Sous développés, Presse Universitaires de France, 1967. Mr. Cotta gives a table showing percentage distribution of labour force among sectors in seven low-income African countries and demonstrates that with the exception of Senegal, the share of tertiary sector in the labour force ranges between 20 to 30 percent, whereas that of secondary sector, only between 10-18 percent (p. 77). In the case of Senegal, the shares of tertiary and secondary sectors were respectively 40 percent and 24 percent. If due account is taken of the element of disguised unemployment, these high figures would be considerably reduced.

in total service employment forms a relatively small proportions and/or (b) it represents a "modern" element (which is a function of income-elasticity of demand) and not the "sponge" which has dried up over the past century or so.[1] Thus, even though in reality $E_{ws}/E_s \neq 1$, the self-employed can be treated at par with the wage-employed so that it is "as if" $E_{ws}/E_s = 1$.

An assessment of the magnitudes of separate elasticities for wage-labour, owner-operators and family workers, can be roughly made by invoking Marshall's four rules on the elasticity of derived demand.[2] These rules are of course, formulated only in terms of price-elasticity. We have considered the elasticity of derived demand with respect to per

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[1]To quote Kaldor, "However, disguised unemployment in "services" had been just as prevalent in Victorian England (as in present-day India or Latin America) there were vast numbers of people who eked out a living in urban areas as hawkers, petty tradesmen, servants, etc. on very low earnings." He goes on to state that this "relates to both self-employed and employees alike. In the population Census of 1891, 15.8 percent of the occupied population of Britain were classified as domestic servants. In the Census of 1961, the figure was 1.4 percent." (See Nicholas Kaldor-Productivity and Growth in Manufacturing Industry: A Reply, Economica, November, 1968.

[2]For an easy reference, Marshall's four rules are summarised below. Their implication for the elasticities of wage and self-employment is also suggested against each:

(I). The demand for factor inputs will be more elastic the larger the elasticity of substitution between them. In principle, the elasticity of substitution between self-supporting and wage-labour will be positive but low if there are qualitative barriers to entry into wage-employment;

(II). The demand for factor inputs is elastic if the elasticity of demand for final products is high. Services which have high income-elasticity of demand (e.g. physicians, lawyers, and the other business and professional services) and very low price-elasticity are likely to represent a rather low proportion in total self-employment;

(III). The demand for factors is inelastic or less elastic if its weight in the total cost of production is small. Since the direct cost of employing family labour is low or zero and its opportunity cost is also likely to be low under limited employment opportunities, the demand for family labour by owner-operators would tend to be inelastic;

(IV). The demand for factors is elastic if the supply elasticity of complementary or substitute factors is large. The derived demand for self-employment is likely to be inelastic since the elasticity of supply of such inputs as capital and entrepreneurial skills tends to be low.

capita income since it is consistent with Colin Clark's thesis. Secondly, it is also more easily amenable to empirical manipulation. Thirdly, the quantity of services produced is in any case, a function of both income-elasticity and price-elasticity of demand.[1]

The size of these elasticities will depend on the relative importance of the elasticity of final demand, the elasticity of factor substitution and the supply elasticity of cooperant factors. The necessary conditions for high or low elasticities of derived demand are summarized in Table 1. For elasticity of derived demand to be high or low, it is necessary but not sufficient that one of the conditions, 2-6, is fulfilled. For example, if elasticity of derived demand for labour in services is high, it implies that either the elasticity of final demand is high and the elasticity of factor substitution is high or at least positive. If condition 6, in Table 1, applies i.e. weight (k) of factor in total cost of production is large, then $(\lambda - \sigma) > 0$ and $(e) > 0$ must hold if the elasticity of derived demand is to be high. Thus condition 6 is necessary but not sufficient.[2]

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[1] If income-elasticity is high and the price-elasticity is relatively low, the substitution of other services for the one in question may be limited and hence the quantity to be produced may not fall with rising costs of production. For instance, for health and education, rising prices may not have any dampening effect on the final demand for these services which is income-elastic.

[2] See M. Bronfenbrenner, Notes on Elasticity of Derived Demand, Oxford Economic Papers, October 1961. Also, see J. R. Hicks, Marshall's Third Rule, A Further Comment, Oxford Economic Papers, October 1961, op. cit. and Koji Taira, The Relation Between Wages and Income from Self-employment: Estimates and International Comparisons, Manchester School, May 1966.

Table 1

Elasticities of Derived Demand for Wage- and Self-Supporting Labour in Services.

Elasticities and Necessary conditions ↓ / Derived Demand for Labour →	Total Service employment (E_s) =	Wage-employment (E_{ws}) +	Self-employment (E_{os}) +	Family Labour (E_{fs})
1. Elasticity of Derived Demand (η)	High/Low	High	Low	Low
2. Elasticity of Final Demand (λ)	High/Low	High	Low	Low
3. Elasticity of Factor-Substitution (σ)	High/Low	Positive	Positive	Low
4. Difference (2-3) or ($\lambda - \sigma$)	> 0	> 0	$\leqq 0$	$\leqq 0$
5. Supply elasticity of factor (e)	Positive/Lg.	Positive/Lg.	Small	Small
6. Share of factor in costs of production (k)	Large	Large	Small	Small

IV. Some Empiricism

We now attempt to examine whether our hypotheses about the disaggregate elasticities of demand are consistent with empirical facts. First, we assume that per capita income is a single measure of aggregate demand so that our interpretation of Colin Clark can be tested. Consider the following simple relationship:

$$E_{ij}/E = f\ (Y) \text{ ---------------------------------- } (4.0)$$

$$\text{or} \quad \log E_{ij}/E = \alpha_0 + \beta_0 \log\ (Y) + \Sigma_0 \text{ -------------- } (4.a)$$

where E_{ij}/E represents the proportion of total employment in the i^{th} labour category (i = 1. . . . 4) and j-th sector (j = 1. . . .5) and Y - is per capita income. The four labour categories refer to aggregate employment in each sector and its components, viz. wage-labour, owner-operators and family labour. Three tertiary sectors, viz. commerce, transport and services, are compared with two non-tertiary sectors (e.g. manufacturing and agriculture). The equation (4.a) was estimated by linear least-squares with the Japanese time-series data. These estimates are presented in Table 2. The results are quite significant. With the exception of agriculture, and to a lesser extent, manufacturing, there is hardly any correlation between self-employment (including family labour) and per capita income, $\bar{R}^2$ being extremely low. The β - coefficient for self-employment in services, with the exception of transport (which incidentally, also includes such activities as gas, water and electricity) is also extremely low both absolutely and relatively to the coefficients for agriculture and manufacturing. This bears out our hypothesis that the elasticity of derived demand in the tertiary sector is high only for wage-employment. Explanations for the employment of own-account workers and family labour are therefore to be sought by other factors, perhaps largely on the supply side.

Table 2

Regression Estimates: Dependent Variable (E_{ij}/E); Independent Variable (Y)

Sector and Employment Category	Constant Term	Income Coefficient	Standard Error of β	Coefficient of Determination	Number of Observations
	α	β	σβ	$\bar{R}^2$	N
JAPAN (1950-'64)					
A. Commerce					
log E_j/E	1.093	0.374	0.061	0.740	15
log E_{wij}/E	-1.649	0.800	0.063	0.923	15
log E_{oij}/E	2.055	-0.096	0.045	0.258	15
log E_{fij}/E	0.907	0.099*	0.118	0.051	15
B. Services (including government)					
log E_j/E	1.416	0.263	0.032	0.838	15
log E_{wij}/E	0.670	0.353	0.049	0.793	15
log E_{oij}/E	1.122	-0.011*	0.055	0.003	15
log E_{fij}/E	-0.258	0.048*	0.081	0.026	15
C. Transport (including communications, gas, water, etc.					
log E_j/E	0.620	0.224	0.033	0.778	15
log E_{wij}/E	0.441	0.252	0.032	0.821	15
log E_{oij}/E	-0.195	-0.375	0.272	0.127	15
log E_{fij}/E	-13.563	2.718	1.137	0.305	15
D. Manufacturing					
log E_j/E	1.115	0.402	0.023	0.957	15
log E_{wij}/E	0.183	0.552	0.041	0.931	15
log E_{oij}/E	1.344	-0.109	0.054	0.238	15
log E_{fij}/E	1.994	-0.316	0.133	0.302	15
E. Agriculture					
log E_j/E	6.227	-0.573	0.025	0.975	15
log E_{wij}/E	2.423	-0.479	0.111	0.587	15
log E_{oij}/E	4.534	-0.432	0.028	0.945	15
log E_{fij}/E	6.057	-0.640	0.033	0.966	15

Notes to Table 2:

N.B. ** - significant at 10% level of confidence.
* - not significant at either 5% or 10% level of confidence.
$\bar{R}^2$ is adjusted for degrees of freedom.
E_j/E = aggregate employment in jth sector as a proportion of total employment in the economy.
E_{wij}/E = wage-employment in jth sector as a proportion of total employment.
E_{oij}/E = owner-operators in jth sector as a proportion of total employment.
E_{fij}/E = family workers in jth sector as a proportion of total employment.

However, it is extremely difficult to measure the supply elasticity of the self-employed labour partly because there is as yet, no real theory of non-wage labour allocation and supply of effort. As a rough approximation, one may assume that the sensitivity of self-employment to unemployment rates (or the excess supply of labour at the prevailing wage) provides a rough indicator of the supply-induced employment, given the per capita income, so that:

$$E_{ij}/E = f\ (Y,\ U/L) \text{ ------------------------------ } (4.b)$$

or $$\log\ (E_{ij}/E) = \alpha + \beta \log\ (Y) + \gamma \log\ (U/L) + \Sigma \text{ ------- } (4.c)$$

where E_{ij}/E is the proportion of the ith employment in j-th sector, Y - per capita income and U/L, unemployment rate. Contrary to expectations, the linear estimation of (4.c) by ordinary least-squares, did not yield very significant $\bar{R}^2$ or the γ - coefficients. Part of the explanation for poor results may be collinearity and an inadequate variation in the time-series on unemployment rates. As a remedy, we take an alternative variable of labour supply, viz. the labour force participation rate (L/N_o). Considerable attention has been paid to the influence of good employment prospects on labour force participation, that is, in other words, of labour demand on its supply.[1] However, there is also an autonomous increase in labour force participation (determined by social customs and low standards of living) which may induce employment on own-account in the absence of any opportunities of better-paid jobs.

The results of this three-variable regression are presented in Table 3. We notice that the introduction of a supply variable improves the goodness of fit in all sectors and all labour categories, and in the latter, this is particularly true for owner-operators and family labour. There is a significant and positive correlation between all types of employment and the supply of labour in the case of commerce. For services and manufacturing, γ - coefficient is positive and significant only for owner-operators and family workers. From these observations, one can roughly conclude that under conditions of wage-rigidity in manufacturing and transport, the pressures of labour supply tend to show in an increase of self-employment in commerce and to a lesser extent, in other economic activities. Thus, the hypothesis of a relatively easier and costless entry into tertiary activities than into non-tertiary ones seems to be validated. One of the explanations of this phenomenon may be the absence of institutional wage-rigidity arising from weaker unionization in such services as trade and commerce. Besides, relatively easier entry also reflects the nature of competition among own-account enterprises which operate mainly through the multiplication of small units. The low capital and skill requirements make the growth of new units quite easy. Finally, a large percentage of female workers may provide another plausible explanation.

[1] Cf. W. G. Bowen, Influence of Employment Prospects on Labour Force Participation Rates, Manpower Journal (New Delhi), July-September 1966; and Alfred Tella, the Relation of Labour Force to Employment, Industrial and Labour Relations Review, April 1964.

Table 3

Regression Estimates: Dependent Variable: (E_{ij}/E)

Independent Variables: (Y) and (L/N_{σ})

(Japan 1950-'64)

Sector and Employment Category	Constant Term	Income Coefficient	Standard Error of β	Labour Supply Coefficient	Standard Error of γ	Coefficient of Determination	Number of Observations
	α	β	σβ	γ	σγ	$\bar{R}^2$	N
Estimating Equation: $\log (E_{ij}/E) = \alpha + \beta \log (Y) + \gamma \log (L/N_o) + \Sigma$							
A. Commerce							
$\log E_j/E$	-4.792	0.358	0.043	1.998	0.515	0.885	15
$\log E_{wij}/E$	-4.371	0.781	0.047	1.944	0.566	0.961	15
$\log E_{oij}/E$	-3.248	-0.102	0.041	1.094	0.499	0.449	15
$\log E_{fij}/E$	-16.125	0.666**	0.076	4.177	0.916	0.653	15
B. Services (including government)							
$\log E_j/E$	1.430	0.257	0.031	0.424**	0.374	0.857	15
$\log E_{wij}/E$	4.189	0.359	0.050	-0.251**	0.610	0.805	15
$\log E_{oij}/E$	-7.436	-0.029**	0.027	1.997	0.329	0.755	15
$\log E_{fij}/E$	-12.796	0.050**	0.038	3.050	0.456	0.802	15
C. Transport							
$\log E_j/E$	7.405	0.236	0.011	-1.232	0.138	0.974	15
$\log E_{wij}/E$	7.900	0.262	0.014	-1.346	0.169	0.969	15
$\log E_{oij}/E$	10.854	-0.305	0.124	-3.179*	1.495	0.494	15
$\log E_{fij}/E$	-11.550	-0.295*	0.161	1.894	1.933	0.248	15
D. Manufacturing							
$\log E_j/E$	2.151	0.404	0.023	-0.247*	0.285	0.959	15
$\log E_{wij}/E$	3.735	0.559	0.038	-0.849	0.455	0.947	15
$\log E_{oij}/E$	-3.855	-0.121	0.048	1.243	0.577	0.450	15
$\log E_{fij}/E$	-9.156	-0.340	0.123	2.667	1.477	0.451	15
E. Agriculture							
$\log E_j/E$	4.897	-0.576	0.025	0.318*	0.301	0.977	15
$\log E_{wij}/E$	-11.683	-0.510	0.083	3.373	0.995	0.789	15
$\log E_{oij}/E$	4.585	-0.432	0.030	-0.012*	0.361	0.945	15
$\log E_{fij}/E$	3.993	-0.645	0.032	0.493*	0.389	0.970	15

Table 3, notes

* = not significant at 5% or 10% level of confidence.
** = not significant at 5% level of confidence.

Since the regression estimates are in double logarithmic form, at least as a rough approximation, the β and γ coefficients can be taken as employment elasticities with respect to per capita income (η_Y) and the size of labour force (η_L) respectively.[1] The following findings go some distance in supporting our hypotheses outlined in the preceding section:.

(a) In commerce and services, η_L is high when η_Y is low or negative for all labour categories. The large values of η_L for self-employment, particularly, family labour, suggest that the "supply effects" are strong and own-account labour presumably engaged mostly in the small-scale enterprises represents a "subsistence" tertiary sector;

(b) η_Y is invariably high for wage-employment and low or negative for both self-employment and family labour. This fact provides an evidence that differential income-elasticities can be used to disaggregate labour into "modern" and "traditional" categories.

(c) The negative η_Y for the owner-operators and positive η_Y for wage-labour in all sectors (except agriculture) suggests substitution of wage-employment for self-employment.

(d) In the case of transport, η_Y for aggregate employment is only negligibly lower than that for wage-employment (i.e. 0.236 against 0.262). On the other hand, in manufacturing, commerce and services, η_Y for wage-employment is much higher than that for aggregate-employment. Thus, our

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[1] In order to ensure homogeneity, the employment variable is expressed as a percentage since the independent variables (Y) and (L/N_o) are in per capita and percentage terms respectively.

hypothesis that η_Y for aggregate employment in a sector is low/large when the share of wage-labour in total (E_{ws}/E_s) is small/large is also tested. η_Y for aggregate employment approaches η_Y for wage-labour as (E_{ws}/E_s) approaches unity. (See equations 3.b and 3.c.) The fact that in transport the two coefficients are almost identical is due to the negligible proportion of the self-employed in the total.

Finally, we consider our simultaneous euqations model which, as expressed in the structural form, should in principle, provide an identification of the supply and demand functions for employment. The simultaneous equations (2.a.-2.d.) were transformed into logarithmic form as follows and were estimated by the two-stage least-squares method:

$$\log (E_w) = \alpha_0 + \beta_0 \log (Y) + \theta_0 \log (K) + \phi_0 \log (W) + \Sigma_0 \text{ --(2.a)}$$

or $$\log (W) = \alpha_0 + \beta_0 \log (Y) + \theta_0 \log (K) + \lambda_0 \log (E_w) + \Sigma_0 \text{--(2.a.1)}$$

$$\log (\hat{E}_w) = \alpha_1 + \phi_1 \log (W) + \gamma_1 \log (N) + \Sigma_1 \text{ ---------------(2.b)}$$

$$\log (E_0) = \alpha_2 + \beta_2 \log (Y) + \lambda \log (E_w) + \Sigma_2 \text{----------------(2.c)}$$

$$\log (\hat{E}_0) = \alpha_3 + \gamma_3 \log (N) + \lambda \log (E_w) + \Sigma_3 \text{ ---------------(2.d)}$$

Equation (2.e) was excluded in order to ensure that the relations in the system were as many as the endogenous variables. E_w, E_0, and W represent absolute values of endogenous variables in the above equations. Y, K, and N are the exogenous variables. Y is per capita income and N - the total labour force (assumed to be determined by total population and its age-structure). Two different varieties of K were considered, viz. gross tangible fixed capital stock (private only) in the economy as a whole and gross fixed private capital in each sector.[1] No significant

[1] An adequate number of observations for both private and public capital stock were not available. The data used were taken from Estimates of Long-term Economic Statistics of Japan Since 1868. Vol. III on "Capital Stock."

difference is made to the results by changing K. Therefore, in the estimated equations presented in Table 4, K - refers only to sectoral capital stock. For lack of information on the endogenous variable, W, for services sector, the estimation of the equations had to be done by the ordinary least-squares method.

The large standard errors in many cases suggest the existence of multi-collinearity. One explanation for this may be the use of time-series data. Therefore, our results should be treated as illustrative rather than definitive.

Nevertheless, some tentative observations can be made regarding (a) wage-elasticity of supply of labour, (b) wage-elasticity of demand for labour, and (c) income-elasticity of derived demand for labour. Firstly, the two-stage least squares results further corroborate our finding that the income-elasticity of demand for wage-labour is positive whereas that for owner-operators is negative. The exceptional case of transport may be due in part to the very small size of the self-employed in this sector. Secondly, an increase in wage-employment does not lead to a decline in the wage-rate in commerce, manufacturing and agriculture. Although this finding is contrary to our earlier supposition of a relatively greater wage-flexibility, much reliance cannot be placed on the λ - coefficients since they are not all very significant. Thirdly, the wage-elasticity of supply of wage-labour, measured by the ϕ - coefficient is high for both commerce and manufacturing.

Our model has a very good explanatory power for all the labour demand equations for wage-labour, $\bar{R}^2$- adjusted for degrees of freedom being above 0.80. On the other hand, the explanatory power of the function of demand

Table 4.
Employment Functions: Simultaneous Equations Model
Japan (1950-'64)

Sector and Dependent Variable	Constant Term	Income-Coefficient	Capital Coefficient	Wage-Coefficient	Labour Supply Coefficient	Wage-Labour Coefficient	$\bar{R}^2$
	α	β	θ	ϕ	γ	λ	
I. Commerce							
log (W)	4.592	0.474 (0.340)	-0.386 (0.272)			0.278 (0.144)	0.954
log ($\hat{E}_W$)	-21.230			0.956 (0.512)	2.463 (0.928)		0.978
log (E_0)	4.788	-0.557 (0.182)				0.671 (0.159)	0.750
log ($\hat{E}_0$)	-39.679				5.241 (3.192)	-1.051 (0.764)	0.355
II. Services[1]							
log (W)	5.366	0.628 (0.060)	0.004 (0.005)			n.a.	0.911
log ($\hat{E}_W$)	-16.593			n.a.	2.340 (0.223)		0.894
log (E_0)	5.388	0.170 (0.246)				0.110 (0.387)	0.454
log ($\hat{E}_0$)	-18.543				3.026 (0.290)	-0.789 (0.117)	0.943
III. Transport							
log (W)	10.961	1.819 (0.844)	-0.033 (0.629)			-2.035 (1.698)	0.846
log ($\hat{E}_W$)	-19.402			-0.317 (0.346)	2.637 (1.066)		0.848
log (E_0)	19.042	1.067 (0.929)				2.595 (1.867)	0.524
log ($\hat{E}_0$)	17.464				-1.447 (1.169)	0.272 (0.642)	0.290
IV. Manufacturing							
log (W)	5.570	1.363 (0.329)	-0.757 (0.272)			0.335 (0.325)	0.969
log ($\hat{E}_W$)	9.393			1.597 (0.779)	-0.505 (1.678)		0.908
log (E_0)	5.238	-0.028 (0.738)				0.201 (0.888)	0.152
log ($\hat{E}_0$)	-11.785				2.169 (0.482)	-0.507 (0.158)	0.770

Table 4, continued

Sector and Dependent Variable	Constant Term	Income-Coefficient	Capital Coefficient	Wage-Coefficient	Labour Supply Coefficient	Wage-Labour Coefficient	$\bar{R}^2$
	α	β	θ	ϕ	γ	λ	
V. Agriculture							
log (W)	-12.514	-0.609 (0.513)	1.334 (0.538)			0.336 (0.159)	0.946
log ($\hat{E}_w$)	-25.661			-1.468 (0.393)	3.345 (0.998)		0.442
log (E_0)	7.587	-0.128 (0.033)				0.251 (0.086)	0.749
log ($\hat{E}_0$)	11.193				-0.450 (0.125)	0.346 (0.088)	0.698

[1]Estimated by ordinary least-squares method.

n.a. - not available.

for the self-employed is much lower with the exceptions of commerce and agriculture where the nature of operations offers greater scope for employment on own-account. Finally, the goodness of fit for the labour supply functions for owner-operators is the poorest. This may be due to the misspecification of this function. Yet, it is of interest to note that in commerce, services and manufacturing, an inverse correlation exists between the wage-earning opportunities and the offer of labour services by the self-employed. Also the labour supply coefficient, γ, is significant and high. One can therefore deduce that there is very little, if any institutional preference for self-employment.

V. Concluding Remarks

In our attempt to explore the mechanism of non-wage labour allocation, we have barely scratched the surface. However, we believe that labour market theory is incomplete without incorporation of the behaviour of self-employment. We have therefore proposed disaggregate employment functions. The conventional disaggregation of total tertiary output alone is inadequate. On the other hand, labour disaggregation has an appeal for both analysts and policy-makers. It helps to provide a conceptual basis for distinguishing between "traditional" and "modern" types of employment. At a policy level, separation of wage-employment from self-employment also provides a guideline for the determination of sectoral employment targets.

It is interesting to note that apart from setting total employment target (determined by particular planned rates of income growth), the Japanese planners envisaged reallocating labour out of the categories of self-employed and family workers into that of wage-labour. In the Ten-Year Plan of Japan (1961-70), the employment target set for 1970 was defined in terms of a transfer of the self-employed and family workers to wage-earning or salaried "modern" employment.[1] Implicit in this target is the implication that all self-employment (including family labour) is the result of "push" rather than "pull" factors, and hence it is of a low-productivity nature. In other words, the conditions of labour supply largely determine the amount of labour demanded in services. We have attempted to show that the simple demand rationale which ignores "supply effects" is inadequate for the analysis of the LDCs tertiary sector. It is for this reason also that Colin Clark's thesis can be valid only under very special assumptions.

The choice of Japan for empirical illustration was conditioned largely by the availability of adequate data classified according to our chosen labour categories. It may be argued that Japan is not an LDC and therefore its experience, particularly of the post-war period is markedly different from that of a developing country. Although in general, this is true, Japan's employment structure in service industries appears to be relevant to at least a few, if not many developing countries. Between 1956 and 1968, the percentage of family labour has remained fairly steady in the Japanese service industries. Increased dependence on family labour in business services also seems to suggest a gradual expansion of own-account business and persistence of small-size of shops.[2] This preponderance of the self-employed and family labour in various types of services is also characteristic of most LDCs with labour surpluses.

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[1] New Long-Range Economic Plan of Japan (1961-1970) - Economic Planning Agency, Japanese Government, Tokyo, pp. 16-17.

[2] See Koichi Emi, Employment Structure in the Service Industries, Developing Economies (Tokyo), June 1969.

Appendix

A. Endogenous Variables

I. Agriculture (including forestry)

Year	(E_i/E) (%)	(E_w/E) (%)	(E_o/E) (%)	(E_f/E) (%)	(W) (ooo Yen) at 1960 prices
1950	45.3	1.4	14.9	28.9	9.3
1951	44.6	1.4	15.4	27.7	9.6
1952	43.9	1.2	15.1	27.5	8.8
1953	43.2	1.5	14.3	27.4	10.4
1954	41.6	1.4	13.8	26.4	11.2
1955	41.2	1.3	13.7	26.3	11.6
1956	39.4	1.5	13.5	24.5	11.7
1957	37.5	1.6	13.0	22.8	12.1
1958	34.0	1.1	12.0	20.8	12.4
1959	32.2	1.3	11.5	19.3	12.7
1960	31.2	1.3	12.3	19.9	13.4
1961	29.9	1.2	10.9	17.8	15.1
1962	28.6	1.0	10.5	17.1	17.2
1963	26.8	0.8	10.1	15.9	18.7
1964	25.6	0.8	9.7	15.1	18.0

Sources: (A) Employment Data: Monthly Statistics of Japan, and Japan Statistical Yearbook. (B) Wage Data: Estimates of Long-term Economic Statistics of Japan Since 1868, Vol. 9, on "Agriculture and Forestry."

II. Manufacturing (excluding mining and construction)

Year	(E_i/E) (%)	(E_w/E) (%)	(E_o/E) (%)	(E_f/E) (%)	(W) (ooo Yen) at 1960 prices
1950	15.8	12.4	2.1	1.3	13.5
1951	17.3	13.2	2.3	1.8	14.9
1952	17.5	13.1	2.4	2.0	16.4
1953	17.3	12.5	2.5	2.3	17.4
1954	17.7	12.7	2.6	2.4	17.4
1955	17.4	12.6	2.7	2.2	18.0
1956	18.2	13.9	2.4	1.8	19.7
1957	18.9	14.9	2.3	1.6	20.1
1958	20.8	16.6	2.3	1.8	20.1
1959	20.6	16.7	2.3	1.6	21.5
1960	21.3	17.7	2.1	1.4	22.6
1961	22.5	18.8	2.2	1.4	23.5
1962	23.4	19.8	2.1	1.5	24.2
1963	24.1	20.4	2.2	1.5	25.0
1964	24.3	20.7	2.2	1.4	26.3

Sources: (A) Employment Data: op. cit. (B) Wage Data: Hundred Years Statistics of Japanese Economy, July, 1966, pp. 70-71.

III. <u>Commerce</u> (including finance, insurance and real estate)

Year	(E_i/E)	(E_w/E)	(E_o/E)	(E_f/E)	(W)[1]
1950	11.8	4.7	4.5	2.6	17.4
1951	14.2	5.5	5.3	3.4	20.1
1952	14.5	5.6	5.2	3.7	21.4
1953	14.7	5.9	5.0	3.8	22.9
1954	16.1	6.3	5.4	4.4	23.8
1955	16.5	6.9	5.3	4.3	23.2
1956	17.8	8.0	5.2	4.6	24.1
1957	18.0	8.2	5.2	4.6	25.4
1958	18.5	9.0	5.0	4.4	25.8
1959	18.9	9.1	5.3	4.4	26.7
1960	19.0	9.6	5.1	4.3	28.2
1961	18.6	9.9	4.8	3.9	28.4
1962	18.5	10.4	4.5	3.6	29.4
1963	19.4	11.1	4.6	3.7	30.7
1964	19.8	11.4	4.6	3.8	32.4

<u>Sources</u>: <u>op. cit.</u> N.B. (1) up to 1956 data for real estate are not available.

IV. Transport (including gas, water, and electricity)

Year	(E_i/E)	(E_w/E)	(E_o/E)	(E_f/E)	(W)
1950	5.0	4.7	0.2	0.1	14.6
1951	5.1	4.8	0.2	0.1	17.9
1952	5.1	4.8	0.2	0.1	21.1
1953	4.9	4.6	0.2	0.1	23.9
1954	4.8	4.5	0.2	0.1	24.3
1955	4.7	4.4	0.2	0.1	26.5
1956	4.9	4.7	0.1	0.0	28.2
1957	5.0	4.8	0.1	0.1	29.3
1958	5.1	4.9	0.1	0.0	29.7
1959	5.4	5.2	0.1	0.1	31.0
1960	5.5	5.3	0.1	0.0	32.2
1961	5.6	5.4	0.1	0.0	33.8
1962	5.8	5.6	0.1	0.0	35.3
1963	6.0	5.8	0.2	0.0	36.0
1964	6.3	6.0	0.2	0.1	38.3

Sources: op. cit.

V. Services (including government)

Year	(E_i/E)	(E_w/E)	(E_o/E)	(E_f/E)	(W)
1950	13.1	9.9	2.5	0.8	n.a.
1951	12.0	8.3	2.8	0.9	"
1952	12.0	8.4	2.8	0.8	"
1953	12.4	8.4	3.0	1.0	"
1954	12.7	8.8	3.0	1.0	"
1955	13.3	9.0	3.2	1.1	"
1956	13.8	9.6	3.2	1.1	"
1957	14.0	9.7	3.2	1.1	"
1958	14.5	10.5	3.0	1.0	"
1959	15.2	11.3	2.9	1.0	"
1960	15.2	11.2	3.0	1.0	"
1961	15.4	11.4	2.9	1.0	"
1962	15.3	11.6	2.8	1.0	"
1963	15.5	11.8	2.8	0.9	"
1964	15.7	12.0	2.7	0.9	"

n.a. = not available

B. Exogenous Variables

Year	(Y) (000 yen at 1960 prices)	(N) (000)	(K) (millions of yen at 1960 prices)	(K_1)	(K_2)	(K_3)	(K_4)	(K_5)
				(millions of yen at 1960 prices)				
1950	62.8	36,280	12,332,457	1,977,717	3,345,971	2,681,202	1,745,369	2,376,329
1951	67.7	36,600	12,535,702	2,080,858	3,560,260	2,637,819	1,698,173	2,319,291
1952	74.3	37,750	13,013,216	2,214,871	3,805,275	2,663,938	1,754,160	2,292,853
1953	76.5	39,570	13,635,786	2,378,958	4,046,268	2,730,413	1,862,191	2,297,331
1954	78.0	40,200	14,553,882	2,548,033	4,347,898	2,842,946	2,092,350	2,321,888
1955	86.5	41,560	15,402,451	2,743,740	4,592,850	2,955,393	2,299,606	2,374,654
1956	91.8	42,350	16,463,699	2,916,395	4,963,266	3,079,101	2,572,095	2,425,020
1957	96.8	43,630	17,925,572	3,095,468	5,584,827	3,287,609	2,848,495	2,508,778
1958	100.0	43,870	19,483,989	3,281,612	6,261,925	3,464,138	3,192,742	2,595,868
1959	112.5	44,330	21,221,353	3,515,257	6,959,723	3,696,447	3,606,007	2,663,588
1960	129.0	45,110	23,900,046	3,828,997	8,211,266	4,058,661	4,094,794	2,799,696
1961	143.1	45,620	27,061,650	4,150,230	9,672,102	4,514,559	4,615,412	2,990,194
1962	152.5	46,140	30,634,913	4,542,647	11,339,431	5,062,688	5,123,623	3,212,353
1963	168.1	46,520	34,366,355	4,965,113	13,063,255	5,672,097	5,700,944	3,433,155
1964	181.3	47,100	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

<u>Sources</u>: (1) Y - Hundred Years Statistics of the Japanese economy, p. 45 and p. 51. NDP was deflated by a GNP implicit-price deflator which was converted to 1960 base; (2) N - Japan, Monthly Bulletin of Statistics; (3) K - Estimates of Long-term Economic Statistics of Japan since 1868, Vol. III on Capital Stock, pp. 260-62.

<u>N.B.</u> K = gross, tangible fixed capital stock in private enterprises in the whole economy.

K_1 = fixed capital stock in agriculture.
K_2 = " " " " manufacturing.
K_3 = " " " " commerce.
K_4 = " " " " transport.
K_5 = " " " " services.