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Labor absorption with import substituting industrialization: An examination of elasticities of substitution in the Brazilian manufacturing sector

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Labor Absorption with Import Substituting Industrialization: An Examination of Elasticities of Substitution in the Brazilian Manufacturing Sector

by W. G. Tyler

CONTENTS:

- In the less developed countries employment generation has emerged as a major problem. Those countries characterized by import substituting industrialization have been especially unable to expand employment opportunities, and their industrialization has been capital intensive in nature.
- Two different explanations for the failure of import substituting industrialization to absorb labor have been put forth. One school of thought stresses the structural characteristics of industrialization, while an alternative explanation focuses on distortions in the factor markets. Much of this controversy implicitly revolves around the magnitude of the elasticities of substitution — the "structural critic" school maintaining very low, or zero, elasticities of substitution and the "market critic" school implying relatively high elasticities of substitution.
- The CES production function is fitted to a regional cross-section of twenty-two Brazilian industries. The OLS estimates, made from 1960 industrial census data, show elasticities of substitution ranging from .44 to 2.67 with over 50 percent of those estimated falling between .8 and 1.1. For the total manufacturing sector the elasticity of substitution (estimated across states) was 1.0. The relatively high estimated elasticities of substitution provide support for the "market critic" school.
- Using the production function estimates to generate factor demand functions, the importance of factor market distortions is indicated. Distortions in the Brazilian labor market are quantified and, assuming their removal, a lower bound estimate of the resulting employment generation is made, amounting to an increase of 11.4 percent in total manufacturing employment. Because of data limitations and the difficulties in quantification, no similar estimates were made regarding the capital market distortions.

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Labor Absorption with Import Substituting Industrialization: An Examination of Elasticities of Substitution in the Brazilian Manufacturing Sector

I. Introduction

In recent years employment provision and the lack of labor absorption have evolved as major problems confronting less developed countries. Import substituting industrialization (ISI) has not proved itself capable of generating substantial increases in manufacturing employment. In Brazil, for example, between the census years of 1949 and 1959 manufacturing employment as a percentage of total employment actually witnessed a decline - falling from 9.4 percent to 8.9 percent. At the same time, this fall in the industrial sector's share of total employment was accompanied by a 144 percent increase in real manufacturing output, with the industrial sector's share in total output increasing from 23.4 percent to 25.4 percent[1]. Even in the eyes of the most ardent advocates of ISI[2], its employment performance was clearly less than satisfactory.

The failure of ISI countries to sufficiently absorb labor in industrial employment has been attributed to a host of factors, and something of a controversy has been developing between, as one writer has recently expressed it, the "structural" critics and the "market" critics of ISI[3]. Stressing the capital intensive character of ISI, the "structural critics" argue that labor absorption has been low because of limited possibilities for factor substitution, the importance of foreign firms and their tendency to utilize production techniques existing in the home country, the inclination of

Remark: The paper is a product of ongoing research at the Kiel Institute of World Economics, dealing with problems of industrialization and export diversification in less developed countries. The author wishes to thank David G. Denslow for comments, criticism, and many helpful suggestions. Morris D. Whitaker also read an earlier draft and made several useful comments. Thanks also go to Peter Eaton for providing considerable assistance with the statistical materials.

[1] Figures were calculated from the Brazilian national income accounts published in Conjuntura Econômica, Vol. XXV, Rio de Janeiro, No. 9, pp. 91-114. By 1970 manufacturing's share of GDP had risen to 28.2 percent. Unfortunately, at the time of this writing comparable employment figures for 1970 were not yet available, but it is not expected that the 1970 Industrial Census data will present a picture substantially different in meaning than that presented in the 1949-1959 comparison.

[2] See for example: Maria da Conceição Tavares, "The Growth and Decline of Import Substitution in Brazil", Economic Bulletin for Latin America, Vol. IX, Santiago de Chile, 1964, No. 1, p. 8.

[3] Werner Baer, "Import Substitution and Industrialization in Latin America: Experiences and Interpretations", Latin American Research Review, Vol. VII, Austin, Texas, 1972, No. 1, pp. 95 sqq. Baer's article presents a useful and succinct, nontechnical overview of the process of ISI and its related issues.

domestic producers to also copy techniques existing in the developed countries, the capital-biased (i.e., labor-saving) nature of technological change, and the absence of technology appropriate for the factor endowments of the less developed countries[1]. For the "structural critics" relative factor prices are of little importance. Seen in this fashion, wage policy is primarily a distributive instrument.

The "market critic" school on the other hand, stresses the importance of relative factor prices in determining the amounts of different factors employed. The "market critics" argue that without the severe distortions introduced into the factor markets by government policy, the labor absorption problem would be far less, or perhaps even non-existent. Credit, fiscal, and exchange incentives have been liberally extended in Brazil (and other LDC's) to promote investment in the industrial sector. These measures have had the effect of rendering the private price of capital cheap relative to its social opportunity cost. In the labor market, on the other hand, government measures have served to increase the price of labor to a price greater than its social opportunity cost. An elaborate system of social welfare and labor legislation in Brazil, dating back to the Vargas period, has included such features as minimum wage laws, liberal vacation pay, a Christmas bonus equal to one month's pay, severance pay depending upon time of service, and a wide range of fringe benefits. The combined effect of the capital and labor market distortions has been to substantially increase the relative price of labor.

Perhaps the resolution of the "structural versus market" controversy concerning labor absorption lies in determining the importance of relative factor prices in the employment of those productive factors. To date much of the empirical research has been of a survey type, interviewing firms as to the factors affecting their choice of technology[2]. For the most part, such research has suggested that the possibilities of factor substitution are somewhat limited[3]. Another approach is available through the statistical estimation of elasticities of substitution. Existing work along the latter lines regarding the less developed countries also provides some support for the "structural" position, i.e., elasticities of substitution are estimated to be strikingly low[4]. This paper also employs the production function estimate approach to the labor

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[1] See R.S. Eckaus, "The Factor Proportions Problem in Underdeveloped Areas", The American Economic Review, Vol. XLV, Menasha, Wisc., 1955, pp. 539 sqq. - Werner Baer and Michel Hervé, "Employment and Industrialization in Developing Countries", The Quarterly Journal of Economics, Vol. LXXX, Cambridge, Mass., 1966, pp. 88 sqq., and Celso Furtado, Um Projeto para o Brasil, Rio de Janeiro, 1968. Furtado, it should be noted, also attributes some degree of importance to factor market distortions thus placing him in the "market critic" school as well as among the "structural critics."

[2] See W. Paul Strassman, Technological Change and Economic Development: The Manufacturing Experience of Mexico and Puerto Rico, Ithaca, N.Y., 1968, and Kent Hughes, "Factor Prices, Capital Intensity, and Technological Adaptation", in: Contemporary Brazil: Issues in Economic and Political Development, Ed. by H. Jon Rosenbaum and William G. Tyler, New York, Washington, London, 1972, pp. 125 sqq.

[3] For example, see: Werner Baer, The Development of the Brazilian Steel Industry, Nashville, Tennessee, 1969.

[4] See Christopher K. Clague, "Capital-Labor Substitution in Manufacturing in Underdeveloped Countries", Econometrica, Vol. XXXVII, New Haven, Conn., 1969, pp. 528 sqq., and Jorge M. Katz, Production Functions, Foreign Investment and Growth: A Study Based on the Argentine Manufacturing Sector, 1946-1961, Amsterdam, London, 1969.

absorption problem, focusing on Brazil. Before taking up in turn a discussion of production function analysis and the empirical results, we first briefly comment on a theoretical conceptualization of the problem.

II. Conceptual Framework

The Cobb-Douglas production function presumes unlimited possibilities for factor substitution and possesses an elasticity of substitution (σ) equal to one. On the other hand, if there are no substitution possibilities and there is only one process available to producers of a commodity, the production function is of a linear, or Leontief, variety and has an elasticity of substitution equal to zero. Consequently, in this latter case, factor prices have no direct bearing on the employment of the productive factors. Their employment is determined by technology and, in a more general sense, the nature and structure of demand. But, as long as $\sigma > 0$, relative factor prices are determinant of factor employment.

In the event that there is not just one process with factor non-substitutibility but, say two separate processes[1], different amounts of the productive factors can be employed through the combination of the two processes. In terms of the Figure which assumes two processes, A and B, of the linear variety and two factors, capital (K) and labor (L) - the isoquant inside the economic boundaries for output X_1 becomes effectively ab[2] (see Figure, p. 14). If competitive factor markets, reflecting a relative abundance of labor, establish P_1P_1 as the factor price ratio for the isocost curves, the relatively labor intensive process B will be that selected by short-run profit-maximizing firms for output X_1. If there are either constant returns to scale in both processes or relative increasing returns to scale in process B, process B will be that chosen at all levels of output.

Now assume that government policy introduces imperfections into both factor markets serving to artificially increase the price of labor (w) and lower that for capital (r) above and below their respective social opportunity costs. Such distortions increase the relative price of labor ($\frac{w}{r}$) causing a clockwise rotation of the isocost curves. Assume that the new isocost curves have a slope equal to that of P_2P_2. Since at this new factor price ratio, the slope of ab is equal to that of P_2P_2, both, process A and

[1] This is discussed extensively in Robert Dorfman, Application of Linear Programming to the Theory of the Firm, Berkeley, Cal., 1951. - See also Eckaus, op. cit., upon which our discussion heavily relies.

[2] The assumptions may in fact be overly restrictive but are nevertheless employed for the purposes of illustration and simplicity. First, it appears severe to assume absolute non-substitutibility within the two processes. Even if the technology is fixed with respect to the primary manufacturing process, presumably factor substitution would still be possible in the myriad of ancillary activities of the firm. The effect of relaxing the non-substitutibility assumption within processes would be to widen the economic boundaries.
Second, by assuming homogenous capital and labor as the only productive factors, such important factors as skilled manpower and managerial capabilities are neglected. In fact, the relative scarcity of these latter factors may be a contributing explanation for a high rate of substitution of capital for labor. For a development of this argument see: Albert O. Hirschman, The Strategy of Economic Development, Yale Studies in Economics, 10, New Haven, Conn., 1958, pp. 150 sqq.

B are equally profitable. Either A, B, or some combination of the two can be selected to maximize short-run profits, but this may not mean complete indifference on the part of the firm's manager, especially as with regards to future production. For a number of reasons expectations may be A-biased, i.e., the firm may expect process A to become more profitable in the future. If such is the case, any new investments will be in process A.

If factor market distortions should be further increased to raise $\frac{w}{r}$ to correspond to the slope of the isocost curve P_3P_3, process A becomes more profitable than B. With competitive product markets process A alone would survive; those firms employing B would entail losses. Under ISI conditions of highly concentrated market structures and government intervention, greater protection, or subsidization, will be required for the firms employing B. At the same time profits for those firms employing A may become excessive. To the extent that the dichotomy between firms employing A and those employing B may be one between foreign and domestically owned firms, the situation has obvious political overtones.

The slope of isoquant ab is critical. At any $\frac{w}{r}$ greater than that represented in P_2P_2, further increases in $\frac{w}{r}$ result in changing profit maximizing factor proportions. All profit maximizing production is in process A and, the elasticity of substitution for a further increase in $\frac{w}{r}$ is equal to zero. On the other hand, at a $\frac{w}{r}$ lower than that represented in the isocost curve P_2P_2 the elasticity of substitution for any further reduction in $\frac{w}{r}$ is also equal to zero. Thus, only with a factor price ratio in the vicinity of that represented by P_2P_2 will $\sigma > 0$. Departures from this situation are possible if (1) firms are not short-run profit maximizers, or (2) competitive product markets do not exist, notably due to the existence of government intervention.

Thus, we see that an increase, or its expectation, in the factor price ratio $\frac{w}{r}$, to where it is equal to or greater than the slope of the isocost curve P_2P_2, will lead to a substitution of capital for labor. At the same time, one must recall that anything serving to decrease the slope of the isoquant ab will also have the same result. Consider two further effects. First, if neutral technological change in process A occurs more rapidly than in process B, A's isoquants will shift in on the expansion path A relative to comparable shifts for process B, thereby decreasing the slope of ab[1]. Second, if process A has increasing returns to scale relative to B, the isoquants at higher levels of output will have a slope less than that of ab.

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[1] Introducing assumptions as to the nature of technological change can modify the analysis. If process A's technological change is capital-biased, i.e., labor-saving, the tendency ceteris paribus will be to decrease the slope ab and bring a further substitution of capital for labor. However, if technological change is capital-biased in process B, ceteris paribus such change will tend to increase the slope of ab and result in less substitution of capital for labor. This counter-intuitive result is also evident in the converse. Labor-biased technological change in process B will tend ceteris paribus to result in a lesser slope for ab and therefore less employment of labor.

III. CES Production Function Estimation

Attempts to fit Cobb-Douglas production functions to Brazilian data have met with little success[1] - no doubt in great part because of the data limitations inherent with the measurement of capital. However, even if the data problems were non-existent, one is tempted to question whether the Cobb-Douglas form of the production function is adequate. A property of the Cobb-Douglas is that the elasticity of substitution is equal to one. In view of the controversy concerning labor absorption and employment, it would appear desirable to fit a production function less restrictive than Cobb-Douglas. In recent years a more general production function has appeared in the literature[2]; it is generally termed after its principal characteristic - a constant elasticity of substitution (CES), which can range from zero to infinity. Thus, both the Leontief type production function, where $\sigma = 0$, and the Cobb-Douglas function, where $\sigma = 1$, are seen as special cases of the more general CES function.

The CES production function is written the following form:

$$V = \gamma \left[\delta K^{-\rho} + (1-\delta) L^{-\rho}\right]^{-\frac{1}{\rho}}, \qquad \gamma \geq 0, \quad \rho \geq -1, \quad 0 \leq \delta \leq 1 \qquad (1a)$$

where V, K, and L represent output, capital and labor respectively. In the form (1a) the production function exhibits homogeneity of degree one, i.e., it possesses constant returns to scale[3]. The technical characteristics of the production function are reflected in the constants, γ, ρ, and δ which can be interpreted as the efficiency, substitution and distribution parameters, respectively. A substantial advantage in using the CES function is that, as developed below, the estimation of the elasticity of substitution does not require capital stock data. Unfortunately, without such information the efficiency and distribution parameters cannot be estimated.

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[1] Two recent, competent and respectable such attempts are: Andrea Maneschi and Egas Moniz Nunes, "Função de Produção Agregada e Progresso Tecnológico na Economia Brasileira", Revista de Teoria e Pesquisa Econômica, Vol. I, São Paulo, 1970, No. 1, pp. 77 sqq., and Antônio Carlos Coelho Campino, Eurico Ueda, and Ivo Tôrres, "Função de Produção paro o Setor Industrial Brasileiro", ibid., pp. 93 sqq.
The basic Cobb-Douglas production function is written as: $V = AK^{\alpha}L^{\beta}$
where V represents output, A is a constant greater than zero, and α and β are constants each greater than zero but less than one and whose sum equals one. For statistical estimation it is easily transformed into the log linear form:
$\log V = \log A + \alpha \log K + \beta \log L$.

[2] The CES production function is generally attributed to K.J. Arrow, H.B. Chenery, B.S. Minhas, and R.M. Solow, "Capital-Labor Substitution and Economic Efficiency", The Review of Economics and Statistics, Vol. XLIII, Cambridge, Mass., 1961, pp. 225 sqq.

[3] The constant returns to scale assumption can be relaxed by rewriting the production function as:

$$V = \gamma \left[\delta K^{-\rho} + (1-\delta) L^{-\rho}\right]^{-\frac{\upsilon}{\rho}} \qquad \upsilon \neq 0. \qquad (1b)$$

When $\upsilon > 1$, there are increasing returns to scale; conversely, when $\upsilon < 1$, the production function exhibits decreasing returns to scale. For the development of this production function see Murray Brown and John S. De Cani, "Technological Change and the Distribution of Income", International Economic Review, Vol. IV, Osaka, 1963, pp. 289 sqq.

Taking the partial derivatives of the CES function expressed in (1a), we can write the marginal productivities for capital and labor as:

$$\frac{\partial V}{\partial K} = \frac{\delta}{\gamma^{\rho}} \left(\frac{V}{K}\right)^{\rho+1} \tag{2}$$

$$\frac{\partial V}{\partial L} = \frac{1-\delta}{\gamma^{\rho}} \left(\frac{V}{L}\right)^{\rho+1} \tag{3}$$

The marginal rate of technical substitution (MRTS) of capital for labor, the ratio of the marginal products, is written as:

$$\text{MRTS} = \frac{\partial V/\partial L}{\partial V/\partial K} = \frac{\frac{1-\delta}{\gamma^{\rho}} \left(\frac{V}{L}\right)^{\rho+1}}{\frac{\delta}{\gamma^{\rho}} \left(\frac{V}{K}\right)^{\rho+1}} = \frac{1-\delta}{\delta} \left(\frac{K}{L}\right)^{\rho+1} \tag{4}$$

Transforming (4) into logarithmic terms, we have:

$$\log \text{MRTS} = \log \frac{1-\delta}{\delta} + (\rho+1) \log \left(\frac{K}{L}\right) \tag{5}$$

Where the constant $(\rho+1)$ can be interpreted as the reciprocal of the elasticity of substitution (σ), as can be seen in:

$$\sigma = \frac{d \log \left(\frac{K}{L}\right)}{d \log \text{MRTS}} = \frac{1}{\rho+1} \tag{6}$$

Assuming competitive product and factor markets, along with profit-maximizing behavior on the part of producers, an industry will employ labor and capital such that the MRTS is equated to the prevailing factor price ratio $\frac{w}{r}$. Substituting $\frac{w}{r}$ into (5) and rearranging terms we have:

$$\log \left(\frac{K}{L}\right) = -\left(\frac{1}{\rho+1}\right) \log \left(\frac{1-\delta}{\delta}\right) + \left(\frac{1}{\rho+1}\right) \log \frac{w}{r} \tag{7}$$

Where, as stated in (6), $\frac{1}{\rho+1} = \sigma$. Also on the assumption that the wage rate paid equals the marginal product of labor, w can be substituted for $\frac{\partial V}{\partial L}$ in (3). Taking logarithms and rearranging terms in the resulting expression, we can write:

$$\log \left(\frac{V}{L}\right) = -\left(\frac{1}{\rho+1}\right) \log \left(\frac{1-\delta}{\gamma^{\rho}}\right) + \left(\frac{1}{\rho+1}\right) \log w \tag{8a}$$

or

$$\log \left(\frac{V}{L}\right) = \log a + b \log w \tag{8b}$$

where $\log a = -\left(\frac{1}{\rho+1}\right) \log \frac{1-\delta}{\gamma^{\rho}}$ and $b = \frac{1}{\rho+1} = \sigma$

Although the interpretation of b in (8b) as the elasticity of substitution σ has been questioned (mainly because of the constant returns and marginality conditions assumptions)[1]; it is the form used in our study. In addition, in our case, the fitting of regression equation (8b) can also be considered as alternatives for fitting (7). The use of value added per employee $\left(\frac{V}{L}\right)$ as a proxy for capital intensity $\left(\frac{K}{L}\right)$ has recently become common practice[2]. In addition, the assumption is made that r is constant across states (but not necessarily across industries). Thus, the changes in $\frac{w}{r}$ occur only through wages (w) which vary widely across states.

Fitting Brazilian cross-sectional data to the CES production function may have some distinct advantages over other existing estimations of CES functions. A difficulty with international comparisons, i.e., cross-section estimates over countries, is that the definitions may not be consistent. Also, unlike the international comparisons, a Brazilian cross-section across states offers no problem of biases introduced by exchange rate distortions. In addition to a common currency in Brazil, a common market for products exists, i.e., commodity prices are essentially the same throughout the country. Such conditions do not exist for an international cross-section and may introduce important biases into the analysis.

Problems such as those described above are non-existent for studies within one country, but, on the other hand, such studies generally show little variation in wages. As a result, the regression estimates suffer from imprecision. in Brazil, however, such uniformity in wages is not apparent. The labor market is far from being integrated on a national basis, and wages vary greatly from area to area[3]. Another advantage, as referred to above, is that the Brazilian capital market, such as it is, is fairly well integrated nationally. For the period in question, credit policies of the Banco do Brasil and other important lending institutions applied fairly evenly throughout the country[4] - despite great differences in the cost of borrowing between industries.

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[1] See, for example, Daniel R. Fusfeld's review of Stephen P. Sobotka with the Collab. of Thomas A. Domencich, Profile of Michigan - Economic Trends and Paradoxes, London, 1963, reviewed in: The American Economic Review, Vol. LIV, 1964, pp. 442 sqq.

[2] See Hal B. Lary, Imports of Manufactures from Less Developed Countries, National Bureau of Economic Research, Studies in International Economic Relations, New York, London, 1968.

[3] For example, the minimum wage in 1971 for Guanabara was nearly 50 percent higher than that for Piauí.

[4] As described below, the period of analysis for the production function estimation is 1959. This was before the substantial fiscal incentives for investment in the Northwest and North - which served to create regional differences in the cost of borrowing.

IV. Results of Empirical Analysis

The basic methodology employed involves the fitting of (8b) above to data for some twenty-two Brazilian two digit industries by ordinary least squares. A cross-section over twenty-five states and territories is used. Owing the difficulties in comparability in industrial output time series, no longitudinal analysis was attempted. The primary data source was the 1960 Industrial Census, actually carried out for 1959[1].

The results of fitting (8b) to the data are shown in Table 1. The estimates of the elasticities of substitution σ range from .44 (textiles) to 2.67 (plastics). With the single exception of the pharmaceutical industry, all the regression coefficients were statistically significant at the 5 percent level. For the 22 industries for which data were fitted, the estimated elasticities of substitution were less than .8 for 5 industries (22.7 percent), between .8 and 1.1 for 12 industries (54.5 percent), and greater than 1.1 for 5 industries. For total manufacturing industry the elasticity of substitution (estimated across states) was 1.0.

It had been hypothesized that the elasticities of substitution estimated for different industries would be negatively associated with their capital intensity. In other words, it was hypothesized that the possibilities of factor substitution would be more limited for the more capital intensive industries. Although it cannot be rejected, the results of Table 1 do not lend support for this hypothesis. The Spearman rank correlation coefficient between σ_i and an industry's proxy for capital intensity - value added per employee, or $\left(\frac{V}{L}\right)_i$ - was estimated to be + .25.

An additional hypothesis was that an industry's elasticity of substitution would be negatively correlated with the percentage share of foreign ownership - the rationale being that foreign firms have a tendency to utilize processes employed in the home country regardless of relative factor prices. The estimated σ_i's were not negatively correlated with the percentage share of an industry's output produced by foreign subsidiaries; the estimated Spearman rank coefficient was +.28[2].

Because of the restrictive assumptions in our approach and the levels of aggregation, no great precision can be attributed to the σ_i's estimated in Table 1. Nevertheless, the evidence suggests that the latitude for possible factor substitution is wider than some writers would have us believe. The relatively high degrees of substitutibility displayed in our results may be in part due to aggregation and to the existence of more than one process in production, as noted in the model presented in Section II. Our results suggest that to dismiss relative factor prices as unimportant in determining factor employment in the Brazilian industrial sector is incorrect. For the manufacturing sector as a whole, substantial flexibility is indicated; in fact, the use of a Cobb-Douglas aggregate production function may be conceptually acceptable.

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[1] At the time of this writing (July 1972) the 1970 Industrial Census was not yet available.

[2] Estimates related to foreign ownership were taken from Frederick Z. Jaspersen, Foreign Investment in Brazil, Paper Prep. for the Agency for International Development, Washington, D.C., 1970. Mimeogr.

V. Factor Market Distortions

It is possible to interpret the elasticity of substitution as a demand price factor elasticity. Following the argument presented in an article by Minasian[1], under certain assumptions[2], the demand curve for labor can be written as:

$$\frac{L}{V} = A\,w^{n} \qquad (9)$$

where as before L, V, and w represent the quantity of labor employed, value added and the wage rate. A is a constant, and n represents the elasticity of demand for labor with respect to its price. By manipulating (9) and putting it into logarithmic form, we can obtain:

$$\log \frac{V}{L} = -\log A - n \log w \qquad (10)$$

which, when compared with (8b), demonstrates that b(or σ) = -n. Hence, our estimates of elasticities of substitution for different industries can be utilized to approximate the employment effects of policies affecting wages and distortions in the factor markets. With an estimate of the magnitude of the distortions in the Brazilian labor market, we could estimate the employment generated through their removal. We now turn to the question of factor market distortions.

No quantitative estimates for capital market distortions were possible because of data limitations[3]. As mentioned above, it is our belief that until recently the magnitude of the distortions within a given industry did not vary appreciably across states. However, the distortions differ widely across industries owing to the preferential emphasis given some activities through explicit policy incentives to promote such activities. We feel that the distortions by industry have been positively correlated with capital intensity.

Labor market distortions have been measured as those apparent in the market for unskilled labor. The distortion per unskilled worker is taken to be the difference between the minimum wage (w_m) and the opportunity cost (w^*), or shadow price, for unskilled labor. We have used Cline's estimates of the marginal product of labor in agriculture for southern Brazil to estimate the shadow price of unskilled labor[4]. The

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1 Jora R. Minasian, "Elasticities of Substitution and Constant-Output Demand Curves for Labor", The Journal of Political Economy, Vol. LXIX, Chicago, Ill., 1961, pp. 261 sqq.

2 The assumptions include constant output, equality of final product prices and material input prices over states, fixed input coefficients for materials, and a constant price of capital.

3 Conceptually, distortions in the capital market can be examined through a comparison of the real effective rate of interest paid by an industry and the opportunity cost of capital, i.e., its shadow price. It also should be noted that with the existence of inflation resultant, negative real interest rates, the capital market distortions have often been of considerable magnitude.

4 William R. Cline, "Preço de Sombra de Mão-de-Obra no Brasil: Estimativas Preliminares", Paper Prep. for IPEA (Instituto de Pesquisa Econômica Aplicada), Ministry of Planning, 1970. Using a Cobb-Douglas type function, Cline estimated that the marginal product of labor in southern agriculture was equal to .781 of the wage for hired agricultural labor.

labor market distortions, so considered, can be viewed in two ways. First, for an idea of the quantitative magnitude of the labor market distortion for an industry expressed as a percentage of output, we can estimate $\frac{{}_uL_i\left(w_m - w^*\right)}{Q_i}$, where Q_i and ${}_uL_i$ represent value of output and the number of unskilled workers employed, respectively. The latter variable is taken as those employees earning no more than 27 percent more than the minimum wage in 1968[1]. The magnitude of the distortion, thus quantified and seen in Table 2, ranged from a low of .37 percent of the value of output for chemicals to a high of 5.09 percent for lumber and wood products.

For our purposes, a more relevent measure of the labor market distortion relates the distortion per unskilled worker $\left(w_m - w^*\right)$ to an industry's average wages ($\bar{w}_i$). It is written as $\frac{w_m - w^*}{\bar{w}_i}$ and serves as a measure of the distortion expressed as a percentage of average wages. Since average wages are used in the estimation, those industries employing a more skilled labor force can be seen to be less affected by the distortion. The elimination of the labor market distortion for an industry would be tantamount to a fall in wages of the amount $\frac{w_m - w^*}{\bar{w}_i}$. From this point, given our derived estimates of the price elasticity of the demand for labor (n), it is a simple matter to make a lower bound estimate of the changes in employment resulting from an elimination of the labor market distortion. The results for 1968 are shown in Table 2. As seen, the resultant employment generation in manufacturing would be of the magnitude of some 232,000 workers. Such an increase in employment would represent an increase of 11.4 percent in total manufacturing employment and a rise of 23.6 percent in the employment of unskilled workers in manufacturing. The greatest absolute increase in employment would occur in the food and kindred products industry, where nearly 43,000 additional workers would be employed.

Some additional qualifications to our partial equilibrium analysis are in order. It should be noted that total manufacturing output is assumed constant for the analysis. The estimated employment generation is of a one shot nature. On the other hand, the elimination of the distortion in unskilled wages would certainly affect the longer-run growth of the economy, allowing for the development of an industrial structure more consistent with Brazil's international comparative advantage[2].

Secondly, it should also be noted that our analysis has ignored the distortions in the capital market, as well as any other labor market distortions not included in the measurement above. Omission of the capital market from the analysis, necessitated by data limitations, understates the employment generation brought by removing factor market distortions. The elimination of policy-induced capital market distortions would also have the effect of increasing employment. The relatively high elasticities of substitution shown in Table 1 suggest substantial effects on employment.

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[1] Workers receiving up to NCr $ 157.50 monthly in 1968 were included as unskilled labor. In monthly terms, the average minimum wage for São Paulo and Guanabara in 1968 was NCr $ 123.45 (about US $ 35), while the opportunity cost of labor was estimated to be NCr $ 59.99.

[2] For a discussion of the basis for Brazil's comparative advantage in manufactures see: William G. Tyler, "Trade in Manufactures and Labor Skill Content: The Brazilian Case", Economia Internazionale, Vol. XXV, Genova, 1972, No. 2, pp. 314 sqq.

Depending upon the magnitude of the capital market distortions, it is quite possible that the elimination of such distortions would have an even greater employment effect than the removal of the labor market distortions. What is not altogether clear, however, is how the elimination of the capital market distortions would affect long-run investment in the Brazilian industrial sector.

It should not be concluded from the foregoing analysis that the minimum wage legislation should be repealed, allowing wages for unskilled labor to fall. Other considerations merit attention such as the distributional effects and the impact on the demand profile. Indeed, a policy of wage subsidization (i. e., the implementation of a shadow pricing policy) by the government may be preferable to an outright elimination or reduction of the minimum wage[1]. Furthermore, since we have been forced to ignore the capital market distortions, it is improper to discuss policy implications solely on the basis of eliminating labor market distortions.

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[1] This is not to say that the fiscal cost of such a subsidy would not be considerable. For 1968, the subsidy would have cost approximately US $ 280.4 million - or about 1.67 percent of the value of total manufacturing output. To the extent that the financing of the wage subsidy was attained either through the existing regressive tax system or deficit financing, the distributive effects are doubtful. Furthermore, if the elasticity of substitution for all manufacturing equals one (as estimated in Table 1), any subsidization of unskilled labor financed through regressive means would aggravate distributional inequality.

Table 1 - Cross-Sectional Estimates of the Elasticity of Substitution for 22 Brazilian Industries

	Elasticity of Substitution[a] b	r^2	N
Mineral extraction	.96 (5.40)	.56	23
Non-metallic minerals	1.07 (7.08)	.67	25
Metallurgy	.79 (5.92)	.62	22
Machinery	1.55 (5.46)	.64	17
Electrical & communications equipment	1.06 (2.50)	.32	12
Transportation equipment	.73 (3.80)	.39	22
Lumber and wood	.92 (5.90)	.60	24
Furniture	.89 (7.81)	.73	23
Paper and allied products	1.56 (5.81)	.66	18
Rubber	1.09 (2.21)	.18	19
Leather	.66 (3.96)	.42	21
Chemicals	.87 (2.25)	.16	22
Pharmaceutical products	.77 (1.46)	.07	17
Perfumes, soaps and kindred products	.98 (5.66)	.60	22
Plastics	2.67 (2.90)	.51	8
Textiles	.44 (2.40)	.19	21
Apparel and shoes	1.08 (3.42)	.32	24
Food and kindred products	.80 (4.74)	.47	25
Beverages	1.36 (9.65)	.80	24
Tobacco	1.43 (10.80)	.87	18
Printing	1.01 (5.94)	.60	24
Miscellaneous	.87 (8.54)	.77	22
Total manufacturing industry	1.00 (6.89)	.66	25

[a]The t-values appear below the regression coefficients. With the single exception of pharmaceutical products, all of the regression coefficients were statistically significant at the 5 percent level of confidence.

Table 2 - Estimates of Brazilian Manufacturing Employment Generation through the Elimination of Labor Market Distortions, 1968 estimates

Industry	Total Employment L_i	Employment of Unskilled Labor ${}_uL_i$	$\frac{{}_uL_i(w_m - w^*)}{Q_i}$ (%)	$\frac{w_m - w^*}{\bar{w}_i}$	$\Delta {}_uL_i / {}_uL_i = n\left(\frac{w_m - w^*}{\bar{w}_i}\right)$	Increase in Employment
Non-metallic minerals	146, 970	102, 851	3.16	.289	.309	31, 781
Metallurgy	233, 533	71, 125	.93	.195	.154	10, 960
Machinery	103, 617	20, 610	.64	.170	.263	5, 427
Electrical & communications equipment	114, 787	31, 073	.75	.180	.191	6, 067
Transportation equipment	150, 607	23, 982	.37	.148	.108	2, 585
Lumber and wood	84, 700	73, 931	5.09	.391	.360	26, 593
Furniture	58, 122	29, 240	2.67	.288	.256	7, 483
Paper and allied products	54, 145	18, 418	.96	.223	.348	6, 409
Rubber	29, 359	10, 208	.67	.190	.207	2, 112
Leather	23, 780	15, 602	2.65	.295	.195	3, 036
Chemicals	104, 252	31, 907	.37	.155	.135	4, 301
Pharmaceutical products	35, 803	8, 784	.44	.128	.099	867
Perfumes, soaps and kindred products	15, 946	7, 976	.75	.184	.180	1, 438
Plastics	30, 291	13, 540	1.31	.249	.665	9, 005
Textiles	308, 345	196, 047	2.43	.301	.132	25, 937
Apparel and shoes	109, 389	75, 509	3.50	.330	.357	26, 919
Food and kindred products	239, 867	174, 976	1.30	.306	.245	42, 799
Beverages	48, 548	18, 063	1.22	.232	.316	5, 699
Tobacco	16, 628	5, 129	.63	.227	.324	1, 661
Printing	74, 528	23, 186	1.42	.184	.186	4, 303
Miscellaneous	43, 102	29, 872	3.12	.241	.210	6, 264
Total	2, 026, 320	982, 029				231, 643

Note: Notation and calculations are explained in the text.

Source: Data sources include information contained in the Anuário Estatístico do Brasil, Rio de Janeiro, Vol. XXX, 1969 and data kindly supplied by Dr. Rudolf Wuensche of the Instituto Brasileiro de Geografia e Estatística, Rio de Janeiro, to whom the author is grateful for both the data and advice.

Figure 1