AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON, D. C. 20523
BIBLIOGRAPHIC INPUT SHEET

FOR AID USE ONLY
Batch 65

1. SUBJECT CLASSIFICATION
A. PRIMARY
TEMPORARY
B. SECONDARY

2. TITLE AND SUBTITLE
The effects of distortions in the factor market,some general equilibrium estimates

3. AUTHOR(S)
DeMelo,Jaime

4. DOCUMENT DATE
1976

5. NUMBER OF PAGES
31p.

6. ARC NUMBER
ARC

7. REFERENCE ORGANIZATION NAME AND ADDRESS
AID/PPC/PDA

8. SUPPLEMENTARY NOTES (*Sponsoring Organization, Publishers, Availability*)
(In AID discussion paper no.34)

9. ABSTRACT
(ECONOMICS R&D)

10. CONTROL NUMBER
PN-AAE-099

11. PRICE OF DOCUMENT

12. DESCRIPTORS

13. PROJECT NUMBER

14. CONTRACT NUMBER
AID/PPC/PDA

15. TYPE OF DOCUMENT

AID 590-1 (4-74)

AID/PRC/PDA PN-AAE-099

THE EFFECTS OF DISTORTIONS IN THE FACTOR MARKET: SOME GENERAL EQUILIBRIUM ESTIMATES*

by

JAIME DE MELO

Agency for International Development
Bureau for Program and Policy Coordination

July 1976

*I am much indebted to Bela Balassa, Michael Crosswell, Constantine Michalopoulos, and Sherman Robinson for valuable advice and guidance; to Martha de Melo, Danny Leipziger, and James Mudge for comments on an earlier draft; and to Devorah Miller for able research assistance. I take full responsibility for any remaining errors, and the views expressed in the paper are mine and are not intended as statements of Agency policy. Finally, I would like to thank members of the A.I.D. Computer Center, particularly Lee White, for their unfailing cooperation.

TABLE OF CONTENTS

		Page
I.	Introduction	1
II.	Framework	3
III.	The Data Requirements For the Colombian Experiments	7
IV.	The Empirical Results	10
V.	Conclusions	22
VI.	Appendix	24
	References	27

THE EFFECTS OF DISTORTIONS IN THE FACTOR MARKET: SOME GENERAL EQUILIBRIUM ESTIMATES

I. INTRODUCTION

For a perfectly competitive economy with no monopoly power in trade, laissez-faire is Pareto optimal as the economy will operate with technical efficiency (i.e., it will be on the "best" transformation surface). Under these circumstances, the first order conditions for an economic maximum will hold for any pair of commodities: DRT=FRT=DRS (where DRT represents the marginal rate of transformation in domestic production, FRT represents the marginal foreign rate of transformation and DRS represents the marginal rate of substitution in consumption). Until recently, economists have usually assumed that rates of return to each factor are equalized across occupations so that the allocation of resources is technically efficient, and they have concentrated on the effects of monopoly power and distortions in product markets (FRT$\neq$ DRT=DRS). However, during the last two decades several studies have investigated the welfare effects of distortions in the factor market.[1/] These studies, usually conducted within the context of a two factor, two commodity model, have shown that distortions in the factor

---

1/ Among others, the following papers examine the welfare effects of distortions (including distortions in the factor market) and the policies that should be applied to increase welfare: Fishlow and David (1961), Bhagwati and Ramaswami (1963), Johnson (1966), Bhagwati (1971), Herberg and Kemp (1971). An excellent survey of the literature is given in Magee (1973).

market lead to a loss of economic efficiency (because the community's output is inside the non-distorted transformation curve), and that the "first best" policy to correct factor market distortions is a tax-cum-subsidy policy on factor use. Some of these analyses have also emphasized the theoretical possibility that factor market distortions may lead to physical and/or value factor intensity reversals, thereby causing a breakdown of the Samuelson factor price equalization theorem.

In general, these studies deal exclusively with the theoretical aspects of distortions. On the empirical side, it is often asserted that the established equilibria are close to a Pareto optimum and welfare losses are of a second order of magnitude. Only a few studies have attempted to estimate the magnitude of these welfare losses caused by distortions in the factor market. These estimates have usually measured losses from monopoly power in trade and product price distortions (See summary by Leibenstein, 1966). For developing countries, Harberger (1959) estimated that the total cost of product and factor market distortions in the Chilean economy could sum up to fifteen percent of GNP. Balassa (1971) and Bergsman (1975), using a modified but similar methodology, found that for a sample of developing countries the static costs of factor misallocation did not exceed 2.4% of GNP.

Two recent studies by Dougherty and Selowsky (1972) (hereafter referred to as D-S) on Colombia and Floystad (1975) on Norway have attempted to measure explicitly the production costs of imperfections in the factor market in the form of wage differentials across sectors.

Their methodology consists of specifying sectoral production functions for primary factors for a number of sectors and solving the supply side of the system under different assumptions keeping product and factor prices fixed. The fixed-price assumption implies either that the economy is small and completely open (without non-traded goods) or that sectoral output changes are sufficiently small so as to leave relative product prices unchanged. The authors' estimates of the cost of factor market distortions are obtained by comparing actual observed sectoral outputs with those obtained under the optimal solution when the selected factors of production get equal returns across sectors.

The purpose of this paper is: (1) to go beyond this methodology by presenting a computable wage and price endogenous (WPE) general equilibrium model of resource allocation where both product and factor prices are allowed to adjust to changes in factor market distortions and; (2) to present some results for Colombia which may be compared to those by D-S. The remainder of this paper is organized as follows: section II presents the basic framework of the model specified in the appendix; section III outlines the data requirements; section IV reports the empirical results; and finally section V contains some concluding remarks.

II. FRAMEWORK

This section describes briefly the approach used to study the effects of factor market distortions on welfare and economic structure.

An important feature of the model is that it determines wages and prices endogenously. Johansen (1964) formulated the first empirical price-endogenous model. His model and that of Taylor-Black (1974) were linear in growth rates, and so could be solved as a set of simultaneous linear equations. The Walrasian approach, which is used here, involves directly solving for a set of market clearing prices and wages for a specified market behavior.

Before focussing on factor markets, the demand and supply sides of the economy will be presented briefly; the reader is referred to the appendix for a summary description of the complete model in equation form. Goods are classified into two categories: non-traded goods, whose prices are endogenously determined, and competitively traded goods. Goods which are imported but not processed domestically are lumped into a non-competitive import sector. Prices for traded goods are determined in world markets.[2/] There is one consumer who maximizes a Stone-Geary utility function yielding the linear expenditure system to represent private final demand. Investment and government demand are exogenously determined and fixed in base year prices. In this model,

---

2/ There is one sector (coffee), however, which faces a quota on the world market. For that sector the export tax varies so as to insure that coffee producers supply the quantity fixed by their quota share in world supply. Although the model was originally designed to include both factor and product market distortions, this paper will be restricted to estimating the effects of removing the differentials in factor markets leaving product market distortions at their existing levels. See de Melo (1975) for a discussion of the welfare effects of these distortions and a full description of the model. See Adelman-Robinson (1975) for a comparison of the programming and Walrasian approaches to specify price endogenous models.

all wages and prices (with the exception of those fixed by the small country assumption) are endogenously determined along with sectoral factor stocks and all quantities produced and traded.

On the supply side, producers maximize profits. A dual technological structure is specified: intermediate inputs enter in fixed proportions, but primary factors respond to changes in factor prices. Primary factors include capital and two types of labor employed by all sectors, and land which is used in the agricultural sectors only. Technology is described by two kinds of production functions: Cobb-Douglas and two-level C.E.S. Their equations are given in the appendix along with the respective factor demand equations.

Decreasing returns to scale are assumed for traded sectors. The economic justification for rising supply costs in import substitution industries follows Ifzal's (1975) study of import substitution in India. Owing to the high level of aggregation common in multi-sector models, sectoral production functions are used as proxies for all industries included in a sector, thereby losing information about the relative comparative advantage of industries within the sector. Defining, for each of these industries, their average cost as the domestic factor cost needed to save one unit of foreign exchange, one can derive the sector's stepped supply curve by ranking industries according to their cost.[3/] Taking a concrete example, the cost of replacing a dollar's

---

3/ This argument is also followed by Chenery-Raduchel (1971, p. 34) although they introduced the assumption of rising supply costs on the demand side. See their import demand function (2.8).

worth of, say, metal products varies according to the particular commodity produced. An expansion (contraction) involves moving up (down) the steps on the curve to a successively higher (lower) cost industry. Ifzal (1975) has derived the relation between cost, efficiency, and output using a neo-classical production function. On the export side, it is argued that increasing exports involve market development (or transport) costs. This assumption helps overcoming the specialization problem found in general equilibrium analysis when there are more product prices fixed through trade than variable factor prices.[4/]

Finally, two alternative assumptions are made with respect to factor mobility: (1) sectoral capital stocks remain fixed; and (2) all factors of production with the exception of land are mobile across sectors. This completes the description of the demand and supply sides of the model.

Two types of factor price differentials can be distinguished. First, factor prices may be the same in all industries but a differential may exist between real factor rewards and their marginal products in one or more industries. Second, real factor rewards may equal their respective marginal products in each industry but there may be a differential between the price of an identical factor in different industries. The differentials incorporated in the model presented here reflect the latter.[5/]

4/ See Samuelson (1953). Virtually all multi-sector trade models assume decreasing returns to scale or fix quantities traded.

5/ See Magee (1973, p. 2) for a list of causes which might give rise to this kind of differential. In his review, Magee distinguishes between distortions and differentials. For the purpose of this empirical analysis, both terms will be used interchangeably. See Bhagwati (1971) for a discussion of endogenous, autonomous, and policy imposed differentials.

In addition to the differential wage rates across sectors (eqs. 3 in the appendix), it is assumed that the differential wage per factor between the agricultural sectors and the rest of the economy remains fixed at its existing ratio in the base period (eqs. 4). In segmented dualistic economies such as Colombia, it is justifiable to assume that the dual wage structure between rural and urban sectors would persist after a removal of distortions in the urban sector. Therefore, although migration in response to increased demand pressures is incorporated in the model, the rural sector is not directly affected by a change in urban wages in urban wages so that the empirical estimates reported below are more directly comparable to previous ones, yet more comprehensive because a general equilibrium model is used.

The empirical experiments reported below consist of removing the differentials observed in the labor market by equalizing the wage rates for skilled and unskilled labor in the urban sectors while maintaining a constant rural-urban wage differential.[6/]

III. THE DATA REQUIREMENTS FOR THE COLOMBIAN EXPERIMENTS

The experiments with the model are based on Colombian data for 1969. Of the 15 sectors included in the model and described in Table 1, sectors 1 to 11 are classified as tradeable and sectors 12 to 15 as non-tradeable. This choice of aggregation was dictated by the input-output

---

6/ Because of the distortions remaining in the capital market these experiments may not necessarily increase welfare.

information available for Colombia which does not distinguish between commerce, professional services, and artisans. Unlike the above mentioned studies, this model covers the whole economy, thereby including the agricultural sector which is disaggregated further into coffee and into other agriculture to take into account the fact that Colombia has a quota for coffee exports determined by the International Coffee Agreement.

Although this study follows a similar strategy concerning the valuation and treatment of wage differentials, the level of factor market aggregation is different in that it is more detailed than Floystad who only considers one category of labor, and less detailed than D-S who distinguish between seven skill classes of labor (but no capital since it is fixed) ranked according to educational levels. Here again the available data did not allow for a greater level of skill differentiation at this level of disaggregation. A brief discussion of the essential data requirements is reported in the appendix. It is important to note that with the introduction of factor wage differentials and the determination of the constants in the production functions (see appendix), the model reproduces the base year. Therefore it becomes possible to compare the actual allocations of resources with those which would prevail in the absence of factor market distortions.

Table 1 describes the return to labor and capital in Colombia in 1969 along with the sectoral breakdown of the economy. The sign entered next to sector names indicates whether that sector is a net exporter (+) or a net importer (-) Multiplying column 2 by column 1 would yield sectoral value added in thousands of current 1969 pesos. The rate of return to capital shown in column 3 differs greatly across sectors ranging from 7.6% in agriculture to 45.6% in light domestic industries.

Table I

ACTUAL WAGES AND EMPLOYMENT OF CAPITAL AND LABOR BY SECTOR, 1964

SECTOR	Gross Output Thousands of Pesos	Value-added (%)	Return on Capital (%)	Unskilled Wage: Pesos Per Man Year	Skilled Wage: Pesos Per Man Year	Capital Stocks Thousands of Pesos	Unskilled Labor Thousand Man Years	Skilled Labor Thousand Man Years
Coffee (+)	548.6	97.2	08.0	370	1,080	1,206.1	470.0	32.1
Agriculture (+)	2,963.6	84.2	07.6	410	1,210	7,477.8	1,979.1	132.7
Food, Beverage, Tobaco (+)	1,403.4	32.1	24.9	1,850	3,730	1,092.7	42.5	14.5
Textiles and Apparel (+)	817.8	46.4	16.1	1,660	3,460	1,078.1	73.9	13.1
Paper, Wood, Leather (-)	310.2	41.2	15.9	1,850	4,160	380.8	18.6	4.7
Rubber and Chemicals (-)	662.5	63.1	30.1	2,660	6,070	823.2	20.8	12.1
Metals and Products (-)	443.4	37.0	14.7	1,820	3,460	552.3	25.1	5.9
NonMetallic Products (+)	196.8	50.2	09.4	1,660	3,230	422.2	21.6	4.1
Mining and Petroleum (+)	482.4	63.2	12.8	800	4,440	1,349.9	76.3	2.4
Machinery (-)	218.0	59.9	22.7	2,560	4,780	252.5	14.1	5.0
Diverse Industries (-)	241.2	57.4	22.3	1,980	3,010	282.7	22.2	5.7
Light Domestic Ind.	507.6	54.9	45.6	3,920	7,100	400.4	13.6	5.9
Construction	1,113.0	67.5	08.4	1,470	15,750	2,014.9	318.5	7.2
Transport and Commun.	1,166.6	71.4	13.1	1,320	15,020	3,261.6	217.6	8.0
Services and Artisans	3,749.4	91.4	18.0	570	3,360	7,313.1	1,884.5	306.1
Column	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)

This set of figures is probably the most unreliable among the data presented in this table, since it is derived from the shaky estimates of capital stocks in column 6 and the exponents in the sectoral production functions. Columns 4 and 5 show the average wage per worker per year for unskilled and skilled labor. As expected, the nominal wages per worker are well below average for agriculture and coffee sectors where there must be a fair amount of payment in kind not captured in these figures, which, however, do attempt to correct for imputed income to non-paid workers. For the service and artisan sectors, which also indicate wages below the economy average, (640 pesos per unskilled worker, 3,000 pesos per skilled worker and 15.1% for the average return to capital) this may be expected since there is no unionization or foreign ownership which would tend to raise wage rates.

IV. THE EMPIRICAL RESULTS

Because it is difficult to have confidence in the estimates of distortions in the capital market, the experiments will be limited to removing distortions in the labor market, except for the rural-urban differential. Therefore, when capital mobility is allowed, it is assumed that the structure of differential rates of return across sectors reflects differences in risk or that they are temporary and due to adjustment costs. On the other hand, when capital stocks are fixed, it is assumed that the capital stock in each industry is exogenously given to the industry because investment decisions are made by the planning authorities. This means that the sectoral rates of return to capital are calculated from the equations determining the sectoral demands for capital (eq. 4 and 4' in the appendix). Therefore, in common with the

other studies, no attempt is made at removing distortions in the shares of wages and capital income.

While the model outlined in section II is capable of portraying a number of clearing principles for labor markets and for commodity markets, as well as a wide range of experiments, only a few experiments relating to the removal of differentials in the labor market are reported here. Following is the list of experiments:

A-1	Remove differentials in the unskilled labor market keeping capital stocks fixed.
A-2	Remove differentials in the skilled labor market keeping capital stocks fixed.
A-3	Remove differentials in both labor markets keeping capital stocks fixed.
B-1	Same as A-1 but, in addition, allow capital to be mobile across sectors.
B-2	Same as A-2 but, in addition, allow capital stocks to be mobile across sectors.
B-3	Same as A-3 but, in addition, allow capital stocks to be mobile across sectors.

Removing distortions in the urban sector is accomplished by setting all the differentials ($d_k^i = 1$, $i = 3 \ldots 15$ in eq. 3) equal to unity, recalculating the differentials for the agricultural sectors so as to maintain a constant rural-urban wage differential, and solving the model under the new market structure.

1) Welfare Effects

Table 2 summarizes the results of these experiments and provides comprehensive estimates of the welfare gains from removing

distortions in the labor market. These estimates differ from those offered so far in the literature in several respects. First, they are estimated in a general equilibrium framework where the presence of substitution in both demand and supply allows for an interaction between tastes and technology so that for commodities whose prices are not determined in world markets, a change in production cost will affect quantities supplied which in turn leads to a price adjustment to clear those markets. As will soon become evident, the price adjustments neglected by Floystad and D-S are likely to be significant (at least in Colombia). Second, and perhaps more important, these estimates are undertaken in a framework which recognizes that factor market distortions not only affect production, but also trade and therefore comparative advantage. With quantities traded endogenously determined, the model takes into account this important effect of factor market distortions, and as a by-product, the exchange rate adjustment required to maintain balance-of-payments equilibrium emerges from the solution of the model.

Before discussing the results in Table 2 it is useful to recall that these estimates, in common with others presented so far, refer not only to distortions which have normative or welfare implications but also to differentials reflecting age and education among workers, regional differences due to geographic concentration of low wage low skill industries, or efficiency differentials between sectors. Thus, as Magee points out, a differential is a necessary but not a sufficient condition for a distortion.[7/] Although the terms differentials and distortions

---

7/ See Magee (1973, p. 2). It is surprising that the other empirical studies do not indicate the possibility that their measures may include differentials which are not a source of welfare distortion.

Table 2

EFFECTS OF REMOVING URBAN LABOUR MARKET DISTORTIONS
(all figures represent % changes)

Experiment	A-1	A-2	A-3	B-1	B-2	B-3
Welfare	1.0	0.2	1.3	0.6	0.8	1.3
GNP[1]	2.4	0.0	2.7	7.8	2.5	10.7
GNP[2]	3.9	0.0	5.7	9.2	2.8	13.3
Average unskilled wage	35.4	2.7	34.6	37.6	1.7	37.0
Average urban wage	-0.5	-0.3	-0.1	1.1	0.0	1.4
Average skilled wage	9.5	36.4	44.0	12.7	39.4	52.8
Average urban wage	6.2	1.8	7.8	9.6	4.1	13.8
Rate of return to capital	0.4	0.0	0.4	3.9	0.0	3.6
Exchange rate	-5.7	+1.0	-5.5	-5.7	0.0	-6.0
Devaluation (+)						
Coffee tax[3] rate (%)	38.4	44.4	38.6	40.6	43.4	39.9

Wage rates are per worker.
1. GNP valued using current prices as weights.
2. GNP valued using base prices as weights.
3. The coffee tax rate is 44% prior to removal of distortions.

are used interchangeably, one should be aware of the potential range of effects captured by these measures.

Because exogenous demand which includes investment (which equals savings ex post) remains fixed, the welfare effects of a removal of distortions are measured by the utility indicator. This is so because the total economic loss from factor market distortions can only be evaluated by taking into account, in addition to the inefficiency of production, the distortion of consumer choices due to the factor market distortion in producing a divergence of private from social opportunity costs in consumption.[8] The results in row one indicate that the welfare gains from removing the differentials are quite sensitive to both the assumptions concerning capital mobility and the factor market(s) in which the distortions are removed. Understandably, the welfare gains are larger if the differentials are removed in both labor markets; they are relatively smaller when distortions are removed in the skilled labor market. It is notable that fixing the rural urban factor wage differential has an important effect on the welfare gains resulting from a removal of distortions in the unskilled labor market. When capital stocks are fixed, there is no rising supply price of capital from agriculture to industry, which exerts a dampening effect on the welfare gains.

Rows 2 and 3 present estimates of the costs of labor market distortions in terms of GNP, valued both at base prices and at current prices. By inspecting these two sets of GNP estimates, one can get an estimate of the importance of the index number problem in assessing the performance of partial equilibrium estimates which assume that prices remain fixed.

---

[8] Johnson (1966 p. 697).

The range of estimates is understandably quite large, as the efficiency gains from an elimination of wage differentials are influenced by the magnitude of these differentials. It is interesting to note that the efficiency gains in case A-3 show an increase in GNP of 5.7% valued at base prices. This gain is well above the estimates of D-S who note that "...the insensitivity of the level of output to the allocation of labor implies that the static first order conditions are of little relevance."9/ With an elasticity of substitution of 1.1 between different types of labor, they find that output would only rise by 0.48%. Although their experiments refer to an earlier year, and although it is likely that their estimates are lower partly because they have a greater number of factors of production resulting in employment changes tending to offset one another, it is likely that the difference in magnitudes between the two sets of estimates is due to the differences in methodologies and to the fact that these estimates allow for a migration of factors outside of agriculture while theirs do not.

Because the general equilibrium model describing the economy can only determine relative prices, one can impose some normalization rule on wages and prices. In comparing relative prices, it is convenient to maintain a constant price level, thereby implying that monetary authorities control the money supply during the resource shifts between sectors. This rule is followed in the price normalization equation (6) in the appendix.

9/ Dougherty and Selowsky (1972, p. 389).

It is notable that the GNP measures are quite sensitive to the choice of weights. However, the difference in the estimates is mainly accounted for by the required variation in the coffee tax rate (bottom row of Table 2) to maintain the quota share in the world markets. It can be seen that the divergence between the two measures is usually greater, the higher the domestic price for coffee (i.e. the lower the tax rate).

Turning to labor markets, Table 2 indicates that the removal of distortions in Labor markets would benefit rural labor whose wage rates would be bid up by the migration out of agriculture. Because the urban sector is more skill intensive than agriculture, the skilled urban wage would in all instances increase more than the unskilled urban wage rate. Therefore, if in fact there is a rising supply price to hired labor out of agriculture, a removal of differentials would benefit labor in general, though the gains would essentially accrue to the remaining labor in agriculture. Because distortions are not removed in the capital market, the average rate of return per unit of capital shows little variation.

Finally one can see that the removal of distortions would entail a small revaluation of the peso. The revaluation would be smaller (and in one case would become a devaluation) if capital stocks are fixed, because factor rigidity increases the price adjustment necessary to eliminate excess demands in non-traded sectors. As can be seen from Tables 3, relative prices of non-traded goods do not all change in the same direction, so that it is difficult to predict a priori whether factor immobility will increase the magnitude of the exchange rate adjustment or not. In general, one cannot

say whether there will be a revaluation or a devaluation, since it depends on the magnitude and relative intensity of the distortions in the non-traded sectors.

2) Structural Effects

Table 3 describes the new allocations of factors after a removal of differentials in both labor markets, along with the corresponding changes in outputs and value-added. Two experiments are reported in that table: in case (A-3) capital stocks are fixed while in case (B-3) they are not. Perhaps the first notable feature of the table is that prices do indeed change when distortions are removed. Consider post-distortion sectoral values-added as a percentage of initial values-added in column 1, i.e. case A-3. As shown, they are substantially affected by the removal of wage distortions.[10/] For traded sectors, net prices are mainly affected by the exchange rate adjustment which in this case is a revaluation of 5.7%. However, due to the presence of non-traded goods whose prices are endogenously determined, adjustments in value-added among traded sectors will differ (see net price equations in appendix). For non-traded goods, an increase in the price of inputs raises value-added as is the case for services and

10/ To remedy the fixed net price assumption, Floystad tested his results by choosing different sets of net prices and found that his results were quite sensitive to the selection of net prices. See his tables 7 and 8, p. 211. On this basis, one can conjecture that the results in Table 3 would have been quite different had prices been fixed.

Table 3

Optimal Employment and Output with Capital Stocks Fixed (elasticity of substitution = 1)
(All figures are percentage of Actual Values)

SECTOR	Value-Added		Unskilled Labor		Skilled Labor		Physical Output		Rate of Return on Capital	
	A-3	B-3	A-3	B-3	A-3	B-3	A-3	B-3	A-3	B-3
Coffee	1.035	1.009	1.062	.957	.987	.879	1.019	.904	1.063	.960
Agriculture	.932	.928	.894	.743	.822	.654	.952	.679	.882	.810
Food, Beverage, Tobacco	.897	.875	2.152	1.381	.873	.537	1.124	.632	1.008	.744
Textiles & Apparel	.899	.886	2.215	2.627	.924	1.051	1.282	1.334	.870	1.568
Paper, Wood, Leather	.903	.879	2.530	3.053	1.143	1.323	1.311	1.396	1.189	1.652
Rubber & Chemicals	.910	.902	3.630	5.713	1.662	2.508	1.297	1.814	1.179	2.104
Metals & Products	.911	.889	2.434	2.846	.927	1.040	1.270	1.322	1.156	1.545
Nonmetallic Products	.890	.880	2.258	2.766	.881	1.035	1.322	1.409	.859	1.668
Mining & Petroleum	.959	.941	.855	.539	.955	.577	.968	.570	.922	.631
Machinery	.918	.907	4.592	16.263	1.717	5.829	1.688	5.358	1.546	6.252
Diverse Industries	.904	.894	2.837	6.553	.866	1.333	1.369	1.942	1.242	2.272
Light Domestic Ind.	.459	.729	2.297	3.053	.943	1.235	1.163	.851	.533	1.151
Construction	.564	.613	1.302	1.323	2.706	2.538	1.371	.875	.774	1.331
Transport & Commun.	.599	.751	1.071	1.253	2.329	2.521	1.157	.902	.695	1.171
Services & Artisans	1.338	1.286	.833	.854	.980	.953	.938	1.168	1.256	.996

artisans, a sector whose wages are below average (see Table 1). The results in Case A-3 show that equating wages to their respective marginal products would result in substantial output gains in the industrial sector. These gains would be mainly at the expense of agriculture and services and artisans which show a decline in output of 4.8% and 6.2% respectively.

The changes in the rate of return to capital are an indicator of the resource pull on capital. Those sectors whose rate of return increase most would draw capital in from those sectors whose rate of return decline most.

Case B-3 indicates the effects of relaxing the fixed capital stock assumption. Compared with Case A-3, sectoral contractions and expansions are generally more pronounced when capital stocks can be relocated among sectors. This, however, is not always the case since the relative factor intensity of expanding and contracting sectors affects the rate of return to capital which in turn determines the allocation of capital between sectors. Moreover, in the case of non-traded goods, the price adjustment is dampened by increased factor mobility (e.g. the net price of services increases by 28.6% instead of 33.8%). This price adjustment is dampened because increased factor mobility reduces excess demand (supply) which in turn reduces the price adjustment necessary to eliminate that excess demand.

Maintaining a constant rural urban wage differential for all factors precludes factor migration in response to a change in wage structure between rural and urban areas following the removal of differentials. Yet, both cases indicate a migration of factors towards the urban sector. The explanation

for this result is to be found in the adjustment of the relative prices of non-traded goods. This change in relative prices alters the consumption pattern which provokes a migration of factors out of agriculture.

Another interesting adjustment is captured by the model: in case A-3 coffee output shows 4% decline while in case B-3 coffee output increases by 1.9%. Yet, in both instances quantities exported are the same. This different output adjustment is due to the deliveries from the coffee sector to the food industries which expand when capital stocks are fixed but contract when they are not.

This last point illustrates some of the important adjustment mechanisms captured by a general equilibrium analysis which insures consistency between aggregate supply and aggregate demand. The results in Table 3 show that there are substantial interactions between the agricultural and urban sectors. While this analysis does not provide a detailed treatment of the linkages between agricultural and non-agricultural sectors, as a resource allocation model portraying a dualistic economy, it attempts to incorporate some of the likely interactions between the rural and urban sectors. In addition, the results in Table 3 indicate that the assumption of fixed prices found in other empirical estimates of distortions in factor markets is likely to seriously underestimate the reallocation of factors brought about by a removal of factor market distortions.

TABLE 4

Optimal Employment, Capital and Output with Capital Stocks Shiftable Between Sectors Under Alternative Magnitudes of the Elasticity of Substitution Between Aggregated Labor and Aggregated Capital
(All figures are percent of actual values)

SECTOR	Unskilled Labor			Skilled Labor			Capital Stock			Physical Output		
	σ_i=0.5	σ_i =1.0	σ_i =1.5	σ_i =0.5	σ_i =1.0	σ_i =1.5	σ_i =0.5	σ_i =1.0	σ_i =1.5	σ_i =0.5	σ_i =1.0	σ_i =1.5
Coffee	.965	.957	.945	.899	.879	.846	.874	.904	.925	.958	.960	.958
Agriculture	.840	.743	.682	.752	.654	.557	706	.679	.682	.858	.810	.768
Food, Beverage, Tobaco	1.212	1.381	1.524	.478	.537	.580	.665	.632	.570	.736	.744	.729
Textiles & Apparel	2.366	2.627	2.885	.960	1.051	1.129	1.465	1.334	1.172	1.555	1.566	1.567
Paper, Wood, Leather	2.608	3.053	3.484	1.146	1.323	1.476	1.491	1.396	1.241	1.586	1.652	1.686
Rubber & Chemicals	3.670	5.713	8.328	1.635	2.508	3.576	1.622	1.814	1.835	1.701	2.104	2.475
Metals & Products	2.429	2.846	3.247	.901	1.040	1.161	1.394	1.322	1.189	1.480	1.545	1.576
Nonmetallic Products	2.713	2.766	2.865	1.030	1.035	1.049	1.663	1.409	1.184	1.758	1.668	1.605
Mining & Petroleum	.550	.539	.508	.958	.577	.532	.552	.570	.574	.624	.631	.626
Machinery	11.231	16.253	22.451	4.087	5.829	7.876	5.211	5.358	5.054	5.138	6.252	7.400
Diverse Industries	3.817	4.553	5.325	1.134	1.333	1.525	2.063	1.942	1.740	2.144	2.272	2.371
Light Domestic Ind.	2.451	3.053	3.461	1.015	1.235	1.327	.947	.851	.789	1.111	1.151	1.185
Construction	1.256	1.323	1.360	2.485	2.538	2.559	.992	.875	.823	1.305	1.331	1.352
Transport & Commun.	1.120	1.253	1.326	2.316	2.521	2.628	.965	.902	.869	1.134	1.171	1.199
Services & Artisans	.874	.854	.833	.999	.953	.905	1.056	1.168	1.273	.977	.996	1.012
								Welfare (%)		.8	1.3	1.7

The effects of systematic variations in the elasticity of substitution between capital and labor on resource allocation are indicated in Table 4. Raising the elasticity of substitution decreases the rate of change of the marginal product of labor or capital when it is added to or withdrawn from a sector and therefore the greater the gain from reallocating capital and labor between sectors.[11/] Raising the elasticity of substitution between capital and labor increases the migration of labor out of agriculture. It is notable that the expansion and contraction of sectors are not always a monotonous function of the elasticity of substitution. For example, physical output in textiles and apparel, food beverages and tobacco, and mining increases when the elasticity of substitution is raised from 0.5 to 1.0 and subsequently decreases as the elasticity of substitution is further increased to 1.5. With the exception of these sectors, the other urban sectors increase their output when factor substitution is eased.

V. CONCLUSIONS

This paper has presented a general equilibrium WPE model with an empirical application to analyze the effects of factor market distortions on welfare and economic structure. The model has been specified to incorporate the lifferential wage structures specified in the theoretical analyses of factor market distortions.

11/ The percentage gains in terms of utility and GNP are roughly equivalent to those reported by D-S in their appendix (p. 390).

The empirical application of the model to Colombia has been constrainted by data availability. At the level of aggregation specified in the study it was only possible to obtain data on labor broken down into two skill categories. Therefore, the results are somewhat tentative, and more definite statements about the static costs of the misallocation of labour should await more work with labor disaggregated into further skill classes.

However, the results in this paper indicate that the efficiency gains from removing distortions in the labor market are likely to be significant, at least for developing countries such as Colombia. Previous estimates of the effects of these distortions using a simpler methodology concluded that the gains from removing such distortions were likely to be of a second order of magnitude. It appears that the low magnitude of the efficiency gains were due to the methdology and the assumptions in these studies resulting in fixed product and factor prices. Therefore, until further empirical estimates become available, one should not rely upon the inferences drawn from abstract two-commodity, two-factor models (Fishlow and David 1961, Johnson 1966) suggesting that factor price distortions lead to little loss in economic efficiency; neither should one rely on empirical estimates based on a partial equilibrium analysis neglecting wage and price adjustments caused by a removal of factor price distortions.

APPENDIX

To facilitate expositon, the following notation is adopted throughout: Greek letters and lower case Roman letters refer to exogenous parameters whose values are given to the model; upper case Roman letters refer to endogenous variables, but upper case Roman letters with a bar are used for exogenous variables. There are $n=q_1 + q_2$ goods produced in the economy; q_1 of these goods are traded; the remainder q_2 are classified as non-traded: Non-competitive imports are lumped into a sector,o. Superscripts are used to distinguish between the initial distorted situation (zero) and any other situation (one). To save space only the Cobb-Douglas version is reported in the model summary. The corresponding equations for the two-level C.E.S specification are based on Sato (1967). In this case, to ensure that the same output levels be obtained with an identical set of sectoral factor stocks, it is necessary to recalculate aggregate (capital and labor) as well as individual factor shares. The equations, as well as the solution techniques applied to this system of non-linear equations, may be found in de Melo (1975).

Note that, although not explicitly incorporated, ad valorem tariffs and subsidies separate domestic prices from world prices. Domestic prices equal world prices times one plus the ad valorem tariff times the exchange rate R which is determined through the normalization equation (eq.6) so as to maintain the balance of payments in equilibrium. The price normalization equation (6) determines a price level such that base year GNP valued at current prices remains constant. Finally the difference between government expenditures and tax revenues is covered by direct taxes which do not appear explicitly in the model.

MODEL SUMMARY

	Production Functions	Number of Equations
(1)	$X_i = A_i \prod_\lambda R_{\lambda i}^{\alpha_{\lambda i}}$; $i = 1 \ldots n$, $\lambda = 1 \ldots s$	n
(1')	$X_i = A_i \left[\gamma_i \; K_i^{-\rho_i} + (1-\gamma_i) \; L_i^{-\rho_i} \right]^{-V_i/\rho_i}$	
	Factor Demand Equations	
(2)	$P_i^* \dfrac{\partial X}{\partial R_{\lambda i}} = W_\lambda$	n·s
	Factor Differential Equations	
(3)	$W_{\lambda i} = d_{\lambda i} \hat{W}_\lambda$	s
	Rural-Urban Wage Differential	
(4)	$\theta_\lambda^1 = \theta_\lambda^o$	s

where $\theta_\lambda = \dfrac{\sum_h w_{\lambda h} R_{\lambda h} \sum_J R_{\lambda j}}{\sum_j W_{\lambda j} R_{\lambda j} \sum_h R_{\lambda h}}$; $h = 1,2$, $j = h+1 \ldots n$

	Net Price Equations:	
(5)	$P_i^* = P_i - \sum_j a_{ji} P_j - a_{oi} P_o$	n
	Price Normalization Equation:	
(6)	$\sum_i P_i^{*1} X_i^o = \sum_i P_i^{*o} X_i^o$	1
	Consumption Equations:	
(7)	$C_i P_i = P_i \delta_i + \gamma_i \; (Y - \sum_j P_j \delta_j)$	n-1

where $Y = \sum_i C_i P_i$

	Resource Constraints:	
(8)	$\sum_i R_{\lambda i} = \bar{R}_\lambda$	s
	Flow Balance Equations	
(9)	$X_i - T_i - \sum_i a_{ji} X_i - a_{oi} X_i = C_i + Z_i$; $T_i = o$ for $i > q_1$	n
(10)	$\sum_k \pi_k T_k - \pi_o \sum_i a_{oi} X_i = \Delta$; $k = 1 \ldots q_1$	1

LIST OF VARIABLES AND PARAMETERS

X_i, C_i, $\overline{Z}_i$	Gross output, private consumption and exogenous demand (Government demand + investment demand + depreciation) in sector i.
$R_{\lambda i}$	Use of primary factor λ. Estimates of sectoral capital stocks are from Berry (1974)
$\hat{W}_\lambda$	Average wage of primary factor λ .
P_i, P_i^*	Domestic and net price (inclusive of tariffs and subsidies) of sector i.
T_k	Quantity traded (competitively) of sector k (> o for exports) T_1 fixed by quota export coffee tax.
$\alpha_{\lambda i}$	The exponent for factor λ in sector i . The exponent for capital, α_{ki}, is derived residually, i.e., $\alpha_{ki} = V_i - \sum_{\lambda \neq k} \alpha_{\lambda i}$
V_i	Returns to scale in sector i : $V_{1 \ldots k} = .9$; $V_{k+1 \ldots n} = 1$
a_{ij}, a_{oi}	Physical input-output coefficient and non-competitive import of sector i.
$\overline{A}_i$	Normalizing constant (shift parameter) defining units of measurement for sector i; calculated from eq. 1 using base year values.
Δ	Trade gap measured at world prices.
γ_i, δ_i	Marginal expenditure share and subsistence minimum for sector i. These were obtained from Howe (1974).
$d_{\lambda i}$	Differential wage scale parameter for primary factor R_λ. These parameters are the weights definining the average wage $\hat{W}$ in the base period so that $\sum_i d_{\lambda i}(R_{\lambda i}/\overline{R}_\lambda) = 1$
Y	Total private expenditures.
Π_k	World price of commodities produced by sector k; $k=1 \ldots q_1$
θ_λ	Ratio of the wage of factor λ in agricultrue to the wage of factor λ in the urban sector.

REFERENCES

Adelman, I. and S. Robinson, "A Wage and Price Endogenous Model for Planning Incme Distribution Policy", Princeton: Econometric Research Program Research Memorandum No. 183, 1975

Balassa, B. and Associates, The Structure of Protection in Developing Countries, Johns Hopkins Press, Baltimore, 1971

Bergsman, J. "Commercial Policy, Allocative Efficiency and 'X-Efficiency" Quarterly Journal of Economics, 1975

Berry, R., "A Descriptive History of Colombian Industrial Development in the Twentieth Century", (mimeo) IBRD, 1974

Bhagwati, J., "The Generalized Theory of Distortions and Welfare", in Trade, Balance of Payments and Growth. Papers in International Economics in Honor of C. Kindleberger, J. Bhagwati, R. Jones, R. Mundell and J. Vanek (eds.) Amsterdam: North-Holland, 1971.

Bhagwati, J. and V. Ramaswani, "Domestic Distortions, Tariffs and the Theory of Optimum Subsidy", Journal of Political Economy , 1963

Chenery, H. and W. Raduchel, "Substitution in Planning Models" in H.B. Chenery (ed.) Studies in Development Planning, Harvard, 1971

de Melo, J., "A Multi-Sector, Price Endogenous Trade Model Applied to Colombia", unpublished Ph.D. thesis, John Hopkins University, 1975

Dougherty, C. and M. Selowsky, "Measuring the Effects of the Misallocation of Labour", The Review of Economics and Statistics, 1972

Fishlow, A. and P. David, "Optimal Resource Allocation in an Imperfect Market Setting", Journal of Political Economy, 1961

Floystad, G., "Distortions in the Factor Market: An Empirical Investigation", The Review of Economics and Statistics, 1975

Harberger, A., "Using the Resources at Hand More Effectively", American Economic Review, 1959

Herberg, H. and M. Kemp, "Factor Market Distortions, the Shape of the Locus of Competitive Outputs, and the Relation between Product Prices and Equilibrum Output", in Trade, Balance of Payments and Growth, Papers in International Economics in Honor of Kindleberger, J. Bhagwati, R. Jones R. Mundell, J. Vanek (eds.), Amsterdam, North-Holland, 1971

Howe, H. "Estimtion of the Linear and Quadratic Expemditure Systems: A Cross-section case of Colombia" Unpublished PhD. thesis; Pennsylvania University, 1974

Ifzal, A., "Incorporation of the Stepped Supply Function in General Equilibrium Modèl", (mimeo) Johns Hopkins University, 1975

Johansen, L., A Multi-Sectoral Study of Economic Growth, North-Holland Amsterdam, 1960

Johnson, H., "Factor Market Distortions and the Slope of the Transformation Curve", Econometrica, 1966

Leibenstein, H., "Allocative Efficiency vs. 'X-Efficiency,'," American Economic Review, 1966

Magee, J., "Factor Market Distiontions, Production and Trade: A Survey", Oxford Economic Papers, 1973

Samuelson, P., "Prices of Factors and Goods in General Equilibrium," The Review of Economic Studies, 1953

Sato, K., "A Two-level Constant Elasticity of Substitution Production Function, Review of Economic Studies, 1967

Taylor, L. and S. Black, "Practical General Equilibrium Estimation of Resource Pulls Under Trade Liberalization," Journal of International Economics, 1974