Open economies review 6: 265–280 (1995)

Free Trade and Income Redistribution in Some Developing and Newly Industrialized Countries

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Key words: free trade, income distribution, developing countries

Abstract

A competitive general equilibrium model of production is specified and the long-run comparative static elasticities of changing prices on factor prices are examined in eight developing and newly industrialized countries. Unskilled labor in these developing countries stands to gain from a program of global free trade characterized by increased manufacturing exports and falling prices of imported business services, while capital owners and skilled labor lose. Results are contrasted with developed countries, the United States in particular, where unskilled labor will lose while capital and skilled labor enjoy gains with global free trade.

Liberalized international trade is widely applauded because of its potential to increase global efficiency. Since the conception of the science, economics has consistently stressed the overall gains that come from free trade. An underlying theme in factor proportions trade theory, however, is that the owners of some productive factors may lose real income with trade liberalization. As an economy reorganizes along its production frontier to face international prices, income is redistributed among the factors of production, generally away from factors that are expensive and scarce relative to trading partners.

This paper examines the long-run factoral income redistribution due to an hypothesized program of global free trade in eight developing and newly industrialized countries, and contrasts outcomes with the United States. The specification technique utilizes the factor proportions general equilibrium model of production and trade. Constant elasticity production functions with constant returns to scale are specified using factor shares and industry shares from national income data. This paper is primarily an exercise in developing quantitative properties of the general equilibrium model of production and trade by specifying a range of instances of comparative static elasticities.

The countries examined are quite different, ranging from newly industrialized exporters of manufactures (Korea, Mexico, Taiwan) to intermediate economies (Argentina, Turkey, Venezuela) to developing countries which generally import manufactures (Bolivia, Ecuador). Nevertheless, each of these countries has an

abundance of unskilled labor relative to the developed countries and a comparative advantage in the production of manufactured goods that are intensive in unskilled labor.

The global trade liberalization considered in this paper consists of two parts: lower protection on manufactured imports in the developed countries and lower protection on business services in the developing countries. Business services include telecommunications, finance, banking, insurance, construction, management, consulting, and so on. It is fair to say that the negotiations under GATT are leading the world economy toward this global trade liberalization. Lower protection of manufactures in the developed countries will lead to increased exports of manufactures from the developing countries.

As a typical developing economy responds to the opening world markets for manufactures, production of manufactured goods increases. The developing economy shifts its resources toward the production of manufactures. The price of manufactures increases in the developing countries when the tariff wedge is removed. In the program of trade liberalization, the developing countries are hypothesized to simultaneously open their markets to imports of business services, leading to increased imports and a fall in the local price. These service industries are often state owned in developing countries, providing inefficient and high-priced services. For developing countries, trade liberalization often means opening the domestic business service industry to international competition.

Agriculture is treated as a separate sector in the present model specification. The pattern of trade in various categories of agricultural products varies across countries, as shown by Leamer (1984). It is not clear how to characterize the move toward global free trade by a change in aggregate agricultural prices. At any rate, nations remain reluctant to open their agricultural sectors to international competition. In the hypothesized program of liberalized trade, agricultural prices are left unchanged.

The technique in this paper produces elasticities of factor prices with respect to prices of goods for any factors and goods that can be separated in national income data. This specification technique could be applied in greater detail to an individual country to provide more information on the income redistribution due to a particular program of trade liberalization, protection, or tax policy. The potential exists to build high dimensional models with many sectors and many factors, including land and natural resources. There is U.S. data for numerous industries in manufacturing and various skill groups of labor. Assuming a given constant elasticity of substitution in production, specification of the model requires only national income data.

The specified model has three factors of production (skilled labor, unskilled labor, capital) and three sectors (agriculture, manufacturing, services). With trade liberalization, the model predicts unskilled labor in the developing countries will generally enjoy large gains while skilled labor and capital will lose to a lesser extent. In developed countries such as the United States unskilled labor faces relatively large losses while skilled labor and capital enjoy gains. These results are anticipated by the Stolper-Samuelson theorem with two factors and two goods:

relatively abundant factors gain from free trade, while relatively scarce factors lose. The trade literature, however, develops many conditions under which the Stolper-Samuelson theorem is relaxed. The present paper makes the assumptions of perfect competition:

1. Cost minimization
2. Competitive pricing
3. Full employment
4. Perfectly inelastic factor supplies
5. Constant returns to scale
6. Homogeneous goods
7. Interindustry trade

Even with these competitive assumptions, the Stolper-Samuelson theorem is relaxed when there are as few as three productive factors, as explored by Jones and Easton (1983) and Thompson (1985). The observed factor shares and industry shares in these developing countries nevertheless lead to the Stolper-Samuelson conclusion.

1. Deriving factor shares and industry shares

The total payment to each productive factor in each sector is the foundation of this specification. The data in the present study was used by Clark and Thompson (1990) to examine the qualitative influence of international migration and investment on income distribution. The United Nations (1982b, 1987b) reports total employee compensation and net operating surplus, which implicitly includes the payment to capital (K) as proprietor's income, rental income, corporate profit, and net interest. Similar data for Taiwan comes from the Directorate-General of the Budget, Accounting and Statistics (1982).

Payments to skilled and unskilled labor must be separated. The wage of unskilled labor (L) is assumed to be the average wage in the four industries with the lowest wage, as reported by the United Nations (1982a, 1987a). The industries most often appearing with low wages are apparel, furniture, wood, footwear, and leather. Lary (1968) and Ibister (1971) use similar procedures to separate unskilled labor. The International Labor Organization (1980) reports the numbers of unskilled workers by industry. Unskilled labor is assumed to include production workers, operatives, laborers, farm workers, and service workers. The payment to unskilled workers in each country is the average unskilled wage times the number of unskilled workers. Skilled labor (S) includes professionals, technical workers, administrators, managers, clericals, and sales. In more detailed studies, these labor inputs can be disaggregated.

Across these sources, there is a complete set of data for eight developing and newly industrialized countries: Argentina, Bolivia, Mexico, Taiwan, Ecuador, Korea, Turkey, and Venezuela. Table 1 reports the total payment in each country's domestic

currency to each of the three productive factors (S, L, K) in each of three sectors: agriculture (A), manufacturing (M), and services (V). The payment data cannot be compared across countries.

Summing down a column in a factor payment matrix in Table 1 gives the total net output or revenue of that sector. The assumption at work is competitive pricing. The payment to capital, net operating surplus, is assumed to absorb the residual of revenue after skilled labor and unskilled labor are paid. The economy is effectively assumed to be in a long-run competitive equilibrium with a "normal" competitive return to capital. In particular circumstances, this assumption may not hold exactly and the results in this paper would have to be qualified. For instance, in a monopolistic industry an above-normal profit can be earned. While economic surpluses do occur, at the high level of aggregation in this paper the assumption of competitive pricing seems fair. Each country in this study is unique, of course, with its own brand of political economy and blend of market economics and state control. No simple model will capture the intricacies at work in every economy, but the competitive model offers at least a standard or benchmark.

Factor share θ_{ij} in Table 2 represents the share of factor i in the revenue of sector j. For instance, the total revenue of manufacturing in Argentina is 105,452, and labor's share is 34,991/105,452 = .332 = 33.2%. The labor shares θ_{Lj} and skilled labor shares θ_{Kj} are very reliable as reported. Capital is treated as the residual recipient of all income in a sector.

Excess profit would decrease capital's share. In agriculture, landowners may have different interests than owners of agricultural capital machinery and equipment, but these groups are lumped together into capital. In particular country studies, a good deal more could be done to examine the distribution of income across nonlabor factors of production.

Table 1. Factor payments matrices.

	A	M	V	A	M	V
S	1,180	7,167	68,337	65	277	1,621
L	15,676	34,991	9,288	3,208	2,802	5,426
K	38,451	63,294	75,766	9,207	3,142	18,173
		Argentina			Bolivia	
S	270	5,651	24,536	2,000	91,104	195,619
L	6,477	9,220	13,801	47,989	193,597	160,052
K	21,723	21,945	55,727	81,325	160,698	293,432
		Mexico			Taiwan	
S	83	786	13,524	475	7,434	52,270
L	4,079	6,357	7,607	11,339	19,308	18,489
K	33,911	21,016	52,013	38,934	15,903	59,903
		Ecuador			Korea	
S	147	7,552	28,211	1,340	1,785	15,284
L	14,550	46,394	26,041	4,245	7,625	14,685
K	166,914	37,028	177,681	34,857	12,385	38,006
		Turkey			Venezuela	

Table 2. Factor shares θ_{ij}.

	A	M	V	A	M	V
S	.021	.068	.394	.005	.045	.064
L	.283	.332	.169	.257	.450	.215
K	.695	.600	.437	.738	.505	.721
		Argentina			Bolivia	
S	.009	.154	.261	.015	.204	.301
L	.228	.250	.147	.366	.435	.247
K	.763	.596	.592	.619	.361	.452
		Mexico			Taiwan	
S	.002	.028	.185	.008	.231	.339
L	.107	.226	.104	.123	.393	.139
K	.891	.746	.711	.869	.376	.522
		Ecuador			Korea	
S	.001	.083	.122	.033	.082	.225
L	.080	.510	.112	.105	.349	.216
K	.919	.407	.766	.862	.569	.559
		Turkey			Venezuela	

Summing across a row of a factor payment matrix in Table 1 gives the total income of that factor. Assuming intersector factor mobility, the price of a factor will be the same across sectors and the industry shares in Table 3 can be derived. The industry share λ_{ij} of each factor i represents the portion of factor i employed in sector j. For instance, the total income of skilled labor in Venezuela is 18,409, and 15,284/18,409 = .830 = 83.0% of this total income is earned in services. Assuming equal payment to skilled workers across sectors, 83% of the skilled workers in Venezuela would be in the service sector.

Table 3. Industry shares λ_{ij}.

	A	M	V	A	M	V
S	.016	.093	.891	.033	.141	.864
L	.196	.438	.366	.281	.245	.474
K	.217	.356	.427	.302	.103	.595
		Argentina			Bolivia	
S	.009	.185	.806	.007	.316	.677
L	.220	.312	.468	.119	.482	.399
K	.218	.221	.561	.152	.300	.548
		Mexico			Taiwan	
S	.006	.054	.940	.009	.224	.767
L	.226	.352	.422	.174	.453	.373
K	.317	.197	.486	.400	.142	.458
		Ecuador			Korea	
S	.001	.080	.919	.073	.097	.830
L	.083	.510	.407	.160	.287	.553
K	.122	.112	.766	.409	.145	.446
		Turkey			Venezuela	

The assumption of intersector factor mobility is difficult to test, even in developed countries with more complete data. For instance, U.S. Census data could be used to create a table of average wages by sector and by skill category. Civil engineers, for instance, are employed in many manufacturing industries, construction, government services, and so on. To some extent, civil engineers move between sectors, attracted by higher wages. In truth, the assumption of intersector mobility has never been seriously tested. There is likely some variation in the degree of intersector factor mobility across these countries, especially from agriculture. It also seems likely that production labor would be more mobile than skilled labor. Analyzing the situation of perfect intersector factor mobility provides a benchmark for other studies. The model predicts factor price changes assuming free intersector mobility. When factors do not move freely between sectors, the factor price changes would be exaggerated in some sectors and smaller in others. Reported factor price changes are thus a weighted average of factor price changes with limited intersector factor mobility.

2. Differences in factor intensities

Insight is gained from examining factor intensity, a bilateral concept that requires interpretation when there are more than two factors of production or two sectors. In the present model, there are three inputs to rank across three pairs of sectors (A&M, M&V, A&V).

Let a_{hj} represent the cost minimizing unit input of factor h in sector j. For any two sectors m and n and any factor h, denote a_{hm}/a_{hn} by a^h_{mn}. Between sectors A and M, for instance, factors K, L, and S are typically ranked $a^K_{AM} > a^L_{AM} > a^S_{AM}$. Using the terminology of Ruffin (1981), K is the extreme factor in sector A, S is the extreme factor in sector M, and L is the middle factor.

With competitive pricing, $p_j = \Sigma_i w_i a_{ij}$, where p_j is the price of good j and w_i the payment to factor i. The factor share can be written $\theta_{hj} = w_h a_{hj}/p_j$. Output is standardized so one unit of output equals one unit of value in domestic currency. The ratio of factor shares then equals the ratio of unit inputs: $\theta_{hA}/\theta_{hM} = w_h a_{hA}/w_h a_{hM} = a^h_{AM}$.

Table 4 reports the factor intensities across the three pairs of sectors, as derived from the factor shares in Table 2. Generally, skilled labor is the extreme input in services, capital is the extreme input in agriculture, and labor is the extreme input in manufacturing. The same classification of extreme factors is found in the United States. Capital in agriculture implicitly includes land, making agriculture extreme in its input of capital. There is a great deal of variety in production techniques in agriculture, and the present scheme does not separate the techniques very well. If land were excluded from capital, manufacturing would become more capital intensive even in these developing countries.

Each pair of industries has to be evaluated separately. In Ecuador, for instance, capital is the extreme input in agriculture and skilled labor is extreme in manufacturing when comparing those two sectors. Labor is extreme in manufacturing and

Table 4. Factor intensities.

	a^K_{AM}		a^L_{AM}		a^S_{AM}	a^L_{MV}		a^K_{MV}		a^S_{MV}	a^L_{AV}		a^K_{AV}		a^S_{AV}
Argentina	1.16	>	.854	>	.314	1.95	>	1.37	>	.173	1.66	>	1.59	>	.053
Bolivia	1.46	>	.571	>	.111	2.09	>	.701	<	.703	1.20	>	1.02	>	.078
Mexico	1.28	>	.912	>	.059	2.17	>	1.05	>	.151	1.03	<	1.25	>	.011
Taiwan	1.71	>	.839	>	.074	2.83	>	.720	>	.681	.892	<	1.66	>	.024
Ecuador	1.19	>	.473	>	.071	1.76	>	.799	>	.681	1.48	>	1.40	>	.050
Korea	2.31	>	.316	>	.035	4.55	>	.531	<	.686	.714	<	1.20	>	.007
Turkey	2.26	>	.156	>	.010	1.62	>	1.02	>	.364	.486	<	1.54	>	.147
Venezuela	1.51	>	.301	<	.402	1.31	>	1.22	>	.213	5.45	>	.498	>	.117

skilled labor is extreme in services when comparing those two sectors. Finally, labor is extreme in agriculture while skilled labor is extreme in services comparing those two sectors.

Factor proportions trade theory suggests that the relative price of a good can generally be expected to have a positive correlation with the price of the input used most intensively in its production. Lower service prices, for instance, can be expected to lower the payment to its extreme factor, skilled labor. Higher manufacturing prices can generally be expected to raise the wage of unskilled labor.

Global trade liberalization should result in increased export of manufactures from the developing countries as developed countries open their markets to manufactured imports. Developing countries have a comparative advantage in assembly-line manufactures due to their large pool of unskilled workers and low wages. With global free trade, the developed countries will import more manufactures. The level of manufactured exports from the developing countries will rise. New manufacturing industries will appear and existing industries will expand.

Figure 1 depicts the international market for manufactures, with excess demand XD* from the developed countries and excess supply XS from the developing countries. Note that * represents the developed countries. The comparative advantage developing countries have in manufactured goods is illustrated by the autarky price difference: $P_A < P^*_A$. The "no trade" price of manufactures is lower in the developing countries. With free trade, M_2 would be exported from the developing to the developed countries at a world price of P_w. Protection in the developed countries, however, drives a wedge between prices in the two regions: $P < P^*$. Trade is reduced by protection to M_1. Inside the developed countries, protection means higher prices than would occur with free trade, $P^* > P^*_w$, and less imports. Inside the developing countries, this protection by the developed countries means lower prices than would occur with free trade, $P < P^*_w$, and less exports.

The global move toward free trade means a lowering of protection and a reduction in the tariff wedge, $P^* - P$. The international market equilibrium approaches M_2 and P^*_w. The level of international trade in manufactures increases. Prices of manufactures in the developing countries rise from P toward P^*_w, and fall in the developed countries from P^* toward P^*_w.

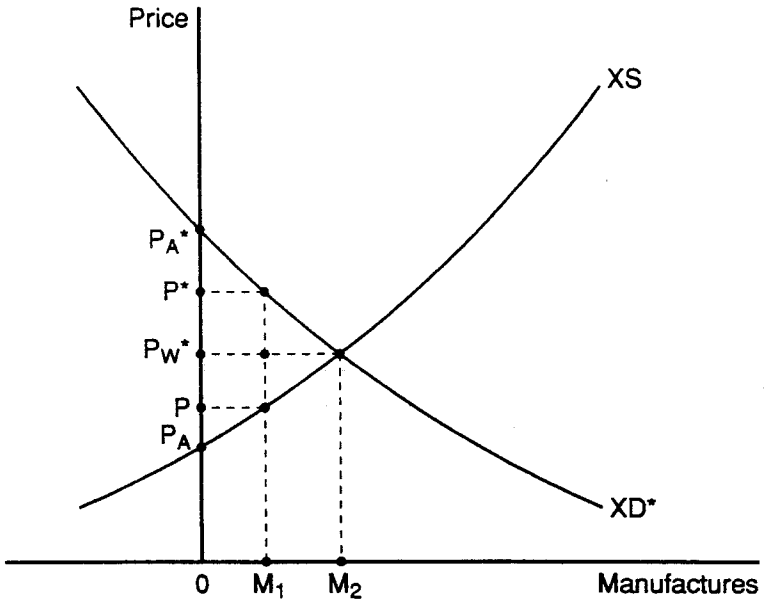

Figure 1.

In the international business services market, lower protection in the developing countries will result in increased international trade in business services, falling prices in the developing countries, and higher prices in the developed countries. The prices of business services inside the developing countries will fall as developed countries expand their communication, management, consulting, and financial services exports into the developing countries.

Korea, Mexico, and Taiwan are newly industrialized countries, already exporting a range of manufactured goods. Bolivia and Ecuador are developing agricultural countries with little industry. Nevertheless, if Europe, Japan, and the United States move to eliminate protection on manufactures, all of the countries in this study should experience an expansion of manufactured production and exports, with the accompanying higher prices. Comparative static elasticities derived in the next section allow analysis of this hypothesized pattern of price changes inside each country.

3. The general equilibrium model of production

The competitive general equilibrium model of production and trade is developed by Jones (1965), Chang (1979), Takayama (1982), and others. Substitution elasticities, which describe the change in the cost-minimizing input of one factor given a change in the price of another, are critical to the comparative statics. Assuming constant elasticity production functions, substitution elasticities can be derived from factor shares and industry shares.

Following Allen (1938), the cross-price elasticity between the input of factor i and the payment to factor k in sector j is written

$$E_{ij}^{k} = \hat{a}_{ij}/\hat{w}_k = \theta_{kj}\, S_{ij}^{k}, \tag{1}$$

where $\hat{}$ represents percentage change in a variable and S_{ij}^{k} is the Allen partial elasticity of substitution from the underlying production function. With Cobb-Douglas production functions, $S_{ij}^{k} = 1$, and with constant elasticity (CES) production, S_{ij}^{k} is constant. Due to homogeneity, $\Sigma_k E_{ij} = 0$, and the own price elasticity E_{ij}^{i} is the negative of the sum of the cross-price elasticities.

The economy's aggregate substitution elasticities are weighted averages of the sectoral cross-price elasticities,

$$\sigma_{ik} \equiv \Sigma_j \lambda_{ij} E_{ij}^{k} = \Sigma_j \lambda_{ij}\, \theta_{kj} S_{ij}^{k} \equiv \hat{a}_i/\hat{w}_k. \tag{2}$$

Factor shares and industry shares can thus be used to derive the aggregate substitution elasticities for each of the developing countries. Table 5 reports substitution for the Cobb-Douglas model where $S_{ij}^{k} = 1$.

Reading down a column in Table 5 indicates the response to a change in the price of that input. A 10% increase in the wage of unskilled labor in Bolivia, for instance, would result in a 2.38% increase in skilled labor input across the economy, a 7.15% decrease in the input of unskilled labor, and a 2.52% increase in the input of capital. All pairs of factors are substitutes because of the assumption of constant elasticity.

Table 5. Aggregate Cobb-Douglas substitution elasticities σ_{ik}.

	$\hat{w}_S$	$\hat{w}_L$	$\hat{w}_K$	$\hat{w}_S$	$\hat{w}_L$	$\hat{w}_K$
$\hat{a}_S$	−.642	.186	.456	−.928	.238	.691
$\hat{a}_L$	.178	−.737	.559	.043	−.715	.672
$\hat{a}_K$	.197	.252	−.449	.044	.252	−.296
		Argentina			Bolivia	
$\hat{a}_S$	−.761	.017	.595	−.731	.307	.424
$\hat{a}_L$	.172	−.803	.631	.221	−.649	.428
$\hat{a}_K$	.182	.187	−.370	.229	.321	−.540
		Mexico			Taiwan	
$\hat{a}_S$	−.825	.111	.714	−.688	.195	.493
$\hat{a}_L$	.088	−.852	.764	.232	−.749	.516
$\hat{a}_K$	.096	.129	−.225	.191	.169	−.360
		Ecuador			Korea	
$\hat{a}_S$	−.887	.196	.691	−.803	.221	.582
$\hat{a}_L$	.081	−.681	.600	.153	−.763	.610
$\hat{a}_K$	.065	.137	−.202	.126	.190	−.316
		Turkey			Venezuela	

Industry in every country is relatively sensitive to the price of capital and more ready to substitute both types of labor for capital than capital for either type of labor. When the price of capital rises, there is a relatively small decrease in the input of capital. Both labor inputs rise by a larger magnitude than the decrease in capital input. There is thus a general ability to substitute labor for capital in these developing countries, due perhaps to a relative abundance of labor. With an increase in the price of one type of labor (skilled or unskilled) there is a relatively large decrease in the input of that type of labor, while the inputs of the other type of labor and capital rise only slightly. There is thus a general inability to substitute capital for either type of labor in these countries.

Full employment and competitive pricing are the structural building blocks of the general equilibrium model of production and trade:

$$\Sigma_j a_{kj} x_j = v_k, \; k = S, L, K, \text{ and} \tag{3}$$

$$\Sigma_i a_{im} w_i = p_m, \; m = A, M, V. \tag{4}$$

The endowment of factor k is represented by v_k. Factor supply is assumed to be perfectly inelastic in the neighborhood of the equilibrium. In particular applications, it would be possible to modify the model by introducing upward sloping factor supply, international factor markets, sector specific inputs, imperfect intersector mobility, and so on. In more detailed studies of particular countries, modifications of the factor supplies would be appropriate. Labor market conditions of course vary across these countries. The assumption of perfectly inelastic factor supply provides a benchmark for further study.

As developed in the literature, for instance in Chang (1979) and Takayama (1982), fully differentiating (3) and (4) leads to

$$\Sigma_i \sigma_{ki} \hat{w}_i + \lambda_{kj} \hat{x}_j = \hat{v}_k, \; k = S, L, K, \text{ and} \tag{5}$$

$$\Sigma_i \theta_{im} \hat{w}_i = \hat{p}_m, \; m = A, M, S. \tag{6}$$

Equation (6) is simplified by the assumption of cost minimization. The six equations in (5) and (6) can be arranged into the system

$$\begin{bmatrix} \sigma & \lambda \\ \theta' & 0 \end{bmatrix} \begin{bmatrix} \hat{w} \\ \hat{x} \end{bmatrix} = \begin{bmatrix} \hat{v} \\ \hat{p} \end{bmatrix} \tag{7}$$

where σ is the country's matrix of substitution elasticities in Table 5, λ is the matrix of industry shares in Table 3, θ is the matrix of factor shares in Table 2, and $\hat{w}$, $\hat{x}$, $\hat{v}$, and $\hat{p}$ are vectors of percentage changes in factor prices, outputs, factor endowments, and prices of goods, respectively.

The 6 × 6 system matrix in (7) relates exogenous percentage changes in factor endowments and prices to endogenous percentage changes in factor prices and outputs. Outputs and factor prices adjust to maintain full employment and competitive pricing in the comparative statics of the general equilibrium.

This study focuses on the $\hat{w}/\hat{p}$ elasticities, which show the general equilibrium effects of changing prices of goods on factor prices. These effects are the same regardless of the degree of the CES production functions.

The model's comparative static $\hat{w}/\hat{p}$ elasticities in Table 6 are found by inverting (7). Reading down a column in Table 6 indicates the effects of a change in a particular price. In Taiwan, for instance, a 2% increase in the price of manufactured goods would raise the wage of skilled labor by 0.60% and the wage of unskilled labor by 8.5%, while the return to capital would fall by 5.02%.

4. Effects of trade liberalization

There are four different sign patterns of comparative static $\hat{w}/\hat{p}$ elasticities, and their magnitudes vary quite a bit across countries. These results depend on the relative magnitudes of the underlying factor shares and industry shares in each country. No single simple explanation isolates the sources of the differences in comparative static elasticities.

Countries are discussed in terms of similar sign patterns, but magnitudes of the elasticities are actually more informative. For instance, $\hat{w}_S/\hat{p}_M$ is positive in Argentina, but more similar in magnitude to the small negative values in Ecuador, Korea, and Turkey than the large positive values in Bolivia and Mexico.

Argentina, Bolivia, Mexico, and Taiwan all have the same qualitative sign pattern of results. A higher price of manufactures in these four countries would raise the wages of both skilled and unskilled labor, with the largest gains going to unskilled labor (especially in Argentina and Mexico). Falling prices of services would

Table 6. $\hat{w}/\hat{p}$ elasticities.

	$\hat{p}_A$	$\hat{p}_M$	$\hat{p}_V$	$\hat{p}_A$	$\hat{p}_M$	$\hat{p}_V$
$\hat{w}_S$	−1.84	0.25	2.59	−16.5	2.03	15.5
$\hat{w}_L$	−8.86	11.3	−1.48	−0.03	3.34	−2.31
$\hat{w}_K$	5.11	−4.63	0.52	1.48	−1.18	0.70
		Argentina			Bolivia	
$\hat{w}_S$	−3.50	1.31	3.19	−2.54	0.30	3.25
$\hat{w}_L$	−3.71	11.1	−6.40	−0.38	4.25	−2.86
$\hat{w}_K$	2.46	−3.33	1.87	1.90	−2.51	1.61
		Mexico			Taiwan	
$\hat{w}_S$	−3.81	−0.76	5.57	−1.78	−0.65	3.43
$\hat{w}_L$	−5.43	7.50	−1.07	−0.08	3.39	−2.20
$\hat{w}_K$	1.79	−0.90	0.11	1.18	−0.47	0.30
		Ecuador			Korea	
$\hat{w}_S$	−7.00	−0.85	8.85	−1.75	−3.08	5.83
$\hat{w}_L$	0.29	2.26	−1.54	−1.98	4.23	−1.25
$\hat{w}_K$	1.07	−0.20	0.13	1.47	−0.40	−0.07
		Turkey			Venezuela	

help labor while hurting skilled labor and capital. The hypothesized program of global trade liberalization in these countries would clearly raise the wage of unskilled labor, while lowering the return to capital, which effectively loses its scarcity rent. The change in the wage of skilled workers would be ambiguous, depending on the sizes of the price changes.

In Ecuador and Korea, qualitative results are similar to those in the first four countries, except that higher manufacture prices would hurt skilled labor. Both skilled labor and capital unambiguously lose under the move to free trade, while unskilled labor clearly gains. In percentage terms, the gains of unskilled labor would be greater than the losses of the other two groups.

In Turkey, the only subsequent change is that higher agricultural prices would help labor. Labor's factor share of income and industry shares in agriculture are smaller in Turkey than in any other country. Note that the aggregate benefit to labor from rising agricultural prices, however, would be small. In the hypothesized move to free trade, skilled labor would lose quite a bit, capital would lose slightly, and labor would gain.

Venezuela has the same sign pattern as Ecuador and Korea except that falling service prices would slightly help capital. It is not clear then in these two countries how the hypothesized move to free trade would affect the return to capital.

Most of the $\hat{w}/\hat{p}$ comparative static elasticities in Table 6 are greater than one in absolute value. The magnification effect of Jones (1965) implies that one elasticity in each column must be greater than one while another elasticity must be negative. Unskilled labor in these countries typically benefits quite a bit from an increase in the price of manufactures. Without exception, lower service prices hurt skilled labor and help unskilled labor.

5. A comparison with the United States

In the hypothesized program of global trade liberalization, the price of manufactures would fall in the industrialized countries as protection for their manufacturing industries is lowered. Simultaneously, the price of business services would rise as demand increases from the developing and newly industrialized countries. If the United States is taken as the typical industrialized country, the results of this section suggest the typical income redistribution in the developed countries.

Data on U.S. capital stocks come from the *Survey of Current Business*. Figures on employment by occupation and industry come from the *Census of Population*. The data is taken for 1980 to be compatible with the other countries. Very little variation occurs over time in factor shares or industry shares at this high level of aggregation.

Factor shares and industry shares for the United States are presented in Table 7. Skilled labor has a larger factor share in every sector in the United States, especially manufacturing, relative to the developing and newly industrializing countries. Capital, on the other hand, has a relatively smaller factor share in every sector in the United States. Comparing industry shares, a smaller percentage of the

Table 7. U.S. factor shares and industry shares.

	A	M	V	A	M	V
S	.170	.430	.576	.012	.135	.853
L	.246	.356	.163	.044	.303	.653
K	.576	.214	.261	.078	.137	.785
		factor shares θ_{ij}			industry shares λ_{ij}	

capital stock is involved in agriculture in the United States relative to the developing countries. A large share of skilled labor is employed in U.S. manufacturing relative to the developing countries. The service sector is relatively large in the United States and employs a large share of every factor. Unfortunately, little effort is spent collecting fundamental production data for services.

Table 8 reports the factor intensity rankings for the United States. Capital is the extreme input in agriculture, skilled labor is the extreme input in services, and labor is the extreme input in manufactures. The United States has the same factor intensity ranking in this model as Mexico, Taiwan, and Turkey, although the magnitudes are different. Comparing agriculture to manufacturing and services, the United States employs much more capital and skilled labor per unit of output. Comparing manufacturing to services, the United States and Taiwan employ more skilled labor than Mexico or Turkey, and the U.S. ranking is most similar to Ecuador's.

The assumption of unit constant elasticity production functions for the three sectors in the United States leads to the aggregate substitution elasticities reported in Table 9. Strengths of substitution differ from those in the developing countries. Industry in the United States is relatively better able to substitute unskilled labor and capital for skilled labor when the skilled wage changes. The cross elasticities in the first column are relatively large, while the own skilled labor elasticity is relatively small. In the last column, notice that U.S. industry is relatively unable to substitute unskilled labor and skilled labor when the price of capital changes.

Industry in the United States is better able to substitute capital for both types of labor than either type of labor for capital, while the opposite is true in the developing countries. The ability of U.S. industry to substitute capital for skilled and unskilled labor may be related to the relative abundance of capital in the United States.

Table 8. U.S. factor intensity.

a^K_{AM}	a^L_{AM}	a^S_{AM}	a^L_{MV}	a^K_{MV}	a^S_{MV}	a^L_{AV}	a^K_{AV}	a^S_{AV}
2.69	> .691	> .625	2.18	> .820	> .747	1.51	> 2.21	> .309

Table 9. U.S. aggregate Cobb-Douglas substitution elasticities σ_{ik}.

	$\hat{w}_S$	$\hat{w}_L$	$\hat{w}_K$
$\hat{a}_S$	−.448	.190	.258
$\hat{a}_L$	.514	−.775	.261
$\hat{a}_K$	.525	.196	−.721

Table 10. U.S. $\hat{w}/\hat{p}$ elasticities.

	$\hat{p}_A$	$\hat{p}_M$	$\hat{p}_V$
$\hat{w}_S$	−0.90	−0.46	2.36
$\hat{w}_L$	−0.17	4.10	−3.24
$\hat{w}_K$	2.09	−1.74	0.66

Likewise, the ability to substitute labor for capital in the developing countries may be related to the relative abundance of unskilled labor.

Table 10 reports the $\hat{w}/\hat{p}$ elasticities for the United States. Falling manufacturing prices coupled with rising service prices will unambiguously benefit skilled labor and capital, and hurt unskilled labor. The effects on unskilled labor are the largest in magnitude. A 2% decrease in the price of manufactures would, for instance, lower unskilled wages in this model by 8.20%. A 2% increase in the price of services would lower unskilled wages by 6.48%.

Leamer (1991) reaches similar conclusions regarding the income redistribution in the United States with a move to free trade. Unskilled labor apparently has a great deal at stake as U.S. policy moves toward liberalized trade. It is worth emphasizing that unskilled labor can lose even though there are global efficiency gains and the economy moves to a higher level of aggregate welfare and income. A main advantage of factor proportions trade theory is that it allows the study of income redistribution and not simply aggregate welfare or income.

6. Conclusion

Neoclassical international trade theory stresses the gains in welfare due to free trade. In factor proportions trade theory, the welfare gains are broken down into factoral income redistribution. The general lesson in this paper is a familiar one, namely that a country's relatively abundant and cheap factors of production will enjoy long-run gains from free trade, while its relatively scarce and expensive factors will lose. This paper takes the extra step of beginning to examine the magnitudes of these long-run changes for skilled labor, unskilled labor, and capital.

Unskilled labor is relatively abundant in developing and newly industrializing countries and relatively scarce in the developed countries, as shown by Leamer (1984). With global free trade, the price of manufactures can be expected to rise inside the developing countries and fall inside the developed countries due to the removal of the tariff wedge between prices across countries. The price of business services can be expected to do the opposite.

The competitive general equilibrium model of this paper predicts that unskilled labor will be a winner in the developing countries and a loser in the developed countries. Skilled labor will lose in the developing countries, but benefit in the developed countries. The model thus suggests that free trade will encourage the international convergence of factor prices.

A word can also be said about technology transfer. Under the assumption of Cobb-Douglas production functions, factor shares are equal to the exponents or technical coefficients for each input. Different factor shares thus indicate different production functions across countries. Technology is generally transferred from developed countries to developing countries. A comparison of factor shares in the United States and the developing countries in this study indicates that skilled labor can be expected to move into a more prominent role in every sector in the developing countries. Capital, on the other hand, will find its share of output declining. While the issue of technology transfer goes well beyond the simple production technique assumed in this study, this insight offers some notion of a broad trend.

The United States will apparently continue its move toward free trade and is adjusting to international competition. Trade unions representing relatively unskilled workers correctly recognize that free trade is not in their own narrow best interest. The wage of unskilled labor in this competitive model is relatively sensitive to the price changes that occur with global free trade. The popular press is full of remarks about the shrinking middle class, labor retrenching, and so on. Adjusting along the production frontier is not an enjoyable process for the owners of the factors used intensively in the shrinking industries. This paper makes the implicit point that the return to acquiring labor skills in the United States is underestimated if the current wage structure is projected for the future.

There is every incentive for governments concerned with international equity and global efficiency to pursue free trade. The fact that developed countries maintain protection on manufactures from the developing countries remains one of the great inequities of our time. This model points out, however, that unskilled labor in the developed countries will lose as international trade liberalizes. Personal income redistribution through taxation promises to become an even more crucial issue in the developed countries as the trend toward free trade continues.

Acknowledgments

Rafael Revveny made many constructive suggestions. The stimulus for this paper came from regular discussions about economic development with Don Street, who recently retired from the Economics Department at Auburn.

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