

**INTERNATIONAL TRADE AND MIGRATION IN THE PRESENCE OF
SECTOR-SPECIFIC LABOR QUALITY PRICING DISTORTIONS**

Harry Huizinga

CentER and Department of Economics
Tilburg University

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Abstract:

In one of two sectors, there are labor quality pricing distortions in the sense that labor obtains the average rather than marginal product. This may be due to a failure on the part of employers to observe individual labor quality or due to an income redistributing union. Relatively low quality workers are in equilibrium employed in the sector characterized by average productivity wage setting. International differences in the quality distributions of the labor force are shown to be a source of comparative advantage and hence a determinant of international trade. The country that imports the good produced by relatively low quality workers may lose from international trade. Immigration by low quality workers may equally lower the welfare of a country's original inhabitants. As a result, a country generally benefits from restricting the immigration of very low quality workers.

1. *Introduction*

This paper examines a simple two sector model of international trade and migration. Labor is the only factor of production. Workers are heterogeneous in their labor quality defined as their effective capacity for work. The two sectors differ in that workers in one sector are paid their marginal product, while workers in the other sector receive their average product regardless of individual worker quality. The latter sector thus is characterized by labor quality spillovers in the pricing of labor. In this setting, national differences in labor quality distributions are a source of comparative advantage and hence a determinant of international trade. A country that is endowed with relatively many high quality workers, for instance, exports the good produced in the sector characterized by marginal productivity wage setting.

A group of workers may be paid their average rather than their individual marginal product for a variety of reason. First, employers may observe only the group's total output without being able to discern the contribution of individual workers to this total product. This may be the case if work is performed by teams of workers rather than simply by individual workers. At the same time, average productivity wage setting may exist where effective monitoring of individual workers is prohibitively costly. Also, workers may effectively be paid their average product on account of union wage setting which implicitly redistributes income from high productivity workers to low productivity workers. The technology of monitoring and the extent of unionization differ across sectors. The relevance of average rather than marginal productivity wage setting thus can also be expected to differ across sectors.

Several authors have examined international trade and migration in the presence of labor market distortions.¹ Brander and Spencer (1988) and Mezzetti and Dinopoulos (1991), among others, consider international goods trade and trade policy in case of a partly unionized international oligopoly. Rivera-Batiz (1981) considers migration into a two-sector national economy characterized by sectoral union wage setting and unemployment.² Staiger (1988) further considers how the presence of a labor union with an exogenous membership in one country affects the pattern of international trade and migration. Apart from their union status, all workers are the same. In Staiger (1988), the partly unionized country is shown to specialize in the production of goods that are relatively labor unintensive. Closest to the present paper perhaps is a contribution by Copeland (1989) on efficiency wages in a Ricardian model of international trade. Copeland in

particular considers how international differences in the monitoring technology or in workers' preferences for leisure determine the pattern of trade. Monitoring is explicitly treated as a separate activity in the extension by Brecher (1992). The present paper differs from earlier contributions in the labor market distortion that is examined. As a result, national distributions of worker qualities play a key role in determining the pattern of production and of international trade.

In the present paper, all workers of a quality below a certain threshold level will be employed in the spillover sector. The labor pricing distortion in the spillover sector leads to an inefficiently low level of output of that sector in autarky. Changes in a country's labor quality distribution affect the sectoral allocation of labor, even if the aggregate effective labor supply is unchanged. International trade generally affects the wages of workers of different quality classes differently. Trade specifically redistributes income towards relatively low quality workers if a country exports the spillover sector good, and vice versa. The country that imports the spillover sector good will reduce its domestic production of this good. As the pre-trade level of production of this good is inefficiently low, free trade may reduce overall welfare.

Free trade equalizes the labor compensation of relatively high quality workers employed in the marginal productivity wage setting sectors. Wages in the two national spillover sectors, however, may not be equalized by international trade. Low quality workers employed in these sectors, therefore, may face an incentive to migrate internationally. The implications of the migration of spillover sector workers for the overall pattern of production and for the wages of original spillover sector workers are somewhat unconventional. The immigration of prospective spillover sector workers may either induce an expansion or a contraction of that sector at given international goods prices. At the same time, such immigration may increase or decrease the real wages of spillover sector workers. Interestingly, immigration may reduce the income of original spillover sector workers by so much that national output at world prices is reduced. Free migration potentially even reduces overall world welfare. Free migration will in fact reduce world welfare if it lowers world supply of the spillover sector at pre-migration world goods prices.

The remainder of the paper is organized as follows. Section 2 outlines the basic model. Section 3 considers how changes in a country's labor quality distribution affect its pattern of production and the wages of all its workers. Section 4 examines the determination of comparative advantage and the pattern of trade. Section 5 analyses free migration. Section 6 concludes.

2. *The model*

These are two countries: home and foreign. Stars denote foreign variables. Homogeneous labor is the only factor of production. Workers differ in the amount of labor they can supply. A worker's quality, denoted a , indicates his effective labor supply. The present model differs in this regard from Findlay and Kierzkowski (1983) who assume that educated and uneducated workers provide intrinsically different kinds of labor. The two countries are symmetric in all respects other than their labor quality distributions. The domestic labor quality variable, a , is distributed on the interval $[\underline{a}, \bar{a}]$ with density $f(a)$, and distribution function $F(a)$. Let μ be the mean domestic worker quality. Each economy's entire effective labor supply is assumed to be unity, which implies that there are $1/\mu$ domestic workers or that $F(\bar{a}) = 1/\mu$. There are two goods, denoted x and y . For simplicity, let us assume that a unit of either good can be produced with a single unit of effective labor. This assumption eliminates any Ricardian reasons for international trade and labor migration. Let p_x be the price of good x in terms of good y . Good y will be taken to be the numeraire good. The two sectors differ in their wage setting conventions. A worker of quality a employed in the x -sector is paid his marginal product, i.e. $p_x a$. Workers employed in the y -sector instead are paid the average y -sector productivity. Specifically, y -sector workers are paid a wage equal to μ_y , where μ_y stands for the average quality of y -sector workers.

Let us assume that the domestic economy does not specialize in production. Let a_c then be the quality of a domestic worker who is indifferent between working in either sector. This implies that,

$$p_x a_c = \mu_y \tag{1}$$

All workers of a quality above (below) a_c choose to work in the x -sector (y -sector). A worker of minimum quality \underline{a} is indifferent between working in either sector from (1) if $p_x = 1$. At the other extreme, a worker of maximum quality \bar{a} is indifferent between working in either sector if $p_x = \mu/\bar{a} < 1$. From (1), we generally see that $p_x = \mu_y/a_c \leq 1$. The sectoral outputs of goods x and y are now given as follows,

$$x = \int_{a_c}^{\bar{a}} a f(a) da \quad (2)$$

$$y = \int_{\underline{a}}^{a_c} a f(a) da \quad (3)$$

In general, there are multiple values of the threshold worker quality level, a_c , and corresponding production levels of x and y , for a given price of good x , p_x . There is a unique threshold quality value, a_c , and thus a unique pattern of production for a given value of p_x , however, if the following condition is satisfied,

$$\frac{da_c}{dp_x} = a_c \left[\frac{a_c - \mu_y}{F(a_c)} f(a_c) - \frac{\mu_y}{a_c} \right] < 0 \quad (4)$$

Equation (4) is equivalent to $a_c f(a_c) / \mu_y F(a_c) < 1 / (a_c - \mu_y)$, which is satisfied if the effective labor offered by marginal workers, $a_c f(a_c)$, relative to the total effective labor of y -sector workers, $\mu_y F(a_c)$, is sufficiently small.

Agents are assumed to have a logarithmic utility specification as follows,

$$U = \alpha \log(x) + (1 - \alpha) \log(y) \quad (5)$$

The general equilibrium in a closed economy can be represented as in Figure 1. The first quadrant graphs the negative relationship between p_x and a_c following the assumption that $da_c / dp_x < 0$ in (4). It indicates that p_x is strictly bounded between μ / \bar{a} and 1, if non-negligible amounts of both goods are produced. The second quadrant links the threshold quality level, a_c , to

the production of good x according to (2). A higher value of a_c implies that fewer workers are employed in the x -sector, and thus that there is a lower x -sector output. The third quadrant simply relates the output of good x to the relative supply of good x , i.e. to $x^s/y^s = x^s/(1 - x^s)$. The fourth quadrant represents the relative supply of good x , x^s/y^s , and the relative demand of good x , x^d/y^d , both as a function of the goods price p_x .³ The equilibrium goods price, denoted p_x' , is indicated by the equality of the relative demand and supply of good x . Both goods are essential and will be produced. The equilibrium price, p_x' , thus lies between μ/\bar{a} and 1. At such an equilibrium price, relative demand (and supply), $x^d/(1 - x^d)$, exceeds $\alpha/(1 - \alpha)$, which is the relative goods demand with $p_x = 1$. The production of good y thus is reduced by the presence of labor quality spillovers in that sector. To correct for this inefficiency, the authorities can institute a y -sector production or wage subsidy combined with an x -sector production or wage tax.⁴

3. *The role of the distribution of individual labor qualities*

In this section, we consider how changes in a country's distribution of labor qualities affect its pattern of production and the wage incomes received by all workers. Specifically, we consider an exogenous change in the labor quality distribution of a small country that takes world goods prices as given. Let all foreign workers in a certain quality bracket migrate to the home country. The variable a^* is taken to be the upper limit of this quality range. The notation da^* then stands for a change in the top limit of the quality bracket of migrating foreign workers.

If $a^* > a_c$, then the immigrants of quality a^* will be employed in the domestic x -sector. In that instance, the production of good x increases, while the production of good y remains unchanged. If instead $a^* < a_c$, then the immigrants will be employed in the domestic y -sector. Such immigration generally changes the sectoral allocation of some original domestic workers. To see how, note that the immigration affects the threshold quality of the two sectors' marginal workers, a_c , as follows,

$$\frac{da_c}{da^*} = - \frac{1}{d(\mu_y/a_c)/da_c} \cdot \frac{a^* - \mu_y}{F(a_c)} \frac{f^*(a^*)}{a_c} \quad (6)$$

where $d(\mu_y/a_c)/da_c = dp_x/da_c < 0$ from (4).

In (6), da_c/da^* has the same sign as $a^* - \mu_y$. This implies that immigration causes some original domestic x-sector workers to take up employment in the y-sector if $a_c > a^* > \mu_y$, and vice versa. In the first instance, the output of good y increases by more than the effective labor supply of the immigrants in a Rybczynski-like fashion. Formally, the changes in sectoral outputs following the immigration of prospective y-sector workers are given by,

$$\frac{dx^s}{da^*} = -a_c f(a_c) \frac{da_c}{da^*} \quad (7)$$

$$\frac{dy^s}{da^*} = a^* f^*(a^*) + a_c f(a_c) \frac{da_c}{da^*} \quad (8)$$

Note that the immigration of foreign workers with $a^* = a_c$ has indeterminate implications for the domestic pattern of production. Such workers may choose to be employed in the x-sector, in which case only the production of only good x increases. Alternatively, they may work in the y-sector, triggering some original x-sector workers to switch to the y-sector, in which case the output of the y-sector (x-sector) increases (decreases).

The implications of the immigration of prospective y-sector workers for individual and national incomes are somewhat unconventional. The immigration of y-sector workers changes the y-sector wage equal to μ_y as follows,

$$\frac{d\mu_y}{da^*} = \frac{a^* - \mu_y}{F(a_c)} f^*(a^*) \left[1 - \frac{a_c - \mu_y}{F(a_c)} \frac{f(a_c)}{a_c} \frac{1}{d(\mu_y/a_c)/da_c} \right] \quad (9)$$

where da_c/da^* has been substituted from (6). With $a_c > a^* > \mu_y$, the immigration y-sector workers and the accompanying increase in the range of original domestic workers employed in the y-sector

both lead to an increase in the mean y-sector worker quality, μ_y . As a result, the wages of all y-sector workers increase. This result is in contrast with the common notion that immigration leads to the crowding out of directly competing original domestic workers and consequently lower real wages for these workers. With $a^* < \mu_y$, however, the immigration of y-sector workers may even reduce the incomes of original y-sector workers by so much that such immigration reduces national income at world prices. To see this, note that the value of national output, I , is affected by the immigration of prospective y-sector workers as follows,

$$\frac{dI}{da^*} = a^* f'(a^*) + (1 - p_x) a_c f'(a_c) \frac{da_c}{da^*} \quad (10)$$

The first term on the right hand side of (10) is the direct, positive contribution of the immigrants to y-sector output. The second term is the change in the value of the output of original domestic workers following a change in their sectoral allocation. With $a^* < \mu_y$, the second term is negative as then $da_c/da^* < 0$ and as $p_x < 1$. It is straightforward that expression (10) is unambiguously negative if $a^* = 0$.⁵ Overall, we see that the original home country y-sector workers are harmed by (gain from) immigration if $a^* < (>) \mu_y$, while they are indifferent if $a^* = \mu_y$. As an implication, countries optimally restrict the immigration of low quality foreign workers with $a^* < \mu_y$.⁶ Many countries, of course, in practice sort prospective immigrants on the basis of their education and their work experience.

4. *The pattern of trade and the welfare implications of trade*

This section demonstrates that international trade may arise if the two countries differ in their national labor quality distributions. Alternatively, trade can arise if the countries have different underlying labor market distortions. These two sources of comparative advantage and hence determinants of international trade are examined in turn. To conclude the section, we examine the implications of international trade for factor prices and national welfare.

To start, let us consider that the two countries only differ in their labor market distributions with labor market distortions as described before. The country that produces relatively much of good x in autarky has the relatively low autarky price p_x , and as a result it exports good x in the

trading equilibrium. The relative production of goods x and y reflects differences, if any, in the two countries' labor quality distributions. To see how differences in the national labor quality distributions matter, let us take as the benchmark the case where the two national labor quality distributions are equal so that there is no international trade. Now we can consider an influx of workers of a quality q , with $\underline{a} \leq q \leq \bar{a}$, into the home country. If such an influx increases the relative autarky production of good x in the home country at the autarky goods price p_x , then the home country will exports good x in the trading equilibrium, and vice versa. We can now show the following,

Proposition 1: Starting from equal national labor quality distributions, an influx of workers of quality q , with $\underline{a} \leq q \leq \bar{a}$, into the home country implies that

- (i) the home country export good x if $q > a_c$
- (ii) the pattern of trade is indeterminate if $q = a_c$
- (iii) the home country exports good y if $a' < q < a_c$
- (iv) there is no trade if $q = a'$
- (v) the home country exports good x if $q < a'$

with,

$$a' = \frac{f(a_c)\mu_y}{f(a_c) - xF(a_c)[d(\mu_y/a_c)/da_c]} > 0, \text{ and } a' < \mu_y.$$

For a proof, see the Appendix. If $a' < \underline{a}$, then the country with relatively many high quality workers of quality higher (lower) than a_c will export good x (y). In this instance, cases (iv) and (v) cannot apply. If instead $a' > \underline{a}$, then the country that has relatively many workers at either end of the quality distribution (of a quality exceeding a_c or lower than a') will export good x , while the country that has relatively many workers in the middle quality segment (of a quality between a' and a_c) exports good y . This reflects that with $a' > \underline{a}$ a relative abundance of domestic workers of a quality lower than a' discourages the relative production of good y in autarky and

hence leads the home country to export good x in the trading equilibrium. Note that the condition $\underline{a} = 0$ guarantees that we have $a' > \underline{a}$.

Next, let us assume that the countries differ in the labor market distortions underlying the determination of wage incomes. For instance, we can assume that all foreign workers obtain their marginal product, while in the home country, as before, y -sector (x -sector) workers receive their average (marginal) product. In autarky, in the foreign country we have $p_x = 1$, while in the home country we have $p_x < 1$. The foreign country thus exports good y in the trading equilibrium, regardless of any difference in the labor force compositions between the two countries. Interestingly, in the free trade equilibrium (at least) one of the two countries specializes in production. If with free trade we have $p_x = 1$, then the home country specializes in good x , while the foreign country produces good y . If instead with free trade we get $p_x < 1$, then the foreign country specializes in the production of good y , while the home country produces good x . In the first instance, free trade increases only home national welfare. In the second case, free trade instead increases foreign national welfare, while the welfare implications for the y -importing home country, as shown below, are ambiguous.

Next, we examine the implications of international trade for the sectoral distribution of income. To this end, let us assume that the home country exports good x in the trading equilibrium. With free trade, the world goods price p_x is above the domestic autarky price. Domestic x -sector workers benefit from trade, as their real wages increase in terms of good y . From (4), we see that a higher p_x reduces a_c , which implies that free trade leads to a reallocation of some original y -sector workers to the x -sector. The mean worker quality, μ_y , in the y -sector thus falls, which implies that the real wage of y -sector workers falls in terms of good y . As p_x rises, these workers' wage also falls in terms of good x .⁷

To conclude this section, let us consider the impact of international trade on national welfare. For this purpose, let us define V to be a utilitarian social welfare index. A change in the world price of good x , p_x , changes national welfare, V , as follows,

$$\frac{dV}{dp_x} = \frac{p_x x^s - \alpha I}{p_x I} + \frac{1 - p_x}{I} a_c f(a_c) \frac{da_c}{dp_x} \quad (11)$$

where x^s and y^s are again the production levels of x and y and where $I = y^s + p_x x^s$. The first term in (11) is the standard terms of trade effect on welfare given an existing production pattern. For a country that exports good x , we have $p_x x^s > \alpha I$. For such a country, an increase in p_x increases national welfare at given production quantities. The second term represents the welfare implications of the change in production following a change in the price p_x . According to (4), $da_c/dp_x < 0$ so that the second term in (11) is negative with $I > p_x$. The increase in the production of good x following an increase in the goods price p_x thus lowers national welfare. Note that expression (7) is unambiguously negative if p_x is increased just above the domestic autarky price of good x as in that instance the first term in (11) vanishes.

5. *Free migration*

This section examines the welfare implications of free migration. Free migration, of course, does not affect national welfares if free international goods trade is a substitute for free migration. Note that free trade equalizes the real wages of workers in the x -sector. Free trade, however, does not necessarily equalize μ_y and μ_y^* and consequently y -sector wages in the two countries.⁸ Workers employed in the y -sector thus generally retain an incentive to migrate if migration itself is assumed to be costless. Domestic y -sector workers, specifically, can benefit from emigration if $\mu_y^* > \mu_y$, and vice versa.

As discussed, migration generally affects the incomes of non-immigrant workers in sending and the receiving countries alike. What remains is to examine how free migration affects world welfare, given by the sum of national welfares, V and V^* . World welfare is easily seen to increase on account of free migration if migration enlarges the world's y -sector production at pre-migration world prices, and versa. Let us assume that in the pre-migration world the highest qualified domestic y -sector worker is less qualified than his foreign counterpart. Formally, this implies $a_c < a_c^*$. If (4) holds for both countries, then free migration leads to a worldwide threshold worker quality, a_c^w , at pre-migration world goods prices, such that $a_c < a_c^w < a_c^*$.⁹ As a result of free migration, some original domestic x -sector worker switch to the y -sector, while some original foreign y -sector workers switch to the x -sector. Following the reallocation of workers in both countries, the change in the world output of good y , denoted $d(y + y^*)$, is given as follows,

$$d(y + y^*) = \int_{a_c}^{a_c^w} a f(a) da - \int_{a_c^w}^{a_c^*} a^* f^*(a^*) da^* \quad (12)$$

Expression (12) can be positive or negative. This is best illustrated as follows. Let us assume that the foreign population consists of two groups with distinct quality levels. In particular, let there be n_l^* and n_h^* foreign workers of quality a_l^* and a_h^* , respectively, with $a_l^* < a_h^*$. Let us also assume that $a_l^* n_l^* / a_h^* n_h^* = (1 - \alpha) / \alpha$, which guarantees that all workers of quality a_l^* work in the foreign y-sector in autarky. Let us further assume that all foreign workers of quality a_h^* work in the x-sector in autarky and with free trade with or without free migration.¹⁰ The home country instead has a continuous labor quality distribution as considered above. In autarky, both countries have a goods price p_x less than one. With free trade, we also have $p_x < 1$. With free migration, the two national y-sectors can be seen as merging. As a result of this merger, some original domestic x-sector workers will be employed in the y-sector if $\mu_y < a_l^* < a_c$ for a given pre-migration price p_x . Worldwide fewer y-sector workers will be employed in this sector if instead $a_l^* < \mu_y$ or if $a_l^* > a_c$. In these instances, free migration thus lowers the world supply of good y and overall world welfare. Note that average productivity wage setting in the y-sector may lead to welfare-reducing international migration, even though all workers remain employed. In practice, migration can of course lead to increased unemployment in the labor receiving country, providing an additional reason why migration may be welfare reducing.¹¹

6. Conclusion

This paper considers international trade and migration in a simple model where labor of heterogeneous quality is the only factor of production. The paper shows that international differences in the labor quality distributions and in the sectoral wage setting institutions each provide reasons for international trade and migration. An international difference in the sectoral wage setting process specifically is shown to be a reason for trade or migration regardless of the two countries' labor quality distributions. If wage setting arrangements instead are symmetric in the two countries, then there can be international trade or migration if the national quality distributions are sufficiently different in the sense that relative sectoral outputs in autarky differ.

A country endowed with relatively many workers at the top end of the labor quality distribution is shown to export the good produced in the sector characterized by marginal productivity wage setting in the trading equilibrium. International trade or migration in the presence of average productivity wage setting in a sector can reduce a country's welfare. The immigration of below-average y -sector workers specifically reduces the aggregate income of a country's original workers at existing world goods prices. The model thus provides a rationale for restricting the immigration of lowly qualified foreign workers.

Sectoral and international migration generate externalities in the present analysis on account of the average productivity wage setting. More conventionally, migration creates externalities, as it affects the physical marginal productivity of non-migrating factors of production in the labor sending and receiving countries. Alternatively, migration gives rise to externalities as it affects international congestion levels. The present analysis of migration can be extended to account for these additional external effects of migration.

Appendix: Proof of proposition 1.

- (i) If $q > a_c$, then $dx^s > 0$ and $dy^s = 0$ at autarky prices. The home country thus exports good x .
- (ii) If $q = a_c$, then an influx of workers increases the output of good x (y), if these workers are employed in the x -sector (y -sector). Note that if immigrants of quality a_c join the y -sector, then some original x -sector workers will be induced to also join the y -sector. The impact on the pattern of trade is ambiguous.
- (iii) - (v) Let $q < a_c$. Consider that there is an influx of workers of quality q drawn from a density $g(q)$. The notation dq stands for an increase of the range of workers that is part of the influx. The country exports good x if at autarky goods prices we have,

$$\frac{dx^s}{dq} \frac{1}{x^s} - \frac{dy^s}{dq} \frac{1}{y^s} > 0$$

Using (7) and (8), we see that this is equivalent to,

$$-qxg(q) - a_c f(a_c) \frac{da_c}{dq} > 0$$

where we use that $x^s + y^s = 1$.

Substituting for da_c/dq from (6) gives us,

$$-qx + \frac{f(a_c)(q - \mu_y)}{F(a_c)[d(\mu_y/a_c)/da_c]} > 0$$

If the above expression is zero with $q = a'$, this implies,

$$\mu_y > a' = \frac{f(a_c)\mu_y}{f(a_c) - xF(a_c)[d(\mu_y/a_c)/da_c]} > 0$$

as $d(\mu_y/a_c)/da_c < 0$ from (4).

Parts (iii) - (v) of the proposition now follow.

References

- Bhagwati, Jagdish N. and T.N. Srinivasan, 1971, The Theory of Wage Differentials: Production Response and Factor Price Equalisation, *Journal of International Economics* 1, 19-35.
- Brander, James A. and Barbara J. Spencer, 1988, Unionized Oligopoly and International Trade Policy, *Journal of International Economics* 24, 217-234.
- Brecher, 1992, An Efficiency-Wage Model with Explicit Monitoring, Unemployment and Welfare in an Open Economy, *Journal of International Economics* 32, 1992.
- Copeland, Brian R., 1989, Efficiency Wages in a Ricardian Model of International Trade, *Journal of International Economics* 27, 221-244.
- Findlay, Ronald and Henryk Kierzkowski, 1983, International Trade and Human Capital: A Simple General Equilibrium Model, *Journal of Political Economy* 91, 957-978.
- Jones, Ronald W., 1971, Distortions in Factor Markets and the General Equilibrium Model of Production, *Journal of Political Economy* 79, 437-459.
- Mezzetti, Claudio and Elias Dinopoulos, 1991, Domestic Unionization and Import Competition, *Journal of International Economics* 1991, 79-100.
- Morrison, Andrew R., 1993, Unproductive Migration Reconsidered: A Stochastic Frontier Framework for Analyzing Internal Migration, *Oxford Economic Papers* 45, 501-518.
- Neary, J. Peter, 1978, Dynamic Stability and the Theory of Factor-Market Distortions, *American Economic Review* 69, 671-682.
- Rivera-Batiz, Francisco L., 1981, The Effects of Immigration in a Distorted Two-Sector Economy *Economic Inquiry* 19, 626-639.
- Rivera-Batiz, Francisco L., 1983, Trade Theory, Distribution of Income, and Immigration, *American Economic Review* 73, 183-187.
- Staiger, Robert W., 1988, Organized Labor and the Scope of International Specialization, *Journal of Political Economy* 96, 1022-1047.

Endnotes

1. Several contributions, including Bhagwati and Srinivasan (1971), Jones (1971) and Neary (1978), consider the implications for the pattern of production and for factor rewards of an exogenously given wage differential in a two sector model.
2. Rivera-Batiz (1983) also considers migration in the presence of a goods market distortion in the form of tariffs.
3. It is straightforward that the relative goods demand, x^s/y^s , is given as follows,

$$\frac{x^s}{y^s} = \frac{\alpha}{1 - \alpha} \frac{I}{p_x}$$

4. A government interested in maximizing a utilitarian social welfare index can set the y-sector wage subsidy, s , and the x-sector wage tax, t , such that,

$$\frac{1 + s}{1 - t} = \frac{a_c}{\mu_y} > 1$$

where a_c and thus μ_y are selected such that $x^s/y^s = \alpha/(1 - \alpha)$.

5. It is also interesting to consider changes in technology. In the text, we have assumed that the production of a unit of either good requires one unit of effective labor. Technological improvement in the x-sector can be modeled as a reduction in the effective unit labor requirement in that sector below unity. Such a technological improvement is welfare improving in so far as it improves the labor productivity of original x-sector workers. At the same time, it induces some y-sector workers to switch to the x-sector. This switch reduces the value of national output at world prices. On net, the welfare consequences of technological progress in the x-sector at given world goods prices are ambiguous.
6. A country's labor quality distribution can be affected by education as well as by migration. Education can be modeled as an increase in the labor quality, a , for some workers. With given goods prices, the education of x-sector workers is beneficial as it simply increases x-sector output. The education of y-sector workers, however, potentially lowers social welfare. This can be the case if the workers being educated originally were above-average y-sector workers, and if the education induces them to switch towards the x-sector. In this instance, education lowers the average quality of remaining y-sector workers, μ_y , which implies additional, welfare-reducing switches of y-sector workers to the x-sector.
7. Note that workers that switch from the y-sector to the x-sector may either lose or benefit from international trade. All switched workers, in particular, below a certain quality level lose, while the remaining switched workers stand to gain from international trade.
8. Note that the country that has the relatively high y-sector wage may well export this good in the free trade equilibrium.

9. Equation (4), its foreign counterpart and the fact that $a_c < a_c^*$ together imply that $\mu^*(a_c)/a_c > p_x > \mu(a_c^*)/a_c^*$. Let μ^w be the mean world y-sector worker quality. We can then show that $\mu^w(a_c)/a_c > p_x > \mu^w(a_c^*)/a_c^*$. The result that $a_c < a_c^w < a_c^*$ now follows.
10. Note that there is a range of the goods price p_x such that all high-quality (low-quality) foreign workers prefer to work in the x-sector (y-sector) on account of the average productivity wage setting in the y-sector. In the pre-migration case, this is the case if $a_l^*/a_h^* < p_x < 1$.
11. Morrison (1993) investigates empirically the implications of internal migration in Peru taking into account the negative externalities of urbanization in an environment characterized by unemployment and distorted relative prices. Migration is argued to have had a positive net impact on the country's GDP.