# Skilled Worker Migration and Trade: Inequality and Welfare

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We develop a two-sector, two-country model where trade is driven by technological differences. Each country is populated by large number of heterogeneous workers, distinguished by their level of skills. The countries are identical but for technological superiority in the production of one of the goods. We show that, in this model, migration of skilled workers and trade are complements. Then we analyze the welfare non-movers in both countries and of migrants, showing that migration and trade are welfare improving. We then proceed to analyze the distributional effects as an input to an analysis of the political economy of migration and redistribution policy.

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# 1. INTRODUCTION

For all the public concern with unskilled immigration, it is notable that a sizable share of immigration involves people that are skilled--relative to both the home and host country labor markets (Docquier and Marfouk, 2006, Defoort and Rodgers, 2008). While such migrations have long been a staple of the literature on the "brain drain" (e.g. Bhagwati and Rodriguez, 1975, Grubel and Scott, 1966, Kapur and McHale, 2009, Kwok and Leland, 1982, Commander et al., 2003), the focus of research on host countries has primarily been unskilled migration (Ethier, 1986). Furthermore, most of this literature has emphasized single-country analysis, not the global equilibrium of such flows. Similarly, most of this literature tends to consider economies that are closed to all global flows but migration (or small, open economies with relative prices fixed by international trade). This was a sensible research strategy in an era characterized by high trade restrictions in North-South trade, but it seems problematic in an increasingly globalized world where international trade constitutes a sizable share of world product. In addition, as long as trade and factor movements take place between countries with democratically elected governments we also need to distinguish welfare outcomes from outcomes that are politically feasible.

To address these issues, we introduce migration of skilled workers in a two-country, two-sector trade model. As in the Roy selection model (Roy, 1951), workers in both countries are differentiated by skill and, in autarky or under trade (but without migration), they will sort themselves among sectors based on the sector that offers the higher income.[1] As in the Roy-Borjas model (Borjas, 1987), when presented with the opportunity to migrate, they will choose whether or not to migrate based on comparison of incomes net of migration costs.[2] It is well-known that in models of the Heckscher-Ohlin-Samuelson type trade and migration are substitutes (Ethier, 1996, Markusen, 1983, Mundell, 1957). In line with much of the recent literature on migration, we will assume that there is a technology gap between countries.[3] Specifically, while the two countries use the same technology in the primary sector, one country has a more efficient technology in the high-tech sector. The two countries have identical endowments of skills (human capital). In the primary sector worker productivity is independent of the level of skills. Skills however matter in the high-tech sector.

After we derive the equilibrium under autarky for each country, we solve for the free trade equilibrium. Next, we do not allow trade but we permit migration. When migration is costless we arrive at a full integration equilibrium where everybody lives in the country that is technologically superior. We also derive the equilibrium when migration is costly and we find

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[1] Bougheas and Riezman (2007), Davidson and Matusz (2006) and Davidson, Matusz and Nelson (2007) use the same framework to analyze a host of trade issues, but not migration.

[2] The Roy-Borjas model has proved to be an extremely useful framework for organizing both theoretical and empirical work on migration (e.g. Belot and Hatton, 2008, Brücker and Defoort, 2006, Grogger and Hanson, 2008, Ortega and Peri, 2009, Chiquiar and Hanson, 2005). It is notable that all of the papers just cited find support for positive selection.

[3] In his Marshall lecture, Lucas (1988, pg. 38) noted in passing that patterns of immigration seem inconsistent with patterns of capital flow in standard growth model. Davis and Weinstein (2002) and Iranzo and Peri (2009) build models of trade and migration with technological differences in which the technologically superior country not only exports the skilled labor-intensive good, but also imports skilled labor. Building on the same empirical observation, Rauch (Rauch, 1991) develops an alternative model with heterogeneous workers in which production requires managerial labor as well as skilled and unskilled labor, only skilled workers ban be managers. Rauch's model also generates the observed patterns of mobility and trade.

that when only skilled workers move the gap between the autarky prices widens. The intuition is that as skilled workers move away from the country that is technologically disadvantaged it increases the relative cost of producing the high tech-good and thus increases its relative price which in turn deteriorates the incomes of the producers of the primary commodity who also are the relatively poor. Migration has exactly the opposite effects on the technologically advanced country.

When we allow for both trade and migration we derive two main results. The first is that trade and migration are complements. Put differently, migration is higher under trade than under autarky. The second result is that welfare is higher when both trade and migration are allowed. More importantly, when we consider separately migrants, and the citizens of each country without including the migrants we find that migration and trade increase the welfare of each of these three groups.

Finally, we turn to the political economy implications of our model. When citizens are allowed to vote for whether or not to allow migration and on whether or not to compensate those who lose as a consequence of migration we find that the sequence of referenda in the source country and the citizenship status of migrants in the host country can both matter. There is now a sizable literature developing on the political economy of migration.[4] In an important early contribution, Benhabib (1996) developed a small, open, one-sector economy with heterogeneous agents (every agent possesses one unit of labor and some non-negative quantity of capital), where migration policy is decided by referendum. Grether, DeMelo and Muller (2001) drop the agent heterogeneity, but consider a small, open, 2-sector economy, with a referendum mechanism. In our analysis, we model a large, 2-sector economy with heterogeneous agents. In our 2-country world, we can follow the literature on selection, while still retaining the tractability to present a simple intuitive model permitting welfare and political economy issues.

## 2. THE MODEL

There are two countries $A$ and $B$ each populated by a continuum of workers of unit measure. Each worker is endowed with one unit of indivisible labor and some level of human capital $h$. In both countries human capital is uniformly distributed on the interval $[0,1]$. In each country there are two competitive sectors. Sector $X$ produces a high-tech product while sector $Y$ produces a primary commodity. The productivity of workers depends on their level of human capital and their sector of employment. Let $z_{AX}(h)$ denote the productivity of a worker with human capital $h$ who works in country $A$ in sector $X$ (other types of employment are similarly defined). All four technologies are linear, but both sector and country matter. The productivity of any worker in the primary sector, anywhere in the world, is the same ($v = z_{AY} = z_{BY}$). By contrast, worker skills ($h$) matter in the high tech sector, and skills matter more in country $B$ than in country $A$. Thus:

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[4]Much of this literature deals with the way redistributive policy interacts with migration (e.g. Mazza and van Winden, 1996, Razin et al., 2002, Wellisch and Walz, 1998). That is not the focus of our paper, and we will not comment on it any further. Similarly, a number of papers have used lobbying models to analyze the political economy of immigration (e.g. Epstein and Nitzan, 2006, Facchini and Willmann, 2005). As our paper focuses on the referendum mechanism, we will not discuss these papers either.

$$z_{AX} = h$$
$$z_{BX} = kh; \quad k > 1$$
$$z_{AY} = z_{BY} = v; \quad 0 < v < 1;$$

All workers have identical Cobb-Douglas preferences given by

$$U = X^{\alpha}Y^{\beta}; \quad 0 < \alpha, \beta < 1; \quad \alpha + \beta = 1$$

Since all technologies are constant returns to scale and all markets are competitive, worker incomes equal their productivities and each workers spend a fraction $\alpha$ of her income on product $X$.

## *a. **Autarky***

Throughout we use good $X$ as the numeraire and let $p_A$ and $p_B$ denote the autarky prices in countries $A$ and $B$ respectively. In what follows we are going to concentrate our analysis on country $B$ since by setting $k = 1$ we can obtain the corresponding solutions for country $A$.

Workers choose their sector of employment by comparing wages. A worker with human capital $h$ will receive income $kh$ if employed in sector $X$ while the same worker will receive income $p_B v$ if employed in sector $Y$. This implies that all workers with human capital higher than $h_B \equiv \frac{p_B v}{k}$ will be employed in the high-tech sector while workers with human capital below this threshold will be employed in the primary sector. Given our specification of preferences the equilibrium autarky price is proportional to the ratio of aggregate production in sector $X$ divided by the aggregate production in sector $Y$:

$$p_B = \frac{\beta}{\alpha} \frac{\int_{h_B}^{1} kh\, dh}{h_B v}$$

The corresponding closed form solution for the autarky price is given by:

$$p_B = \frac{k}{v}\sqrt{\frac{\beta}{2\alpha + \beta}}$$

Notice that the above solution implies that $p_B > p_A$ which follows from the fact that country $B$ has a superior technology for producing the high-tech product. It also follows that $h_A = h_B$.

**--Figure 1 about here--**

Figure 1 shows the derivation of the production frontier from the production functions and the labor constraint. The SW quadrant shows the labor constraint common to both countries and the SE quadrant shows the linear production function that transforms labor into good *Y* (also common to both countries). The NW quadrant is a bit trickier. As in Figure 1, workers are arranged such that the worker with the highest human capital, and thus highest productivity in sector *X*, is at the origin, and human capital dereases monotonically as one moves out along the $L_X$ axis. As a result, output increases at a decreasing rate, which we reflect with a the production functions in the NW quadrant. Furthermore, country *B*'s production function lies above country *A*'s at every point except the origin. Using this information, we can trace out the two production frontiers in the usual fashion. Finally, note that the autarky equilibrium is characterized by both countries allocating the same share of *L* to the production of good *Y*, so the equilibrium output of *Y* is the same in both countries. Given the technological difference between countries, although both countries allocate the same amount of *L* (and human *K*) to *X* production, country *B* produces more *X* in autarky. Finally, it should be clear that the relative price of good *Y* in country *B* must be greater than that in country *A*.

**--Figure 2 about here--**

While Figure 1 has the virtue of illustrating the autarky equilibrium in a standard fashion, it will prove convenient for our purposes to use a different graphical apparatus. Thus, consider the autarky equilibrium as illustrated in Figure 2. The horizontal axis shows the (uniform) distribution of skill from 0 to 1. Since both countries share the same distribution of skill, both can be shown on the same graph. The left vertical axis shows value marginal product in *Y*. Since the marginal physical product of labor in *Y* is assumed to be constant across all workers, and the same in both countries (i.e. *v*), the value marginal product in each country will be determined by the price of *Y*. Because *X* is the *numeraire*, the right vertical axis shows the product of each worker employed in the *X* sector. Any worker whose productivity in *X* exceeds that in *Y* will choose to work in *X*, with the cutoff at *h* (where the $V_X$ curve intersects the $V_Y$ curve). Our assumption that $k > 1$ implies that the value marginal product curve for *X* in country *B* lies above that in country *A*. Finally, we see both $p_B > p_A$ and $h_A = h_B$ (which we simply denote $h$ in the diagram).

*b. Trade*

From Figure 1, we know that country *A* has the lower autarky relative price of primary commodity *Y*. Thus, when the two economies trade, we expect country *A* to export good *Y* and country *B* to export the high-tech commodity *X*. The world price $p^T$ will lie between the two autarky prices and be given by

$$p^T = \frac{\beta}{\alpha}\frac{\int_{h_A^T}^{1} h\,dh + \int_{h_B^T}^{1} kh\,dh}{(h_A^T + h_B^T)v}$$

where $h_A^T = p^T v > h_A = h_B > \frac{p^T v}{k} = h_B^T$. The corresponding closed form solution for the world price is given by:

$$p^T = \frac{\sqrt{k}}{v}\sqrt{\frac{\beta}{2\alpha + \beta}}$$

**--Figure 3 about here--**

Because both countries share the same homothetic utility function, when trade equalizes commodity prices, the relative quantities of the two goods consumed will be the same. That is, they will lie on a common ray from the origin passing between the two autarky consumption points in Figure 1 and their shares of each good in national income will also be the same (given by the parameters α and β). The national income lines, with slopes given by the common relative price, will support consumption levels not available under autarky, so trade is mutually beneficial. We can use Figure 3, which extends Figure 2, to illustrate the equilibrium with trade. Free trade equalizes prices, so both countries face $p^T v$, which produces new, and internationally different, cutoff values identifying the marginal skilled worker in each of the two countries. Thus, we see country *B* specializing in the production of good *X*, as *h* to $h_B^T$ workers shift from *Y* production to *X* production. Similarly, in country *A*, *h* to $h_A^T$ workers shift from *X* production to *Y* production.

The income distribution effects are also straightforward. For country *B*, workers with skill greater than *h* experience an increase in real income greater than the change in relative price, while workers with skill less than $h_B^T$ experience a fall in income proportionally equal to the fall in the price of good *Y* (country *B*'s importable). Workers with skill between $h_B^T$ and *h*, by switching sectors and applying their human capital, experience a smaller fall in income, or even gain (though not by as much as pre-change workers in *X*). Thus, the income share of pre-change *X* workers rises and that of pre-change *Y* workers falls. The case of country *A* is exactly the reverse.

## *c. Migration*

Suppose that the two economies do not trade but migration is allowed.

### *Costless Migration*

Given that the two countries use the same technology to produce the primary commodity but country $B$ has a superior technology for producing the high-tech product every worker in country $A$ will emigrate in country $B$. The integration equilibrium price is equal to $p_B$, i.e. country $B$'s autarky price.

### *Costly migration*

Now suppose that migration entails a cost $\gamma$ measured in numeraire units. We are going to assume that this cost is sufficiently high so that workers in the primary sector do not wish to emigrate.[5] Let $p_A^M$ and $p_B^M$ denote the two new autarky prices. The utility of a worker who is a citizen of country $A$, employed in sector $X$ and does not emigrate is equal to

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[5] When we introduce trade, these workers will not have an incentive to emigrate. Thus, by restricting their movement in the absence of trade allows for clearer comparisons between the two cases.

$(h)^{\alpha}(\frac{h}{p_A^M})^{\beta} = h\left(p_A^M\right)^{-\beta}$.[6] If the same worker emigrates to country $B$ her new utility will be $(kh-\gamma)^{\alpha}(\frac{kh-\gamma}{p_B^M})^{\beta} = (kh-\gamma)\left(p_B^M\right)^{-\beta}$. Then there exists a threshold level of human capital $h^M = \frac{\gamma\left(p_B^M\right)^{-\beta}}{k\left(p_B^M\right)^{-\beta}-\left(p_A^M\right)^{-\beta}}$ such that all workers with human capital above it and who initially were citizens in country $A$ emigrate to country $B$. Letting $h_A^M$ and $h_B^M$ denote the new threshold levels of human capital that separates those employed in sector $X$ from those employed in sector $Y$, in countries $A$ and $B$ respectively, the new autarky prices are given by the system of equations:

$$p_A^M = \frac{\beta}{\alpha}\frac{\int_{h_A^M}^{h^M} hdh}{h_A^M v}$$

and

$$p_B^M = \frac{\beta}{\alpha}\frac{\int_{h^M}^{1}(kh-\gamma)dh+\int_{h_B^M}^{1} kh\,dh}{h_B^M v}$$

Notice that the two equations need to be solved simultaneously since $h^M$ depends on both new autarky prices. This complication implies that it is not possible to derive closed-form solutions for the two prices. Nevertheless, the effect of migration is to increase the gap between the autarky prices, i.e. $p_B^M > p_B > p_A > p_A^M$. The intuition is that in country $A$ the old threshold level of human capital that separates those employed in sector $X$ from those employed in sector $Y$ is too high, given that only high ability workers have migrated while the corresponding threshold in country $B$ is too low.[7]

**--Figure 4 about here--**

Figure 4 shows diagrammatically the costly migration equilibrium. While the principle is straightforward, our graphical apparatus gets messier here. Since all workers with human capital above $h^M$ migrate from $A$ to $B$, we truncate the $A$ distribution at $h^M$ and append the $\mu$ skilled workers to the $B$ distribution.[8] It is easy to see that, with unchaged preferences and no international trade, the migration of workers that produce only good $X$ results in too little $X$ production in country $A$ and too much in country $B$. This results in an increase in the relative price of $X$ in country $A$ and a reduction country $B$ (i.e. a fall in $p_A^M$ and a rise in $p_B^M$) and, of course, an increase in the allocation of labor to $X$ production in $A$ and to $Y$ production in $B$.

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[6] All utilities have been divided by $\alpha^{\alpha}\beta^{\beta}$.

[7] Let $\mu$ denote the proportion of migrants. Given that both populations originally were of unit measure the new population of country $A$ is of measure $1-\mu$ and human capital is uniformly distributed on the interval $[0,1-\mu]$.

[8] It should be clear now why we prefer the graphical apparatus applied in Figures 2-5 to that in Figure 1.

## 3. MIGRATION AND TRADE

### a. Costless Migration

When migration is costless it is optimal that the whole production of the high-tech product takes place in country $B$. In the absence of trade costs, the production location of the primary product is inconsequential. In the presence of trade costs it is optimal that all workers move to country $B$. In either case we have full integration. The full integration equilibrium price $p^{FI}$ is given as the solution of

$$p^{FI} = \frac{\beta}{\alpha}\frac{\int_{h^{FI}}^{1} kh\,dh}{h^{FI}v}$$

where $h^{FI} = \frac{p^{FI}v}{k}$. It is clear that the equilibrium world trade price and the critical threshold are the same as those for the autarky case for country $B$.

### b. Costly Migration

Once again suppose that migration entails a cost $\gamma$ measured in numeraire units. Given that when the two countries trade all workers face the same price, the only workers that move across borders are some of those workers who were citizens of country $A$ and employed in sector $X$ and now move to country $B$ and are employed in the same sector. For these workers their pre-migration income was equal to $h$ while their post-migration income is equal to $kh-\gamma$. This implies that there exists a threshold level of human capital $h^{*} \equiv \frac{\gamma}{k-1}$ such that all workers with human capital above it and who initially were citizens in country $A$ emigrate to country $B$.[9] Letting $h_A^{*}$ and $h_B^{*}$ denote the new threshold levels of human capital that separates those employed in sector $X$ from those employed in sector $Y$, the new equilibrium price $p^{*}$ is given by

$$p^{*} = \frac{\beta}{\alpha}\frac{\int_{h_A^{*}}^{h^{*}} h\,dh + \int_{h^{*}}^{1}(kh-\gamma)dh + \int_{h_B^{*}}^{1} kh\,dh}{(h_A^{*}+h_B^{*})v}$$

The corresponding closed form solution is:

$$p^{*} = \frac{\sqrt{k}}{v}\sqrt{\frac{2k-\gamma}{1+k}}\sqrt{\frac{\beta}{2\alpha+\beta}}$$

Given that $\sqrt{k} > \sqrt{\frac{2k-\gamma}{1+k}}$ we have $p^{B} > p^{*}$. In addition, the inequality $\gamma < k-1$ implies that

[9]Notice that here it is sufficient to compare incomes because the prices in the two countries are equal. Earlier we examined the case where there is no trade and therefore the prices in the two countries were different.

$p^* > p^T$ which in turn implies that $h_B^* > h_B^T$ and $h_A^* > h_A^T$. This is because migration has allowed a more efficient allocation of resources by moving high skilled workers to country $B$ which has a superior technology for producing the skill-intensive product $X$.

Comparing the threshold levels of human capital that separate those who emigrate from those who do not for the cases of migration without trade and migration with trade we get the following result

**Proposition** 1 *Migration and trade are complements*.

**Proof** The proposition follows from the inequality $p_B^M > p_A^M$ which ensures that $h^* < h^M$.

Figure 5 illustrates the equilibrium with trade and migration.

**--Figure 5 about here--**

There is more migration under free trade and the skilled migration to the skill abundant country supports increased comparative advantage based trade. The intuition is that, under trade, prices converge which further boosts the incomes of the migrants and thus the incentive to migrate. Of course this is not a new result. Markusen (1983) and Razin and Sadka (1994) have, within more traditional trade modes, demonstrated the complementarity between trade and migration when countries differ in technologies.

## 4. WELFARE

We measure group welfare as the sum of utilities of its individual members. We are focusing on three groups: The citizens of country $B$ (excluding migrants), the migrants and the citizens of country $A$ excluding migrants. Below we demonstrate that migration increases the welfare of all three groups and thus global welfare.[10]

### *a. Citizens of Country B (Excluding Migrants)*

Those workers who were employed in the primary sector during the pre-migration period and are still employed in the same sector during the post-migration period are better off in the later period. This is because migration increases the price of the primary commodity and hence their income. For exactly the same reason those workers that are employed in the high-tech sector during both periods experience a loss in utility. In addition, the inequality $h_B^* > h_B^T$ implies that there are some workers who before migration were employed in the high-tech sector and after migration they moved to the primary sector. Among these workers some are better off and some are worse off. More specifically, there exists a threshold level of human capital, $\tilde{h}^B$, such that all

[10]All utilities have been divided by $\alpha^\alpha \beta^\beta$. In addition, by $p$ we denote the equilibrium price $p^*$ where for notational simplicity we have dropped the superscript when confusion can be avoided..

workers with human capital below that level are better off after migration while all those workers with human capital above that level are worse off after migration.

**Lemma 1** Migration *increases the welfare of the citizens of country* $B$.

**Proof** The post migration utility of an agent working in sector $X$ is equal to

$$(kh)^{\alpha}(k\frac{h}{p})^{\beta} = khp^{-\beta}$$

and the corresponding utility of an agent working in sector $Y$ is equal to

$$(pv)^{\alpha}v^{\beta} = p^{\alpha}v$$

Then, the post-migration welfare, $W^B$, of the citizens of country $B$ is given by

$$W^B = \int_0^{\frac{pv}{k}} p^{\alpha}v dh + \int_{\frac{pv}{k}}^{1} kp^{-\beta} dh =$$

$$= \frac{p^{1+\alpha}v^2}{k} + \frac{1}{2}kp^{-\beta} - \frac{1}{2}\frac{p^{2-\beta}v^2}{k} =$$

$$= \frac{1}{2}\left[\frac{v^2}{k}p^{1+\alpha} + kp^{-(1-\alpha)}\right].$$

Next consider the effect on welfare of a small change in the migration cost $\gamma$.

$$sign\left[\frac{dW^B}{d\gamma}\right] = sign\left[\left((1+\alpha)\frac{v^2}{k}p^{\alpha} - \frac{(1-\alpha)k}{p^{2-\alpha}}\right)\frac{dp}{d\gamma}\right]$$

Substituting for $p^*$ and rearranging we get

$$sign\left[\frac{dW^B}{d\gamma}\right] = sign\left[\left(1 - \frac{1+k}{2k-\gamma}\right)\frac{dp}{d\gamma}\right]$$

Given that $\gamma < k-1$ and $\frac{dp}{d\gamma} < 0$ a decrease in migration costs will increase welfare.

### b. *Migrants*

**Lemma 2** *Migration increases the welfare of the migrants.*

**Proof** The pre-migration utility of a migrant is equal to

$$h(p^T)^{-\beta}$$

while the post-migration utility of a migrant is equal to

$$h(p^*)^{-\beta}k$$

Substituting for $p^T$ and $p^*$ we find that migration increases the welfare of migrants if and only if

$$\frac{\left(\sqrt{1+k}\right)^{1-\alpha}}{\left(\sqrt{2k-\gamma}\right)^{1-\alpha}}k>1$$

As $\gamma \rightarrow 0$ the left-hand side of the above expression approaches

$$\frac{\left(\sqrt{1+k}\right)^{\frac{1-\alpha}{2}} k^{\frac{1+\alpha}{2}}}{2^{\frac{1-\alpha}{2}}}$$

The above expression is increasing in $k$ and is equal to 1 for $k=1$ which, given that $k>1$, completes the proof.

## c. *Citizens of Country A (Excluding Migrants)*

For exactly the same reasons as those analyzed for country $B$, those workers who were employed in the primary sector during the pre-migration period and are still employed in the same sector during the post-migration period are better off in the later period. Once more, the inequality $h_A^* > h_A^T$ implies that there are some workers who before migration were employed in the high-tech sector and after migration they moved to the primary sector. Among these workers some are better off and some are worse off. Again, there exists a threshold level of human capital, $\tilde{h}^A$, such that all workers with human capital below that level are better off after migration while all those workers with human capital above that level are worse off after migration.

**Lemma 3** *Migration increases the welfare of the citizens of country $A$ excluding the migrants.*

**Proof** The post migration utility of an agent working in sector $X$ is equal to

$$h^{\alpha}(\frac{h}{p})^{\beta} = hp^{-\beta}$$

and the corresponding utility of an agent working in sector $Y$ is equal to

$$(pv)^{\alpha} v^{\beta} = p^{\alpha} v$$

Then, the post-migration welfare, $W^A$, of the citizens of country $A$ is given by

$$W^A = \int_0^{pv} p^{\alpha} v dh + \int_{pv}^{\frac{\gamma}{k-1}} p^{-\beta} h dh =$$

$$= p^{1+\alpha} v^2 + \frac{1}{2} p^{-\beta}\left(\frac{\gamma}{k-1}\right)^2 - \frac{1}{2} p^{2-\beta} v^2 =$$

$$= \frac{1}{2}\left[v^2 p^{1+\alpha} + \frac{\gamma^2}{(k-1)p^{(1-\alpha)}}\right]$$

Next consider the effect on welfare of a small change in the migration cost $\gamma$.

$$sign\left[\frac{dW^A}{d\gamma}\right] = sign\left[\left\{\left((1+\alpha)v^2 p^{\alpha} - \frac{(1-\alpha)k\gamma^2}{(k-1)p^{(2-\alpha)}}\right)\frac{dp}{d\gamma}\right\} + \frac{2\gamma}{(k-1)p^{1-\alpha}}\right]$$

Notice that a change in migration costs will affect the number of migrants and the last term captures the change in welfare as a result of the change in the size of the group. We know that a decrease in migration costs will increase the number of migrants and we know that their welfare will increase. Here, we need to concentrate only on the first term. Given that $\gamma < k-1$, $\frac{\gamma^2}{k-1} < 1$ and the proof is completed by following the same steps as those used in the proof of proposition 1.

### *d. Global Welfare*

The following proposition is a direct implication of the three lemmas.

**Proposition 2** *Migration increases global welfare.*

## 5. POLITICAL ECONOMY

The results of the previous section suggest that migration increases welfare in both countries even when migrants (who definitely gain) are ignored. This implies that the gains of those who benefit are more than sufficient to cover the losses of those workers who are worse off as a result of migration. However, for countries with democratically elected governments where majority voting decides key policy issues people might vote against migration and even if they decide to allow it losers might not be compensated. In this section, we identify the conditions under which each of these outcomes materializes.We begin by examining the possible outcomes of a referendum on migration ignoring, for the moment, any compensation policies.

### *a. Referendum on Migration*

Consider the voting outcome in country $A$. The proportion of people who would vote in favor of migration, $\varphi_A^M$, is equal to

$$\varphi_A^M = \tilde{h}^A + \left(1 - \frac{\gamma}{k-1}\right)$$

where the second term captures the votes of the migrants. The median voter's pre-migration utility is equal to $\tilde{h}^A (p^T)^{-\beta}$ while the same voter's post-migration utility is $(p^*)^{\alpha} v$; keeping in mind that in the pre-migration period is employed in sector $X$ and then moves to sector $Y$. Equating the two utilities, solving for the median voter's human capital and substituting in the above equality, we get

$$\varphi_A^M = p^T v \left(\sqrt{\frac{2k-\gamma}{1+\gamma}}\right)^{\alpha} + \left(1 - \frac{\gamma}{k-1}\right)$$

Next consider the voting outcome in country $B$. The proportion of people who would vote in favor of migration, $\varphi_B^M$ , is equal to

$$\varphi_B^M = \tilde{h}^B = \frac{\tilde{h}^A}{k}$$

The proposition below follows from the inequality $\varphi_B^M < \varphi_A^M$ and the fact that both countries have to vote in favor of migration.

**Proposition 3** *In the absence of any compensation policy migration will take place if and only if* $\varphi_B^M > 0.5$ .

Also, notice that a decline in migration costs increases the likelihood that the voting outcome will favor migration.

### *b. Referenda on Migration and Compensation*

Suppose that citizens in each country have the opportunity to vote on two referenda. In one referendum, as in the previous section, they vote on whether or not to allow migration (emigration in country $A$ and immigration in country $B$). In the other referendum they vote on whether or not there will be compensation for those who experience a loss in income as a result of migration. We demonstrate that outcomes would depend on whether or not migrants are allowed to vote on the compensation referendum in the host country ($B$) and on the sequence of referenda in the source country ($A$).

We begin with country $A$. We assume that if the compensation referendum takes place first the compensation scheme can include a tax on migrants whose revenues can be used for compensating the losers. The proposition below identifies conditions such that the sequence of referenda matters.

**Proposition 4:** Suppose that $\tilde{h}^A + 1 - \frac{\gamma}{k-1} > \frac{\gamma}{k-1} - \tilde{h}^A > \tilde{h}^A$. Then country $A$ will vote for compensation if and only if the migration referendum takes place first..

**Proof** The first inequality states that the winners together with the migrants are a majority group. The second inequality states that the proportion of losers is higher than the proportion of winners. Suppose that the compensation referendum takes place first. The migrants do not have an incentive to vote for compensation given that together with the winner will vote in favor of migration. In contrast, when the migration referendum takes place first there will be an unaminous vote in favor of migration. The winners are still better off and the losers know that they can get compensation after the next referendum.

Now consider the referenda in country $B$.

**Proposition 5** *Suppose that* $\tilde{h}^B + 1 - \frac{\gamma}{k-1} > 1 - \tilde{h}^B > \tilde{h}^B$. *Then country* $B$ *will vote for compensation if and only if migrants are not allowed to vote on the compensation referendum.*

**Proof** Clearly, if migrants are allowed to vote on the compensation referendum they would vote against compensation. The first inequality states that the winners together with the migrants are a majority group. The second inequality states that the proportion of losers is higher than the proportion of winners. Notice that if migrants were allowed to vote and given that they would vote against compensation there would be a vote against migration given that the losers (in the absence of migrant vore) are a majority group.

## 6. CONCLUSION

We have presented a two-country model of trade and skilled labor migration. Trade and migration are induced by differences in technologies and thus are complements. Cross-border movements of workers has significant welfare implications for both source and host countries. In our model, where only skilled workers have an incetive to migrate those workers who are employed in skill-intensive sectors (other than the migrants) suffer welfare losses. Nevertheless, we have shown that, in both countries, the welfare gains of those workers who benfit from migration exceed (in absolute terms) the losses of of those workers who suffer losses. However, we have also shown that in countries where both migration and any compensation policies are decided by majority vote, there is no guarantee that neither the loses will be compensated should migration take place nor there will be a vote in favor of migration.

This framework can be easily extended to account for unskilled worker migration by having the two countries using different technologies for the production of the primary commodity. For that matter a general version can allow for migration of both types of workers which can be either in the same or in the opposite direction.[11]

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[11] For example, Ishikawa (1996) offers a model of trade and migration, where the two countries differ in their endowments, and where both types of workers move in the same direction.

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**Figure 1:** Autarky Equilibrium I

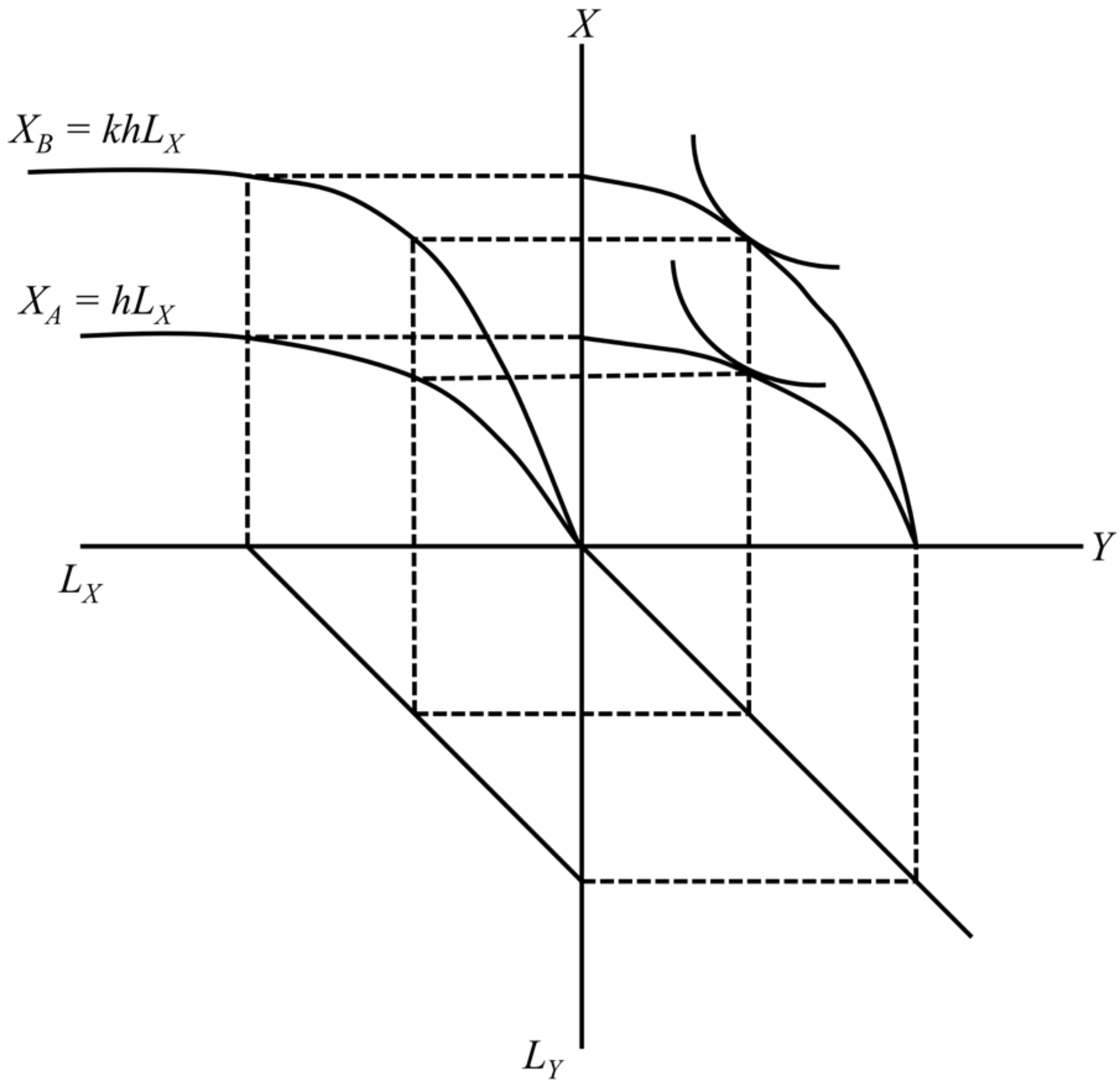

**Figure 2:** Autarky Equilibrium II

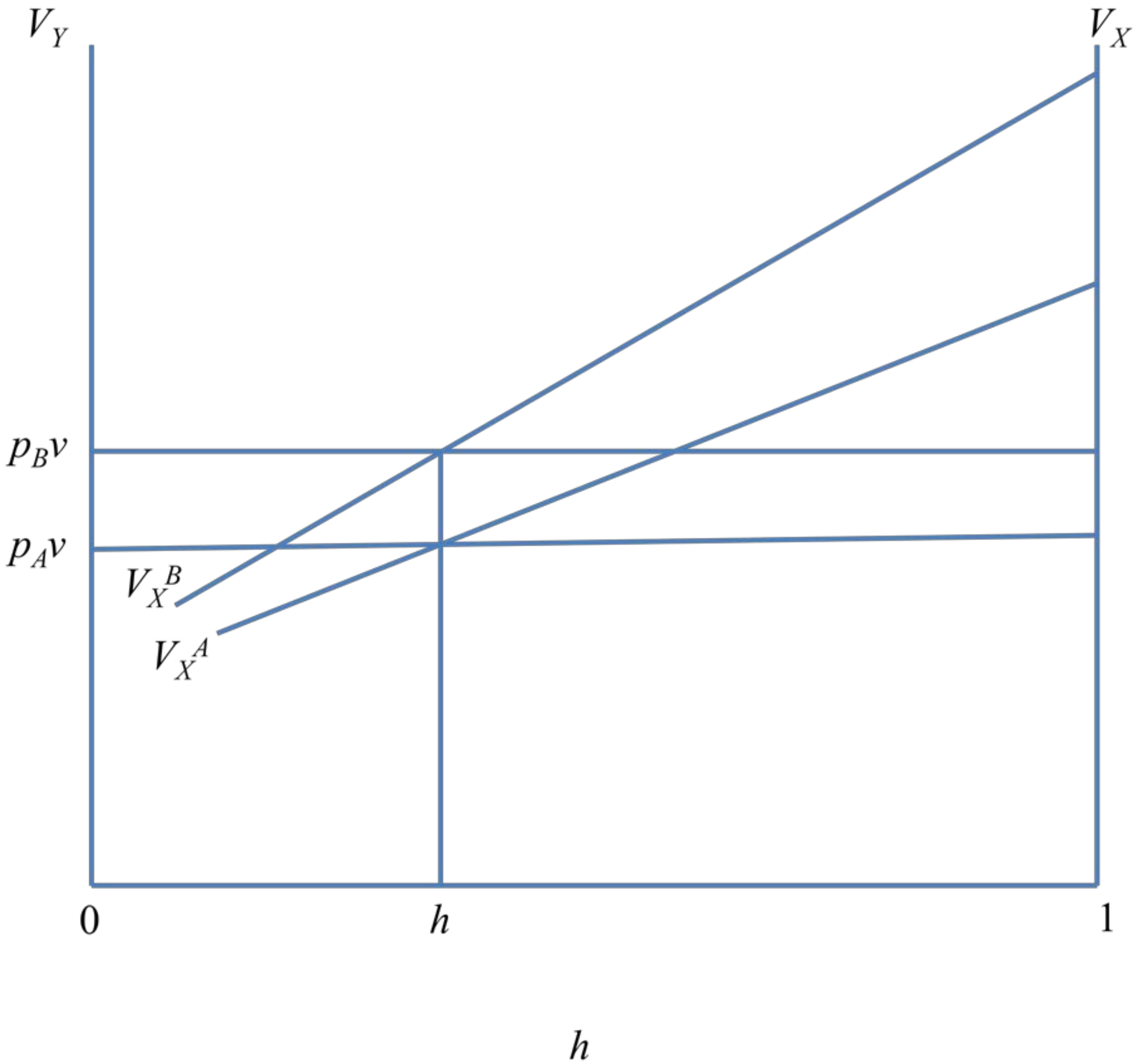

**Figure 3:** International Trade without Migration

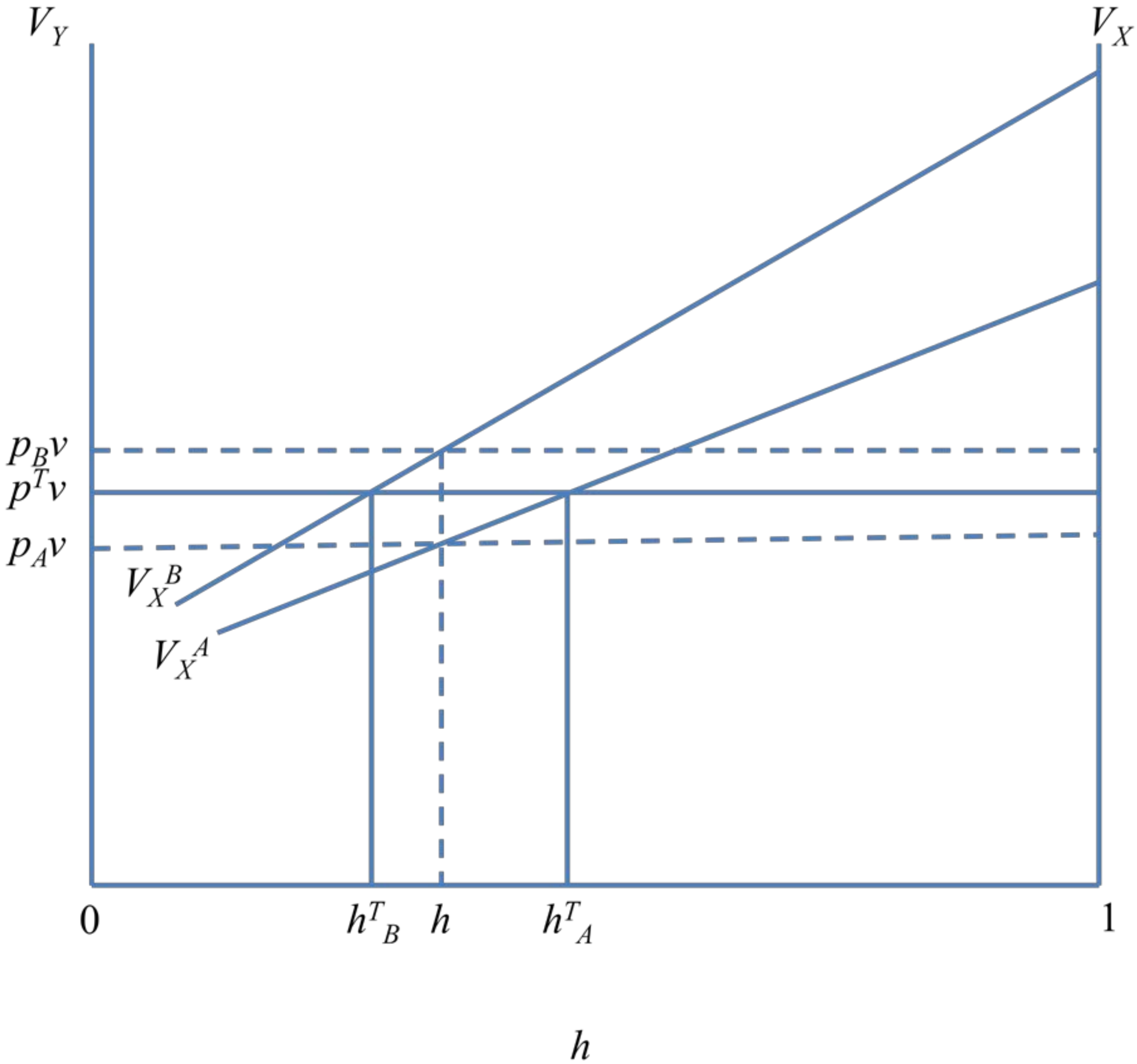

**Figure 4:** Migration without International Trade

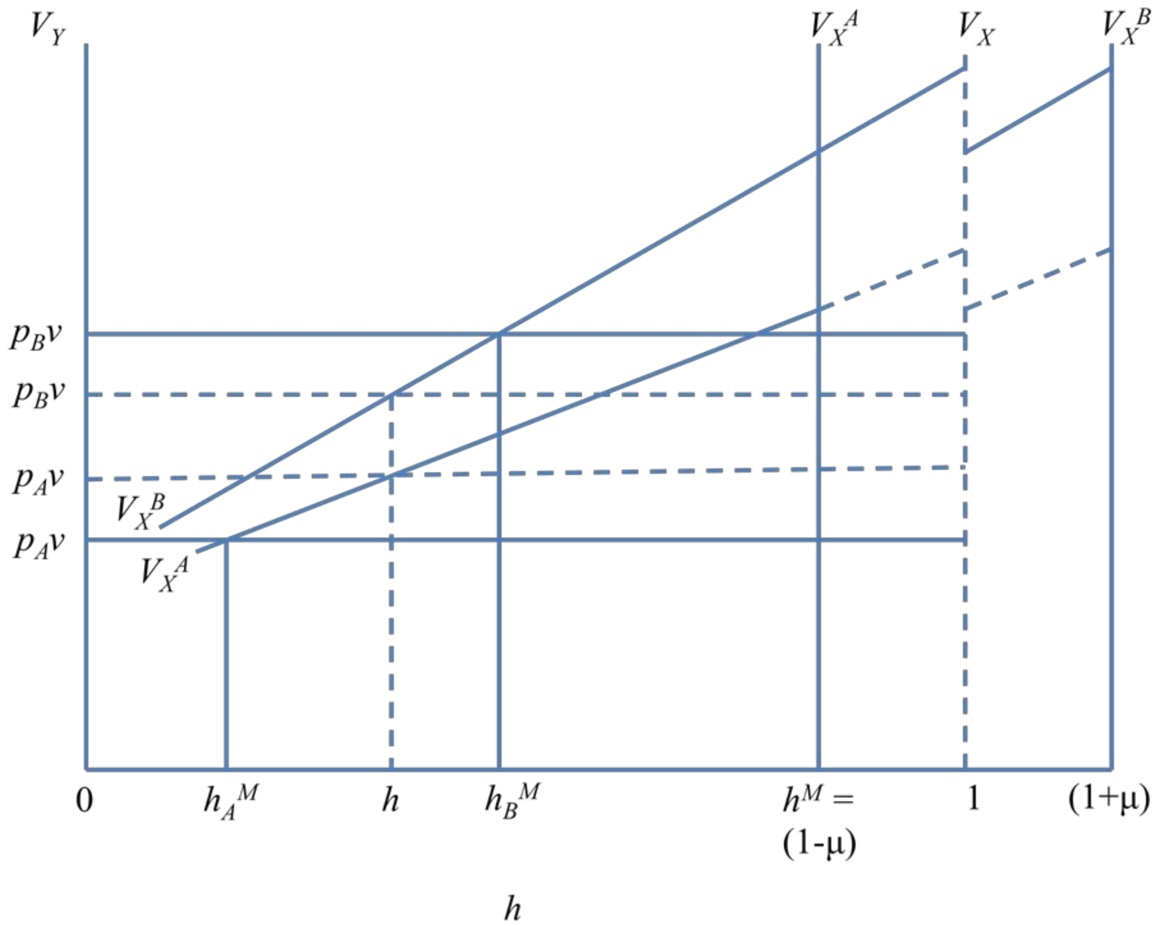

**Figure 5:** International Trade and Migration