Notes to Understand Migration Policy with International Trade Theoretical Tools

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1. INTRODUCTION

Recent developments have placed immigration at the forefront of the policy debate, creating much controversy around the associated trade-offs for host economies. Indeed, immigration triggers opposing effects on the welfare of different groups within a country, and this opens the door for conflicting arguments and heated debates. The implication has been a proliferation of arguments both in favor and against immigration. In turn, this creates a need for accomplishing theoretical and empirical work that can better inform the policy debate.

The present chapter takes a step in this direction by showing how instruments traditionally included in the economists' tool kit can shed light on relevant but largely controversial issues. The chapter uses a standard model of international trade to show that immigrants with complementary skills may increase scarce factors productivity and, through this channel, enhance overall welfare in host nations. However, given that some groups within the host country may be negatively affected in their income levels, they may oppose migration.

There are several arguments that either have been or could in principle be used to support immigration. One of these arguments claims that immigrants play an active and indispensable role in promoting dynamism, innovation and scientific progress in host economies. This argument is consistent, for instance, with the finding that 45 percent of high-tech firms from the Fortune 500 had

*The views and conclusions presented in this paper are exclusively the responsibility of the authors and do not necessarily reflect those of Banco de México. All errors remain ours. We are grateful to Alejandrina Salcedo Cisneros for helpful comments. Please address correspondence to: dchiquiar@banxico.org.mx.

either a first or a second generation immigrant among its founders (Partnership for a New American Economy, 2011).[1] Moreover, the premise that immigrants largely contribute to scientific progress is consistent with Figures 1 and 2.[2] Figure 1 shows that the amount of Nobel prizes obtained by a country is positively associated with the ratio of immigrants-to-natives that have won the prize, and Figure 2 shows that this ratio is positively correlated with the number of registered patents, even after controlling for real GDP per capita.

An additional argument in favor of migration could be that immigrants complement native workers in host labor markets. According to this argument, immigrants' skills are generally complementary to those possessed by native workers and, therefore, immigration reduces labor shortages in both low and high-skilled occupations. By complementing native workers in production, immigration would create job opportunities and increase their wages. Consistent with this idea, Figure 3 shows that immigrants in the U.S. are relatively concentrated at the top and at the bottom of the skill distribution, while natives are relatively more concentrated in the middle of this distribution.

On the opposite side of the debate, several arguments have been or could be used to oppose immigration and favor restrictions to international labor mobility. One of these arguments emphasizes that, in those markets in which natives compete with foreigners, immigration triggers competition for the same types of jobs, depressing wages and raising unemployment (see De New and Zimmermann [1994] for evidence on the German labor market). Another argument relies on the fiscal costs that foreigners could impose on host countries. It has been argued that, due to their age, skill, fertility and language characteristics, immigrants may consume large amounts of government-funded goods but, on the other hand, increase fiscal revenues only to a small amount (Nowrasteh 2014).

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[1] The report by the Partnership for a New American Economy also finds that by 2010 more than 40 percent of the Fortune 500 companies were founded by immigrants or by their children, that seven of the 10 most valuable brands in the world come from companies founded by first or second generations of immigrants and that the revenue generated by Fortune 500 companies founded by immigrants or children of immigrants is greater than the GDP of every country in the world outside the United States, except China and Japan.

[2] Although the figures provide information only on the correlation between the variables illustrated, they serve to suggest that high-skilled migration entails net benefits for host countries.

The fact that immigration can in principle generate several and conflicting effects on welfare, as well as the existence of inconclusive answers to relevant questions, highlights the need for economists to take part of the policy debate that surrounds immigration. Indeed, economists need to steer this debate towards policy prescriptions and cost-benefit analysis that is better informed by economic theory and empirical work. A proper cost-benefit framework and, more generally, a more proactive role by economists, could improve our understanding of relevant trade-offs and increase the amount of good estimates about immigration impacts.

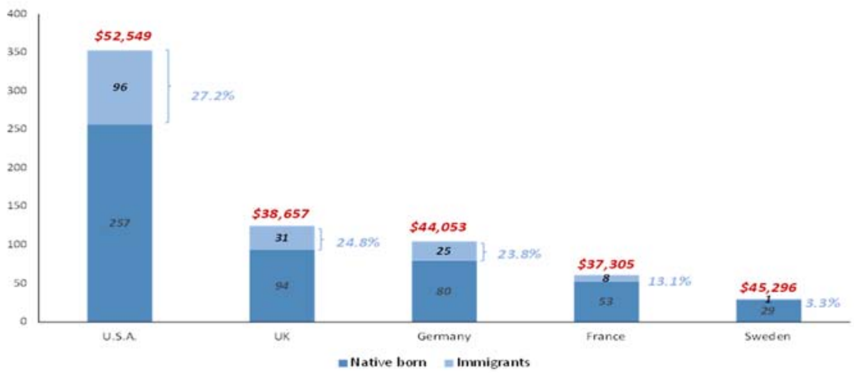
In this context, the present chapter proposes a simple framework to formalize some of the trade-offs that have been associated with immigration. Specifically, it sets a standard two-good, two-factor, two-country model of trade and explores a topic that has not been deeply investigated in the literature yet. To be more precise, the model explores the importance of assessing the skill composition of migration when performing welfare analysis and investigates how certain public policies affect migration.

The analysis is carried out by studying the impacts of international trade and migration under five different scenarios: (i) autarky; (ii) free trade and no migration; (iii) mutual trade restrictions and no migration; (iv) free migration and no international trade, and (v) tax on migration and no international trade. This analysis generates several interesting and insightful conclusions.

First, when the welfare function of the recipient country is assumed to correspond to the well-being of local inhabitants—that is, either because immigration policy decisions are taken *ex ante* or because, just as in any theoretical model of political economy, decision makers care about voters, the free-trade and the free-migration scenarios generate isomorphic results in terms of welfare and redistribution. That is, by complementing the abundant factor, immigrants increase overall welfare, but reduces the scarce factor's returns in the recipient country.

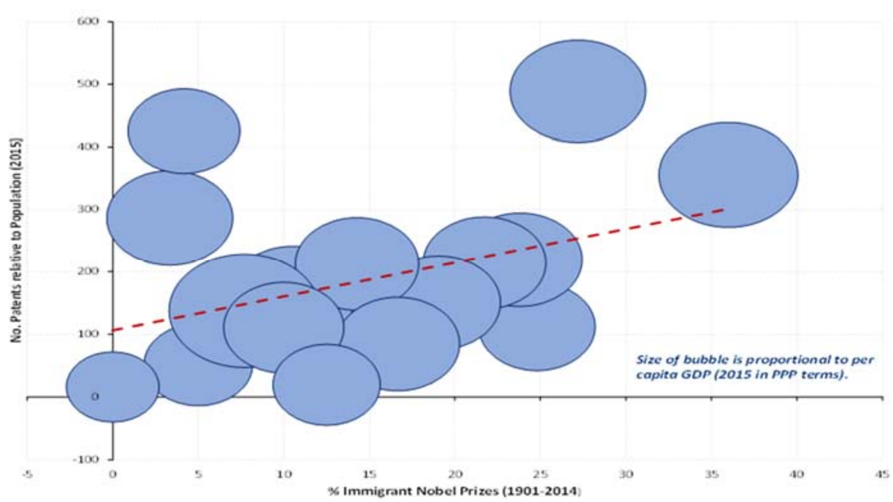
Although the aforementioned equivalence between trade and immigration has been numerously evoked in academic circles, this chapter contributes to the literature by showing that the result holds precisely for the most relevant measure of welfare from a political point of view (migrants do not vote and, thus, electoral speeches frequently focus only on natives). Moreover, the use of this measure is an innovation relative to existing theories that investigate the effects of migration in factor proportion models (Dixit and Norman 1980).

Figure 1 Nobel Prize, 1901–2014 (top five countries)



SOURCE: Author’s own calculations based on data from Nobelprize.org and the World Atlas.

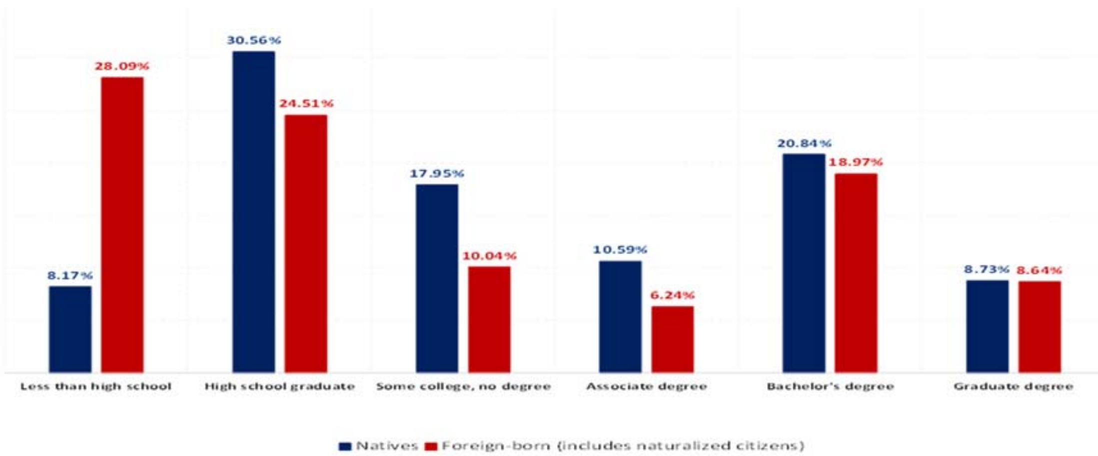
Figure 2 High-Skill Migration and Patents Registered (as a percentage of GDP per capita)



NOTE: Each observation in the figure is represented as proportion of real GDP per capita.
SOURCE: Author’s own calculations based on data from Nobelprize.org, World Atlas, World Bank, and U.S. Patent and Trademark Office.

Second, there is an additional and relevant contribution of the chapter that is also based on the equivalence between the free trade and the free migration scenarios and on public policies associated with the associated equilibria. Specifically, it compares the outcomes of the mutual trade restrictions environment analyzed in scenario (iii) with those that arise from the immigration policy case considered in scenario (v). This comparison allows showing that, for each level of mutual trade restrictions, there is a migration tax that replicates the same results in terms of welfare and redistribution effects from the perspective of the host country.

Figure 3 Native-Born Americans and Nonnatives (as a percentage of their total population, age 25 and over, 2015)



NOTE: The total population aged 25 and over is divided into native and foreign born, and then each category is divided according to educational attainment. Thus, the red bars sum up to a 100% and the blue bars sum up to 100%. The category "graduate degree" groups people with masters, doctoral and professional degrees. SOURCE: Author's calculations based on data from the Current Population Survey, 2015.

Third, it is then concluded that, given that migration enhances overall welfare but generates income redistribution, just as an imports tariff does, migration policies may be strongly influenced by political economy concerns and, in particular, not necessarily by efficiency considerations—that is, protectionist policies on trade and migration have the same redistribution effects and, therefore, may be based on the same kind of political economy considerations. Hence, the chapter proposes an extension of the model to illustrate one of the channels through which this influence may occur. That is, it combines a standard relative endowment framework with a political economy model for the determination of immigration policies. Consistent with the results of Galiani and Torrens (2015), we conclude that restrictions to international labor mobility may result from political economy motivations.

The remainder of the chapter is structured as follows. Section 2 presents a short literature review. Section 3 develops the model setup and Section 4 points out preliminary considerations that generalize the solution method of the model. Sections 5–8 present scenarios (i)–(iv), Section 8 states general welfare results and Sections 10 and 11 analyze scenario (v) and establish the equivalence between this scenario and mutual trade Restrictions. Finally, Section 12 sets the political economy debate and Section 13 concludes.

2. LITERATURE REVIEW

Economists have been long interested in understanding the effects and determinants of immigration, as well as the impacts of different immigration policy measures. This interest has given rise to both theoretical and empirical works, several of which keep a close relationship with this chapter. On the empirical front, economists' interest has produced a large body of literature performing evaluations in three domains: (i) the determinants of migration decisions; (ii) the impacts of migration on host labor markets and (iii) the effects of migration policies.

As for the factors determining immigration decisions, Borjas (1991) and Chiquiar and Hanson (2005) are two relevant studies. Both studies coincide that educational attainment is a critical determinant of immigration, meaning that differences in the skill returns between source and host countries provide distinct incentives to migrate to workers located in different segments of the skill distribution. Along these lines, the latter of these studies shows that Mexican immigrants to the U.S. are on average more educated than Mexican residents, but less educated than U.S. natives. Continuing with this line of research, Beine et al. (2010), Mayda (2010), and Ortega and Peri (2013) find that immigration decisions are also influenced by three additional determinants: income per capita and unemployment in the source and destination countries; the stock of people from the source nation residing in the destination country and the restrictiveness of immigration policies.

Regarding the strand of literature dealing with the impacts of migration on host labor markets, several of the arguments were proposed by Card and Borjas in the context of the “Mariel boatlift” episode, i.e., 45,000 Cubans arrived to Miami increasing its labor supply by 7 percent (mostly low-skill labor). On one hand, Card (1990) compared (a) the labor market outcomes of workers from different ethnicities and workers at different segments of the wage distribution within Miami across time periods and (b) the outcomes for different workers in Miami with outcomes of similar workers in other American cities. This comparison led him to conclude that the surge of labor supply in 1980 had no discernible impact on labor market outcomes in Miami (i.e., the changes in employment and wages in Miami were comparable to those observed in other American cities over the same period). On the other hand, Borjas (2016) later revisited the “Mariel boatlift” episode and argued that 60 percent of the influx of Cuban workers were high-school drop outs and that, as one focused on this specific segment of the labor market, wages in Miami decreased between 10 percent and 30 percent.

The third strand of empirical literature explores the effectiveness of immigration policies mainly on the size and the composition of migration flows. It has been shown that tighter immigration restrictions significantly reduce the size of migration flows, except for the case of asylum migration (Czaika and de Hass 2014; Thielmann 2004).[3] In contrast, the impacts on the composition of migration flows are harder to assess, mostly because it is difficult to construct indexes that can capture the restrictiveness of policies on specific groups of immigrants. Along these lines, Thielemann (2004) and de Haas, Natter, and Vezzoli (2014) propose different indexes and using them show that immigration policies have affected the size of migration flows but not necessarily their composition. This could be interpreted as evidence that deeper research is required to come up with appropriate restrictiveness measures when studying the composition of migration flows. An additional challenge

[3] Even though both studies measure policy effectiveness in terms of volume, Thielemann (2004) specifically assesses the impact on noneconomic migrants. That is, those immigrants whose decisions are driven by political motivations.

is given by the lack of studies evaluating the long-term impact of immigration policies, i.e., most existing studies focus on immediate impacts (Czaika and de Hass 2013, 2015).

As a final remark on the empirical literature, it should be noted that, while much has been done in terms of assessing relevant impacts, there is additional need for empirical work investigating the relationship between the skill profile of migrants and the skill profile of the host country's labor force. At the same time, it is important to investigate whether the skill supply of migrants is generally complementary to or substitute of the skill supply of the native labor force.

On the theoretical front, two papers keep a close relationship with ours: Dixit and Norman (1980) and Galiani and Torrens (2015). Just as we do here, Dixit and Norman (1980) set a standard model of international trade to investigate the effects of immigration. In particular, they feature a neoclassical factor proportion framework with two goods, two factors, and two goods and further complicate this model later in some of their extensions.

An interesting point of comparison between Dixit and Norman's (1980) and our work refers to the measure of welfare used in each case. Unlike us, they take as a welfare measure the well-being of both native and migrant workers and, in this context, show that immigration entails two types of effects. First, there is a direct effect that results from changing the size of the host country's population while holding prices constant—that is, given our interest in using a more politically relevant measure, this is the effect that our model does not take into account. Besides, there is an indirect effect that results from changes in the terms of trade. Dixit and Norman's conclusion (1980) is that there are no clear-cut answers for the net effects of migration.

The second theoretical paper related to ours is Galiani and Torrens (2015). In contrast with our factor proportion approach to international trade, they opt for a Ricardian framework featuring differences in technology across sectors and countries. However, just as this chapter does, their work extends a standard model of trade to account for political economy motivations. In particular, they combine their Ricardian economy with a simple international political economy model in which governments jointly decide on trade and immigration policies. In their framework, countries specialize in different goods and thus use different types of technologies. This implies that trade does not reduce real wages in any of the countries, but immigration diminishes them in the technologically advanced, rich nation. In particular, real wage differences induce workers to migrate there, increasing the labor supply and depressing real labor returns. Hence, while trade can be supported as a Nash equilibrium of the international political economy game, free international labor mobility cannot. In the same spirit of this note, they conclude that restrictions to migration are the result of political economy motivations.

3. MODEL SETUP

Consider a world with two countries, two factors, and two goods. The two countries, North and South, are indexed by N and S; the two factors, skilled and unskilled labor, are denoted by H and L; and the two goods are a skilled-intensive good and an unskilled-intensive good. The price of the former good is referred to as P, while the price of the latter good is chosen as the numeraire and will thus take the value of 1. North is assumed to be the skilled-labor-abundant country; hence, $L_N/H_N < L_S/H_S$. Technologies are identical across nations. In both countries, production is given by the following Cobb-Douglas constant-returns-to-scale functions:

$$Y_{js} = \varepsilon_s \left(H_{js}^{\beta} L_{js}^{1-\beta}\right), \tag{1}$$

$$Y_{js} = \varepsilon_s \left(H_{js}^{\alpha} L_{js}^{1-\alpha}\right), \tag{2}$$

where Y_{js} and Y_{ju} refer to the production of the skilled- and unskilled-intensive goods in country j and our skill-intensity assumption implies $\beta > \alpha$; where $\beta < 1$ and $\alpha < 1$.; H_{js} and L_{js} denote the amounts of skilled and unskilled workers used in the production of Y_{js} and $\varepsilon_s = \beta^{-\beta}(1-\beta)^{-(1-\beta)}$ and $\varepsilon_u = \alpha^{-\alpha}(1-\alpha)^{-(1-\alpha)}$ are normalizations of the production functions.

Preferences, also identical across regions, are given by the following utility function:

$$U_j = c_{js}^{\gamma}\, c_{ju}^{1-\gamma}\ , \tag{3}$$

where $\gamma < 1$ represents the relative preference for the skilled-intensive good and c_{js} denotes country j's consumption of this product. The indirect utility function associated with Equation (3) can be written as follows:

$$V_j = \gamma^{\gamma}(1-\gamma)^{1-\gamma} I_j P_j^{-\gamma}, \tag{4}$$

where I_j and P_j are the nominal income level and the price of the skilled-intensive good in country j. Equation (4) states a standard microeconomics result: utility is increasing in the real income of country j—that is, given that the price of Y_{ju} has been chosen as the numeraire, the price index faced by consumers in this region equals $(1)^{1-\gamma} P_j^{\gamma} = P_j^{\gamma}$.

Labor and product markets are perfectly competitive and thus in equilibrium profits must equal zero. Finally, we assume that relative labor supplies are sufficiently similar across regions that there is always incomplete specialization in equilibrium.

4. PRELIMINARY CONSIDERATIONS

There are similarities among the five scenarios we consider. In all of these cases, the zero-profit conditions will determine the wages of skilled and unskilled labor as a function of the price for the skilled-intensive good (P). Moreover, using these wages, the labor market clearing conditions will pin down in all these cases the supply of goods as a function of P. Finally, depending on the scenario that is being considered, this price will be determined by clearing in the market of the skilled-intensive good and/or by the size of migration flows.

Indeed, according to the manner in which P is determined, the five scenarios can be classified in three groups: 1) in autarky, there is neither migration nor trade and, thus, P is determined only by market-clearing conditions and these conditions are defined at the local level; 2) in scenarios (ii) and (iii) there is international trade and, therefore, P is determined only by market-clearing conditions defined at the global level; finally, scenarios (iv) and (v) allows for immigration so that P is determined by both market-clearing conditions defined at the country level and by migration flows.

Furthermore, it is possible to illustrate common patterns among our five scenarios in terms of welfare. For scenarios (i)–(iii), we follow the literature and use the indirect utility function shown in Equation (4), which, as noted above, is increasing in the real income of country j. In scenarios (iv) and (v), the argument is subtler given that these cases consider migration, which in turn may threaten the validity of Equation (4) as an appropriate welfare measure. To see this, note that when utility is measured by (4), total income increases with factor endowments, and therefore migration flows generate almost mechanically an increasing effect on utility by increasing the population of the country. In turn, the problem is that, by increasing the population size, migration flows could also end up diminishing welfare in per capita terms.

Thus, to prevent our measure of welfare from increasing mechanically in response to migration flows, but also to concentrate on political economy aspects of migration policies, we will focus exclusively on the welfare of native inhabitants. That is, in scenarios (iv) and (v), in which immigration takes place, we will use the following measure of welfare:

$$V_j^{(\text{iv})-(\text{v})} = \frac{(1-\gamma)^{1-\gamma}\gamma^{\gamma} I_j(\widehat{L_j},\widehat{H_j},w_j(L_j,H_j),q_j(L_j,H_j)\,)P_j(L_j,H_j)^{-\gamma}}{\widehat{L_j}+\widehat{H_j}}, \tag{5}$$

where the numerator is given by the indirect utility function shown in Equation (4), and the hats over L_j and H_j indicate the cases in which these variables remain fixed in the calculation of welfare. Note in Equation (5) that, when considering scenarios (iv) and (v), the analysis abstracts from the direct impact of migration on the labor income of skilled and unskilled workers. Precisely, this analysis focuses on the impact of migration on welfare through its effect on wages and the relative price of the skilled-intensive good. Hence, to evaluate welfare effects in scenarios (iv) and (v), the chapter will concentrate on changes in real income and only on changes in this income arising from variations in relative prices, just as we will in scenarios (i)–(iii). In this regard, it is important to note that this common pattern arises only from the fact that we have chosen the most relevant measure of welfare from a political economy point of view.

Furthermore, note that in Equations (4) and (5) this measure is fully determined by real income ($I_j P_j^{-\gamma}$), which in turn is equal to the sum of real returns to skilled and unskilled labor. That is, the expression for real income can be written as follows:

$$I_j P_j^{-\gamma} = \widehat{L_j} w_j P_j^{-\gamma} + \widehat{H_j} q_j P_j^{-\gamma}, \tag{6}$$

where $w_j P_j^{-\gamma}$ and $q_j P_j^{-\gamma}$ denote the real unskilled and skilled wages, respectively.

Moreover, the fact that in the five scenarios the outcomes derived from the zero-profit conditions can be written as a function of P_j implies that w_j and q_j can also be fully written in terms of this price. In particular, using the zero-profit conditions, it is possible to write the real unskilled and skilled wages in all scenarios as follows (see Appendix 2 for a full derivation): [4]

$$q_j = P_j^{\frac{1-\alpha}{\beta-\alpha}}, \tag{7}$$

$$w_j = P_j^{\frac{-\alpha}{\beta-\alpha}}. \tag{8}$$

Intuitively, simple algebra on (7) and (8) shows that an increase in the price of the skilled-intensive good (P_j) leads to a rise in the unskilled wage (q_j) and a reduction in the unskilled wage (w_j). Substituting the definitions of q_j and w_j in Equation (6), we can write real income as follows:

$$I_j P_j^{-\gamma} = \widehat{L_j} P_j^{\frac{-\alpha(1-\gamma)-\beta\gamma}{\beta-\alpha}} + \widehat{H_j} P_j^{\frac{1-\alpha(1-\gamma)-\beta\gamma}{\beta-\alpha}} = P_j^{\frac{-\alpha(1-\gamma)-\beta\gamma}{\beta-\alpha}} (\widehat{L_j} + \widehat{H_j} P_j^{\frac{1}{\beta-\alpha}}). \tag{9}$$

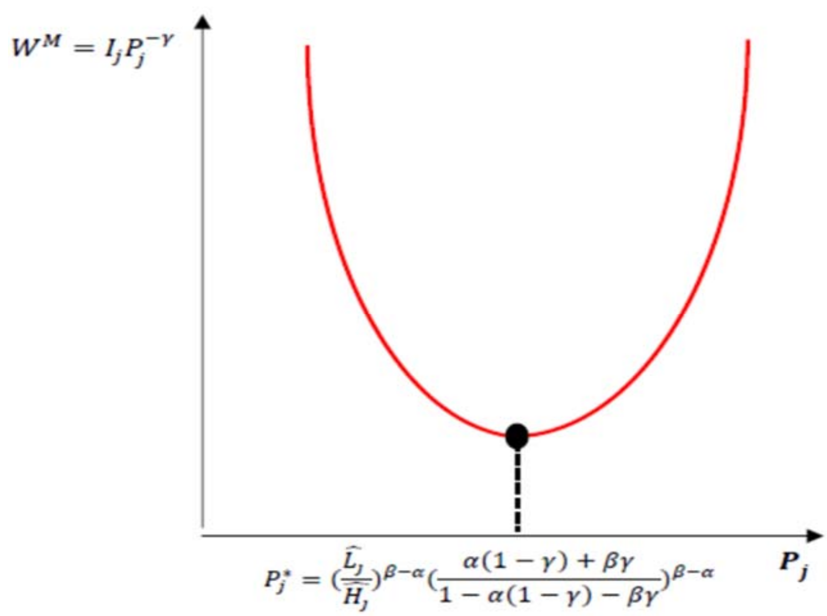
Equation (9) states that, as the "politically relevant" measure of welfare is taken into account, immigration flows affect welfare only through prices. In addition, this equation states that an increase in P_j has two opposing effects on real income: on the one hand, the increase reduces the real returns to unskilled workers but, on the other hand, it raises the real returns to skilled employees. Note that

[4]As understood from the equations shown in upcoming sections, for the case of mutual trade restriction, the price of P_j in (7) and (8) must be interpreted as the effective relative price of the skilled-intensive good.

the strength of the former negative effect is increasing in $\widehat{L_j}$ and α, while the strength of the latter positive negative effect is increasing in $\widehat{H_j}$ and β.

Using these results, Appendix 2 shows that the expression in Equation (9) has a single critical point—that is, a minimum, within the interval $P_j \exists (0, \infty)$. Thus, under the proper assumptions on the concavity on $I_j P_j^{-\gamma}$, Figure 4 plots real income as a function of P_j. In this figure, W^M indicates that real income is our welfare measure and $P_j = P_j^* = (\frac{\widehat{L_j}}{\widehat{H_j}})^{\beta-\alpha}(\frac{\alpha(1-\gamma)+\beta\gamma}{1-\alpha(1-\gamma)-\beta\gamma})^{\beta-\alpha}$ is the price at which the effect of a marginal price change on the skilled wage fully offsets its effects on the unskilled wage, that is, the effect of a marginal price change on real income equals zero. Intuitively, the larger $\widehat{L_j}$, the higher the value of P_j^* is a great value of $\widehat{L_j}$ raises the negative impact of increases in P_j on real income, so that this negative impact is only offset at a higher value of P_j. The same result holds for β.

Figure 4 Real Income (Our Measure of Welfare) as a Function of P_j



5. AUTARKY

This section studies the equilibrium properties and welfare characteristics of two autarkic economies, North and South. The absence of international trade or migration implies that the two regions must be understood as fully completely separate economies. That is, North and South will have different prices for the skilled-intensive good and that their real skilled and unskilled wages will be different. Indeed, in each region the skilled and the unskilled wages are determined by the corresponding pair of zero-profit conditions. In a perfectly competitive environment, these conditions are fulfilled when the effective price of each good equals its unitary cost. When technology is given by the constant-returns-to-scale production functions shown in Equations (1) and (2), unitary costs equal marginal costs and, therefore, the zero-profit conditions in North can be written as follows (see Appendix 3 for a general derivation of marginal costs and zero-profit conditions):

$$q_N^{aut\,\beta} w_N^{aut\,1-\beta} = P_N^{aut}, \tag{10}$$

$$q_N^{aut\,\alpha} w_N^{aut\,1-\alpha} = 1, \tag{11}$$

where q_N and w_N refer to the skilled and unskilled wages in North, P_N^{aut} is the price of the skilled-intensive good under the autarkic regime in this country and the price of the unskilled-intensive good has been again chosen as the numeraire. Combining Equations (10) and (11) one can write q_N and w_N in terms of P_N^{aut} as follows:

$$q_N^{aut} = P_N^{aut\,\frac{1-\alpha}{\beta-\alpha}}, \tag{12}$$

$$w_N^{aut} = P_N^{aut\,\frac{-\alpha}{\beta-\alpha}}. \tag{13}$$

By dividing (12) and (13) by the price index—which equals $P_N^{aut\,\gamma}$ because the price of the unskilled-intensive is equal to 1—one can obtain the expressions for real skilled and unskilled wages. In turn, these wages can be used to derive the expression for real income, that is, our measure of welfare. Hence, using Equations (12) and (13), real wages and income can be written as follows:

$$\frac{q_N^{aut}}{P_N^{aut\,\gamma}} = P_N^{aut\,\frac{1-\alpha(1-\gamma)-\beta\gamma}{\beta-\alpha}}, \tag{14}$$

$$\frac{w_N^{aut}}{P_N^{aut\,\gamma}} = P_N^{aut\,\frac{-\alpha(1-\gamma)-\beta\gamma}{\beta-\alpha}}, \tag{15}$$

$$I_N^{aut}\,P_N^{aut\,-\gamma} = (H_N\frac{q_N^{aut}}{P_N^{aut\,\gamma}} + L_N\frac{w_N^{aut}}{P_N^{aut\,\gamma}}) = P_N^{aut\,\frac{-\alpha(1-\gamma)-\beta\gamma}{\beta-\alpha}}(L_N + H_N P_N^{aut\,\frac{1}{\beta-\alpha}}). \tag{16}$$

Note that Equation (16) shows the same definition of real income that appears in Equation (9), except for the superscripts indicating that we are dealing with the autarky case. This illustrates that Equation (9) provides a general definition that can therefore, after the corresponding superscript switch, be applied to the any of five scenarios under consideration.

Furthermore, using Equations (12) and (13), one can write the skill-premium in North as $P_N^{aut\,\frac{1}{\beta-\alpha}}$. In turn, this premium determines the total demands for skilled and unskilled labor as a function of P_N^{aut}. Equating these demands to H_N and L_N, the Northern supplies of skilled and unskilled labor, the supply of each good can also be written as a function of P_N^{aut} (see Appendix 4 for a general derivation of labor market clearing conditions). The following equations summarize the results:

$$Y_{Ns}^{aut} = P_N^{aut\,\frac{-\beta}{\beta-\alpha}}(H_N P_N^{aut\,\frac{1}{\beta-\alpha}}(1-\alpha) - L_N\alpha)/(\beta-\alpha), \tag{17}$$

$$Y_{Nu}^{aut} = P_N^{aut\,\frac{-\alpha}{\beta-\alpha}}(L_N\beta - H_N P_N^{aut\,\frac{1}{\beta-\alpha}}(1-\beta))/(\beta-\alpha). \tag{18}$$

Equations (17) and (18) have left the most relevant endogenous variables as a function of P_N^{aut}. To find the equilibrium value of this price, one needs to equate the supply shown in Equation (17) to the demand for the skilled-intensive good. Hence, this equilibrium price can be written as follows (see Appendix 5 for a full derivation of this price under general product market clearing conditions):

$$P_N^{aut} = (\frac{L_N}{H_N})^{\beta-\alpha}(\frac{\alpha(1-\gamma)+\beta\gamma}{1-\alpha(1-\gamma)-\beta\gamma})^{\beta-\alpha}. \tag{19}$$

Intuitively, Equation (19) states that the autarky price of the skilled-intensive good is increasing in the unskilled-to-skilled labor ratio; that is, the skilled intensive good in autarky will be relatively more expensive when the relative supply of the factor used intensively to produce it is scarcer. Using the same logic we follow above, one can obtain real wages and the price in South:

$$\frac{q_S^{aut}}{{P_S^{aut}}^{\gamma}} = P_S^{aut\,\frac{1-\alpha(1-\gamma)-\beta\gamma}{\beta-\alpha}} \qquad (20)$$

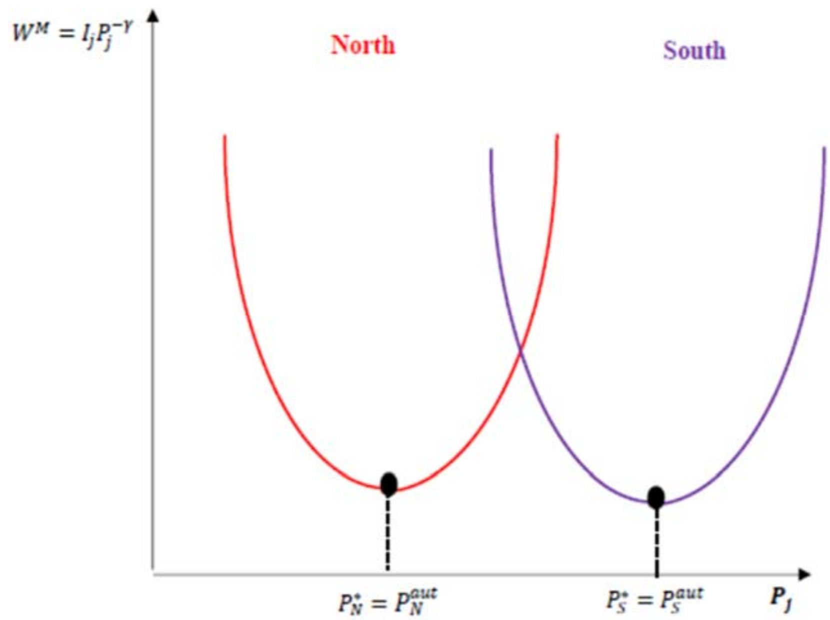
$$\frac{w_S^{aut}}{{P_S^{aut}}^{\gamma}} = P_S^{aut\,\frac{-\alpha(1-\gamma)-\beta\gamma}{\beta-\alpha}} \qquad (21)$$

$$P_S^{aut} = (\frac{L_S}{H_S})^{\beta-\alpha}(\frac{\alpha(1-\gamma)+\beta\gamma}{1-\alpha(1-\gamma)-\beta\gamma})^{\beta-\alpha} \qquad (22)$$

A comparison between Equations (19) and (22), along with the fact that $L_N/H_N < L_s/H_s$, reveals that $P_N^{aut} < P_S^{aut}$: the autarky price of the skilled-intensive good is smaller in the skilled-abundant country (North). This is a standard result in the literature of factor-proportion models.

Furthermore, inspection of Equations (19) and (22) shows that the autarky prices are the values of P_j at which the effect of a marginal price change on real income equals zero—that is, using the notation from Figure 4, we write $P_N^{aut} = P_N^*$ and that $P_S^{aut} = P_S^*$. In this regard, it notes that, although Figure 5 would seem to suggest that the welfare function attains a minimum at P_j^* for given endowment levels, we are not minimizing welfare through resource allocation. Indeed, the autarky equilibrium is the most efficient among all feasible choices for the resources held in the economy. Any of the other allocations in Figure 5 yield a higher welfare but nonetheless require relaxing the constraints defining this function (i.e., more resources or better technology). Indeed, as noted below, reaching greater welfare is possible through the separation of consumption and production decisions generated by trade, which will lead economies to different points of the curves by allowing them to consume a different bundle from the one they produce, just as if they had more resources.

Figure 5 Real Income as a Function of P_j in Autarky



6. FREE INTERNATIONAL TRADE

This section considers a scenario in which there is an international exchange of goods but no migration flows. While international trade equalizes the price of the skilled-intensive good across countries, the absence of migration implies that real wages will be determined only by this price, and, in particular, will not be determined by migration flows.

Just as in the previous section, we begin with the zero-profit conditions. Marginal costs are given exclusively by the technologies used in production and are, therefore, the same that appear in the left-hand sides in Equations (10) and (11). For the purpose of solving the model, the only difference between the relevant conditions in this section and Equations (10) and (11) is that, in this case, the price of the skilled-intensive is the same across countries and should not carry, as a result, a j sub-index—thus, the derivation of the zero-profit conditions are in this case are also consistent with the general derivation shown in Appendix 3. Hence, it follows that the skilled and unskilled wages are also the same across countries and that their expressions can be found by using Equations (10) and (11). These wages can be written as follows:

$$q^{FT} = P^{FT\frac{1-\alpha}{\beta-\alpha}}, \tag{23}$$

$$w^{FT} = P^{FT\frac{-\alpha}{\beta-\alpha}}. \tag{24}$$

As for real wages, they can also be obtained in this case by dividing nominal wages through the price index, which is equal to $P^{FT\,\gamma}$, given that the price of the unskilled-intensive good is now also equal to 1. Thus, real wages can be written as follows:

$$\frac{q^{FT}}{P^{FT\,\gamma}} = P^{FT\frac{1-\alpha(1-\gamma)-\beta\gamma}{\beta-\alpha}} \tag{25}$$

$$\frac{w^{FT}}{P^{FT\,\gamma}} = P^{FT\frac{-\alpha(1-\gamma)-\beta\gamma}{\beta-\alpha}} \tag{26}$$

The difference with the autarky case in terms of the solution method lies in the products market equilibrium, which is in this section defined at the global level. The supply of goods differs across countries due to differences in factor proportions. Using the same logic as in the previous section, one can obtain labor demands in each country by using the skill-premium implied by Equations (23) and (24). The difference is that now the sum of demands must be equated to the sum of supplies, leading to the following equilibrium values:

$$Y_{Ns}^{FT} = P^{FT\frac{-\beta}{\beta-\alpha}}(H_N P^{FT\frac{1}{\beta-\alpha}}(1-\alpha) - L_N\alpha)/(\beta-\alpha) \tag{27}$$

$$Y_{Nu}^{FT} = P^{FT\frac{-\alpha}{\beta-\alpha}}(L_N\beta - H_N P^{FT\frac{1}{\beta-\alpha}}(1-\beta))/(\beta-\alpha) \tag{28}$$

$$Y_{Ss}^{FT} = P^{FT\frac{-\beta}{\beta-\alpha}}(H_S P^{FT\frac{1}{\beta-\alpha}}(1-\alpha) - L_S\alpha)/(\beta-\alpha) \tag{29}$$

$$Y_{Su}^{FT} = P^{FT\frac{-\alpha}{\beta-\alpha}}(L_S\beta - H_S P^{FT\frac{1}{\beta-\alpha}}(1-\beta))/(\beta-\alpha) \tag{30}$$

Regarding the equilibrium value of P^{FT}, it is possible to find it by solving the product market-clearing conditions. Nonetheless, unlike in the autarky case, these conditions are now defined at the global level. In particular, P_N^{FT} is the price that equates the global demand for the skilled-intensive good and the sum of supplies shown in Equations (27) and (29). By equating global supply and demand, we obtain the following equilibrium price (see Appendix 5 for a proof):

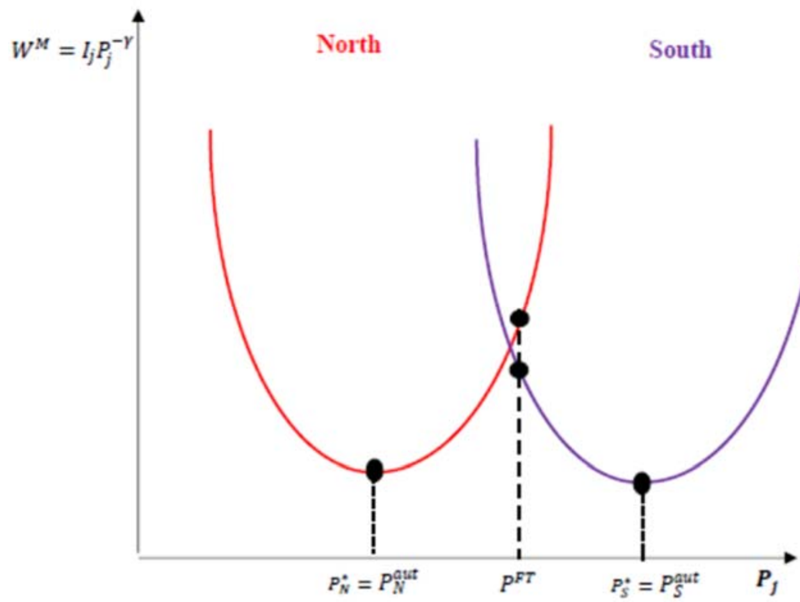
$$P^{FT} = (\frac{L_W}{H_W})^{\beta-\alpha}(\frac{\alpha(1-\gamma)+\beta\gamma}{1-\alpha(1-\gamma)-\beta\gamma})^{\beta-\alpha} \quad (31)$$

where $H_W = H_N + H_S$ and $L_W = L_N + L_S$ refer to the world's supplies of skilled and unskilled labor. Note in Equation (31) that the expression for P^{FT} is similar to the expression defining the equilibrium price in the autarky case; the difference is that, while in the autarky regime there is a relevant unskilled-to-skilled labor ratio for each country, in the free trade equilibrium the single relevant ratio refers to the entire world. Indeed, the latter result implies that, as well-known, the free-trade equilibrium replicates the allocations of the integrated economy—the one we would observe in a world with no boundaries.

Equation (31) can also be used to evaluate changes in P_j that result from trade liberalization, that is, the transition from the autarky case to the free trade equilibrium. Recall that P_j provides enough information to judge changes in welfare and redistribution. Note in this regard that, given that $L_N/H_N < L_s/H_s$, we know that $P_N^{aut} < P^{FT} < P_S^{aut}$: the equilibrium price under free trade lies within the range of prices determined by the autarky prices and, therefore, this price increases in North but diminishes in South, relative to autarky. This result also takes part of the standard set of outcomes in the literature of factor-proportion models of international trade.

As for the welfare implications of the transition from trade liberalization, we can explore them by using the results obtained in Section 4. Using Figure 5, it is possible to build a three-step argument showing that free trade enhances welfare in both countries; the three steps are as follows: 1) $I_j P_j^{-\gamma}$, and thus welfare, is decreasing in P_j for any $P_j \ni (0, P_j^*)$ and increasing for any $P_j \ni (P_j^*, \infty)$; 2) P_N^{aut} is P_N^* and P_S^{aut} is P_S^*; and 3) as noted in the previous paragraph, $P_N^{aut} < P^{FT} < P_S^{aut}$ (see Figure 6). International trade leads both countries to an equilibrium price that is not feasible in the autarky regime. This result is consistent with the idea that free trade enhances welfare by allowing countries to separate consumption from production bundles and, in particular, to reach a consumption bundle that lies in the set of unfeasible allocations for the autarky case.

Figure 6 Real Income as a Function of P_j under Free Trade



The fact that we know how P_j changes in the transition from the autarky to the free trade equilibrium implies that we can also find out the corresponding redistributive effects. These redistributive impacts can be summarized as follows:

$$P^{FT} > P_N^{aut} \xrightarrow{yields} \frac{q_N^{aut}}{P_N^{aut\,\gamma}} < \frac{q_N^{FT}}{P^{FT\,\gamma}} \; ; \; \frac{w_N^{aut}}{P_N^{aut\,\gamma}} > \frac{w_N^{FT}}{P^{FT\,\gamma}} \tag{32}$$

$$P^{FT} < P_S^{aut} \xrightarrow{yields} \frac{q_S^{aut}}{P_S^{aut\,\gamma}} > \frac{q_S^{FT}}{P^{FT\,\gamma}} \; ; \; \frac{w_S^{aut}}{P_S^{aut\,\gamma}} < \frac{w_S^{FT}}{P^{FT\,\gamma}} \tag{33}$$

Trade liberalization increases the real skilled wage and diminishes the real unskilled wage in the skilled-abundant country. By contrast, the former wage falls and the latter wage rises in the unskilled labor abundant country. This result is also standard in international trade theory and frequently referred to in the context of the Stolper-Samuelson Theorem.

7. MUTUAL TRADE RESTRICTIONS

This section considers a scenario in which migration is still not allowed. However, starting from a free trade environment, countries mutually impose an imports tariff. The mutual trade restrictions regime lies between the autarky and the free trade scenarios, and thus, as is well known, a mutual imports tariff harms abundant factors, benefits scarce factors, and reduces welfare in aggregate terms in each country, as compared to the free trade equilibrium.

In this context, the mutual trade restriction scenario sets a benchmark for comparison with Section 8, in which immigration is restricted by a choice of migration policy, just as international trade is restricted by the import tariff in the present section. As more clearly noted below, the mutual trade restriction equilibrium can be replicated by the appropriate choice of a migration tax.

Here, the imports tariff is assumed to be identical across countries and to take the iceberg form so that, in order for one unit of a product to arrive in the other country, $\tau > 1$ must be shipped—the rest melts away in transit. By creating a wedge between domestic and international prices, the tariff will prevent the effective price of the skilled-intensive good from equalizing across countries. In the absence of migration, this will in turn also prevent real wage equalization.

Regarding the zero-profit conditions, it should be noted that the tariff increases the effective price of imported products: the skilled-intensive good in South and the unskilled-intensive good in North. In contrast, because marginal costs depend exclusively on the technology used for production, they remain unaltered relative to previous sections. Hence, the zero-profits conditions can be written as follows:

$$q_N^{\beta} w_N^{1-\beta} = P^{MTR} \tag{34}$$

$$q_N^{\alpha} w_N^{1-\alpha} = \tau \tag{35}$$

$$q_S^{\beta} w_S^{1-\beta} = \tau P^{MTR} \tag{36}$$

$$q_S^{\alpha} w_S^{1-\alpha} = 1 \tag{37}$$

where P^{MTR} is the price of the skilled-intensive good in the mutual trade restriction scenario. Solving the systems formed by equations (34)–(35) and by equations (36)–(37), it is possible to write wages as follows:

$$q_N^{MTR} = P^{MTC\,\frac{1-\alpha}{\beta-\alpha}}\,\tau^{\frac{-(1-\beta)}{\beta-\alpha}} \tag{38}$$

$$w_N^{MTR} = P^{MTC\,\frac{-\alpha}{\beta-\alpha}}\,\tau^{\frac{\beta}{\beta-\alpha}} \tag{39}$$

$$q_S^{MTR} = P^{MTC\,\frac{1-\alpha}{\beta-\alpha}}\,\tau^{\frac{1-\alpha}{\beta-\alpha}} \tag{40}$$

$$w_S^{MTR} = P^{MTC\,\frac{-\alpha}{\beta-\alpha}}\,\tau^{\frac{-\alpha}{\beta-\alpha}} \tag{41}$$

Equations (38)–(41) can be used to derive the real skilled and unskilled wages in each country. When calculating real wages, it is important to note that the imports tariff modifies the price index in both nations. In particular, while the price index in North is now given by $(P^{MTR})^{\gamma}(\tau)^{1-\gamma}$, in South this index is given by $(P^{MTR}\tau)^{\gamma}$. Taking this into account, we write real wages as follows:

$$\frac{q_N^{MTR}}{(P^{MTR})^{\gamma}(\tau)^{1-\gamma}} = (P^{MTR}/\tau)^{\frac{1-\alpha(1-\gamma)-\beta\gamma}{\beta-\alpha}}, \tag{42}$$

$$\frac{w_N^{MTR}}{(P^{MTR})^{\gamma}(\tau)^{1-\gamma}} = (P^{MTR}/\tau)^{\frac{-\alpha(1-\gamma)-\beta\gamma}{\beta-\alpha}}, \tag{43}$$

$$\frac{q_S^{MTR}}{(P^{MTR}\tau)^{\gamma}} = (P^{MTR}\tau)^{\frac{1-\alpha(1-\gamma)-\beta\gamma}{\beta-\alpha}}, \tag{44}$$

$$\frac{w_S^{aMTR}}{(P^{MTR}\tau)^{\gamma}} = (P^{MTR}\tau)^{\frac{-\alpha(1-\gamma)-\beta\gamma}{\beta-\alpha}}, \tag{45}$$

A comparison of Equations (42)–(43) with (14)–(15) and (25)–(26) reveals that Northern real wages have symmetric expressions in the mutual trade restriction case and in the remaining scenarios; however, in the former case, the price of the skilled-intensive good is divided by the imports tariff (P^{MTR}/τ). Note that the same result holds for South; nonetheless, in this case, the price of the skilled-intensive good must be multiplied by the imports tariff. Indeed, trade restriction creates a wedge between relative prices across countries.

Moreover, inspection of (38)–(41) shows that a similar result can be formulated in terms of skill-premia. While the Northern skill-premia in the autarky and free trade scenarios equal $(P_N^{aut})^{\frac{1}{\beta-\alpha}}$ and $(P^{FT})^{\frac{1}{\beta-\alpha}}$, respectively, the skill-premium implied by (38)–(39) is obtained by dividing the price of the skilled-intensive good through the imports tariff, i.e., and equals $(P^{MTR}/\tau)^{\frac{1}{\beta-\alpha}}$. By the same token, to obtain the Southern skill-premium implied by (40)-(41) one must multiply the price by the tariff $(P^{MTR}\tau)^{\frac{1}{\beta-\alpha}}$. Just by multiplying or by dividing through the imports tariff, one can go back and forth from the mutual trade restriction and the remaining scenarios.

Just as in previous sections, the skill-premia can be used to derive the demand for skilled and unskilled labor in each country and, subsequently, to obtain the supply of goods. Indeed, the fact that technologies are the same implies that labor demands as a function of skill-premia are also exactly the same. Thus, the only difference in setting up the labor market clearing conditions lies in the divergence of skill-premia among the different scenarios. Taken this difference in consideration, we can solve for the labor market clearing conditions and derive the following output supplies (Appendix 6 proves this result):

$$Y_{Ns}^{MTR} = (P^{MTR}/\tau)^{\frac{-\beta}{\beta-\alpha}}(H_N(P^{MTR}/\tau))^{\frac{1}{\beta-\alpha}}(1-\alpha) - L_N\alpha)/(\beta-\alpha) \tag{46}$$

$$Y_{Nu}^{MTR} = (P^{MTR}/\tau)^{\frac{-\alpha}{\beta-\alpha}}(L_N\beta - H_N(P^{MTR}/\tau)^{\frac{1}{\beta-\alpha}}(1-\beta))/(\beta-\alpha) \tag{47}$$

$$Y_{Ss}^{Tar} = (P^{MTR}\tau)^{\frac{-\beta}{\beta-\alpha}}(H_S(P^{MTC}\tau)^{\frac{1}{\beta-\alpha}}(1-\alpha) - L_S\alpha)/(\beta-\alpha) \tag{48}$$

$$Y_{Su}^{Tar} = (P^{MTR}\tau)^{\frac{-\alpha}{\beta-\alpha}}(L_S\beta - H_S(P^{MTR}\tau)^{\frac{1}{\beta-\alpha}}(1-\beta))/(\beta-\alpha) \tag{49}$$

Now, note that the Northern supply of goods represented in Equations (46) and (47) allows calculating the income level in North as a function of P^{MTR} and, therefore, solving for real income in this country. Obtaining the expression for real income in North will be critical to set a benchmark for comparison with the study of a migration tax. In particular, in Section 12, we will investigate whether a migration policy can replicate the same real income as the imports tariff considered in this section.

Taking this in consideration, we use expressions (46) and (47) to write income and real income in North as follows:

$$I_N^{MTR} \;=\; Y_{Ns}^{MTR}\, P^{MTR} + Y_{Nu}^{MTR}\, \tau = P^{MTR\frac{-\alpha}{\beta-\alpha}} \tau^{\frac{\beta}{\beta-\alpha}} (L_N + H_N P^{MTC\frac{1}{\beta-\alpha}} \tau^{\frac{-1}{\beta-\alpha}}) \tag{50}$$

$$I_N^{MTR}\, ((P^{MTR})^{\gamma} (\tau)^{1-\gamma})^{-1} = (P^{MTR}/\tau)^{\frac{-\alpha(1-\gamma)-\beta\gamma}{\beta-\alpha}} ((P^{MTR}/\tau)^{\frac{1}{\beta-\alpha}} H_N + L_N) \tag{51}$$

Not surprisingly, a simple comparison between (9) and (51) shows that we have again found the same pattern: the expression for real income, and thus welfare, in the mutual trade restriction case is symmetric to the expression for the remaining scenarios, but in the former case the price of the skilled-intensive good must be divided by the import tariffs. Putting together Equation (42)–(43) and (51) we know that as long as a migration tax is able to generate an equilibrium price equal to P^{MTR}/τ, it will generate the welfare level and redistributive implications as the imports tariff. In section 12, it will be shown that such a migration tax actually exists.

Given what we have just said, it is critical to find the equilibrium value of P^{MTR}. For this purpose, we will use the supplies of goods shown in Equations (46)–(49) to set product market equilibrium. Nonetheless, in contrast with the product market equilibrium conditions from previous sections, in this section the conditions must consider that a country can only satisfy a certain demand for imports by producing that demand plus the quantity lost in transit. Taking this into account, we solve for product market clearing and find the following price (see Appendix 6 for a full proof):

$$P^{MTR} = \left(\frac{(\alpha(1-\gamma)+\beta\gamma)(L_N+\tau L_S)}{(1-\alpha(1-\gamma)-\beta\gamma)(H_N \tau^{\frac{1}{\alpha-\beta}} + \tau^{\frac{-1+\alpha+\beta}{\alpha-\beta}} H_S)}\right)^{\beta-\alpha} \tag{52}$$

8. FREE MIGRATION AND NO INTERNATIONAL TRADE

This section investigates the equilibrium characteristics and welfare implications of allowing for migration. For this purpose, it considers a scenario in which workers are allowed to migrate freely to a different country and there is no international trade. In order to construct this scenario, we take as a point of departure the autarky regime presented in Section 5. In particular, starting from this point, we will find the ensuing incentives for migration and resulting equilibrium prices.

As clearly stated in Section 5, the autarky price of the skilled-intensive good is smaller in North ($P_N^{aut} < P_S^{aut}$). In turn, it is easy to see that this implies $\frac{q_N^{aut}}{{P_N^{aut}}^{\gamma}} < \frac{q_S^{aut}}{{P_S^{aut}}^{\gamma}}$ and $\frac{w_N^{aut}}{{P_N^{aut}}^{\gamma}} > \frac{w_S^{aut}}{P_S^{aut}}$: in a scenario with no international trade and migration barriers, *s*killed workers have incentives to migrate South and unskilled workers have incentives to migrate North. Moreover, these incentives are only exhausted once migration flows lead real skilled and unskilled wages to be equal across countries. Indeed, this will be our main equilibrium condition in the present section.

Using the expressions for real wages shown in Section 5, we can write real wages in a situation with no international trade as follows:

$$\frac{q_N^{FM}}{{P_N^{FM}}^{\gamma}} = {P_N^{FM}}^{\frac{1-\alpha(1-\gamma)-\beta\gamma}{\beta-\alpha}} \tag{53}$$

$$\frac{w_N^{FM}}{{P_N^{FM}}^{\gamma}} = {P_N^{FM}}^{\frac{-\alpha(1-\gamma)-\beta\gamma}{\beta-\alpha}} \tag{54}$$

$$\frac{q_S^{FM}}{{P_S^{FM}}^{\gamma}} = {P_S^{FM}}^{\frac{1-\alpha(1-\gamma)-\beta\gamma}{\beta-\alpha}} \tag{55}$$

$$\frac{w_S^{FM}}{{P_S^{FM}}^{\gamma}} = {P_S^{FM}}^{\frac{-\alpha(1-\gamma)-\beta\gamma}{\beta-\alpha}} \tag{56}$$

where the superscript *FM* denotes that we are dealing with the free migration case and P_N^{FM} and P_S^{FM} are the prices of the skilled-intensive good in North and South, respectively. Following Section 5, we know that the equilibrium values of these prices can be written as follows:

$$P_N^{FM} = (\frac{L_N}{H_N})^{\beta-\alpha}(\frac{\alpha(1-\gamma)+\beta\gamma}{1-\alpha(1-\gamma)-\beta\gamma})^{\beta-\alpha} \tag{57}$$

$$P_S^{FM} = (\frac{L_S}{H_S})^{\beta-\alpha}(\frac{\alpha(1-\gamma)+\beta\gamma}{1-\alpha(1-\gamma)-\beta\gamma})^{\beta-\alpha} \tag{58}$$

Note, however, that unlike in Section 5, the number of unskilled workers in North in this section is given not only by the original population but also by the number of unskilled migrants—recall that we have left these migrants aside from welfare calculation but not from price calculation. In other words, we can write: $L_N = \widehat{L_N} + M_{LN}$, where M_{LN} refers to the number of (net) unskilled immigrants to North. By the same token, it is known that $H_N = \widehat{H_N} + M_{HN}$ and that $L_S = \widehat{L_S} + M_{LS}$ and $H_S = \widehat{H_S} + M_{HS}$.

As noted above, in the absence of migration barriers, skilled workers have incentives to migrate South and unskilled have incentives to migrate North until real wages equalize. Using Equations (53)–(59), it is easy to see that this equilibrium condition can be written as follows:

$$\frac{q_N^{FM}}{P_N^{FM\,\gamma}} = \frac{q_S^{FM}}{P_S^{FM\,\gamma}} \;;\; \frac{w_N^{FM}}{P_N^{FM\,\gamma}} = \frac{w_S^{FM}}{P_S^{FM\,\gamma}} \xrightarrow{yields} P_N^{FM} = P_S^{FM} \xrightarrow{yields} \frac{L_S}{H_S} = \frac{L_N}{H_N} \tag{59}$$

Equation (59) states that in equilibrium good prices and therefore unskilled-to-skilled labor ratios must be the same in both countries; it is only in this way that real wages are identical across regions. Importantly, note that because real wages do not depend on the supply of skilled and unskilled workers in absolute terms, the equilibrium condition only pins down the corresponding unskilled-to-skilled labor ratios.

In order to find the precise value of the unskilled-to-skilled labor ratio that fulfills (59), let us use the following full-employment definition:

$$L_S + L_N = L_W \tag{60}$$

where L_W denotes the world's unskilled labor supply. Dividing Equation (60) through H_W (the world's labor supply) we can write:

$$(\frac{\boldsymbol{H_S}}{H_W})(\frac{L_S}{\boldsymbol{H_S}}) + (\frac{\boldsymbol{H_N}}{H_W})(\frac{L_N}{H_N}) = \frac{L_W}{H_W} \tag{60'}$$

Let us now substitute $\frac{\boldsymbol{H_N}}{H_W}$ with the expression $1 - \frac{\boldsymbol{H_S}}{H_W}$ in Equation (60') and write:

$$(\frac{\boldsymbol{H_S}}{H_W})(\frac{L_S}{\boldsymbol{H_S}}) + (1 - \frac{\boldsymbol{H_S}}{H_W})(\frac{L_S}{\boldsymbol{H_S}}) = \frac{L_W}{H_W} \tag{60''}$$

Equation (60'') states the full employment condition for the world. Note that this condition is only fulfilled when

$$\frac{L_S}{H_S} = \frac{L_N}{H_N} = \frac{L_W}{H_W} \tag{61}$$

The equilibrium value of the unskilled-to-skilled labor ratio in the free migration regime must be the ratio prevailing in the entire world. This has a relevant implication for the price of the skilled-intensive good because this price depends directly on the unskilled-to-skilled labor ratio. In particular, putting together Equations (57)–(58) and (61) yields the following result:

$$P_N^{FM} = P_S^{FM} = P^{FT} = P^{INT} \tag{62}$$

Equation (62) states that, just as international trade, migration leads to price and wage convergence and that the underlying prices are the same as in the integrated economy. This makes it easy to find out the welfare implications of migration. A shown above, and is largely known, free trade is welfare-improving relative to the autarky (and no-migration) equilibrium. More generally, it is known that the prices under free trade reproduce any of the allocations within the continuum set of Pareto efficient allocations i.e., this can be proved simply by applying the First Fundamental Welfare Theorem and by noting that our framework does not exhibit market failures. Driven by these results, we know that, because free migration implements the same price vector as free trade, this migration is not only welfare improving but also optimal from a Pareto point of view.[5]

Furthermore, an important feature of the free migration equilibrium is that it does not determine the absolute number of worker types in each country, it only determines the unskilled-skilled labor ratio. The fact that the absolute number of workers in each country is not determined confronts us with the need for choosing the focus of our study. In response to this need, we proceed by focusing exclusively on migration going on a single direction, from South to North. Besides being consistent with one of the equilibria, a situation in which migrants only go North constitutes the most interesting one and, importantly, is also the only equilibrium configuration in a more realistic scenario in which this country has a technological advantage over South.

[5] Furthermore, in any Pareto optimal allocation, the skilled-to-unskilled labor ratio is the world's ratio in both countries.

Let us present the redistributive effects of free migration through the following results:

$$P_N^{FM} = P^{FT} > P_N^{aut} \xrightarrow{yields} \frac{q_N^{aut}}{P_N^{aut\,\gamma}} < \frac{q_N^{FM}}{P_N^{FM\,\gamma}} \; ; \; \frac{w_N^{aut}}{P_N^{aut\,\gamma}} > \frac{w_N^{FM}}{P_N^{FM\,\gamma}} \tag{63}$$

$$P_S^{FM} = P^{FT} < P_S^{aut} \xrightarrow{yields} \frac{q_S^{aut}}{P_S^{aut\,\gamma}} > \frac{q_S^{FM}}{P_S^{FM\,\gamma}} \; ; \; \frac{w_S^{aut}}{P_S^{aut\,\gamma}} < \frac{w_S^{FM}}{P_S^{FM\,\gamma}} \tag{64}$$

In the spirit of the Stolper-Samuelson Theorem for the case of international trade, Equations (63) and (64) state that migration benefits the abundant factor and harms the scarce factor in each country, relative to the autarky regime. In particular, free migration increases the real return of skilled workers and reduces the real return of unskilled workers in North.

9. GENERAL WELFARE IMPLICATIONS OF IMMIGRATION

Even though we have been able to show that fully removing migration barriers is optimal from a Pareto point of view, this section takes a more general approach and investigates the welfare consequences of migrants, regardless of whether moving across regions is fully or only partially free. The goal is to simplify the welfare analysis that we will undertake in the next section.

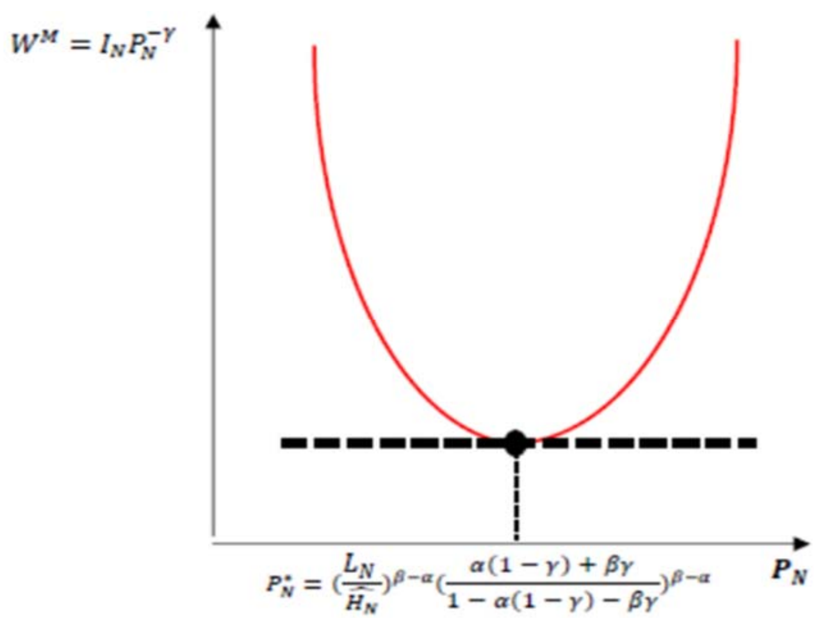
As a first step, let us focus on North and consider the expression for real income, our measure of welfare: $I_N P_N^{-\gamma} = P_N^{\frac{-\alpha(1-\gamma)-\beta\gamma}{\beta-\alpha}}(\widehat{L_N} + \widehat{H_N} P_N^{\frac{1}{\beta-\alpha}})$. As noted above, we will only consider the effect of migration on welfare through its impact on prices and this results from using the most relevant measure of welfare from a political economy point of view. Following this point, and as a first glance to the welfare effects of migration, let us take the partial derivative of real income with respect to P_N:

$$\frac{\partial I_N P_N^{-\gamma}}{\partial P_N} = \frac{P_N(H_N, L_N)^{\frac{\beta}{\alpha-\beta}-\gamma}(\widehat{H_N} P_N^{\frac{1}{\beta-\alpha}}(1-\alpha(1-\gamma)-\beta\gamma) - \widehat{L_N}(\alpha(1-\gamma)+\beta\gamma))}{\beta-\alpha} \tag{65}$$

where the hats again indicate those cases in which the corresponding variables remain fixed. Simple algebra on (65) shows that $\frac{\partial I_N P_N^{-\gamma}}{\partial P_N} = 0$ at the value of P_N at which it is evaluated under autarky, that is, in a noninternational trade regime, such as the one considered in the free migration scenario. In other words, this partial derivative equals 0 exactly at $P_N^* = (\frac{\widehat{L_N}}{\widehat{H_N}})^{\beta-\alpha}(\frac{\alpha(1-\gamma)+\beta\gamma}{1-\alpha(1-\gamma)-\beta\gamma})^{\beta-\alpha}$.

Given this result, one may be tempted to argue that migration has no welfare implications. Indeed, this interpretation obtained at first glance is partially true: starting from an autarkic situation, migration flows that induce marginal price changes have absolutely no welfare impacts. Although the higher supply of unskilled labor induced by immigration may at first affect real wages in North, agents' reoptimization fully offsets this initial impact. To put it differently, the fact that marginal price changes have no welfare implications is simply the application of The Envelope Theorem. Figure 7 shows the result.

Figure 7 Welfare, Immigration and the Envelope Theorem



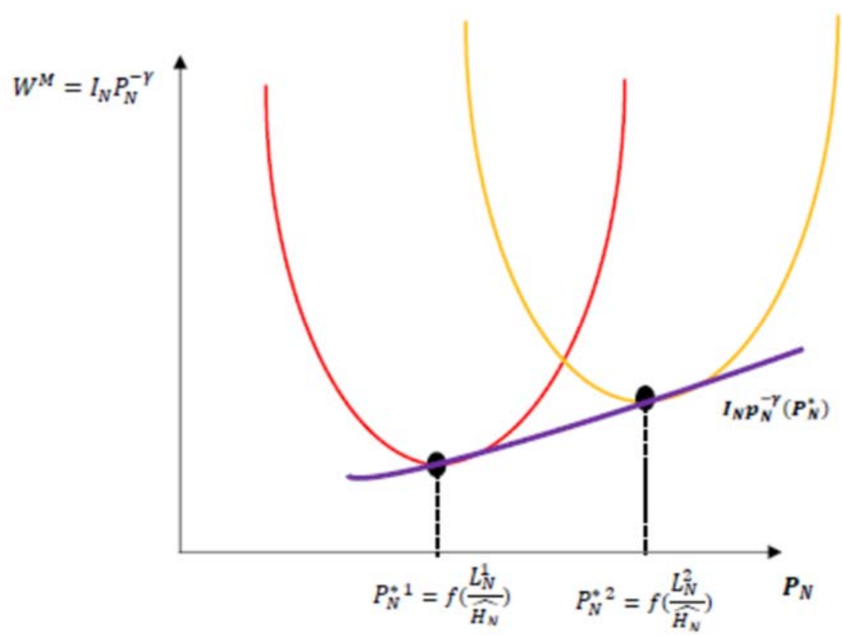
However, this result only holds for marginal changes in the price of the skilled-intensive good. Although migration flows that induce marginal changes on prices have no impacts on migration, migration flows in reality induce discrete (nonmarginal) changes in prices, and these changes do affect welfare in a positive way. To see this, use the expression for P_N^* to take the partial derivative with respect to the amount of unskilled workers in North and note:

$$\frac{\partial P_N^*}{\partial L_N} > 0 \tag{66}$$

Equation (66) states that migration indeed shifts upward the curves presented in previous graphs. Thus, using this result, we can conclude that migration flows inducing discrete changes on prices have positive impacts on welfare. This result is summarized in Figure 8.

Finally, note that to investigate the welfare implications of a migration tax, it is sufficient to use the graphical method developed above. As noted previously, our measure of welfare is restricted exclusively to native residents and, therefore, migration affects welfare through prices effect.

Figure 8 Discrete Changes in Prices



10. TAX ON MIGRATION

This section investigates the effects of a tax on migration. To this end, it takes as a point of departure the autarky regime and focuses on migration flows of unskilled workers going from South to North, in the same manner as Section 8.

The tax on migration we consider is assumed to take the iceberg form. Thus, a worker migrating to North receives only a fraction $1-\phi$ of her wage and the rest melts away in "her transit." For the purpose of our analysis, this tax is a sufficient statistic of migration policy, that is, a sufficient indicator of policy-induced restrictions to international labor mobility.

Just as in Section 8, it is assumed that the expression for wages is initially the same as in the autarky regime. Because we concentrate on migration by unskilled workers going from South to North, we hereby refer only to real unskilled wages:

$$\frac{w_N^{TM}}{P_N^{TM\,\gamma}} = P_N^{TM\,\frac{-\alpha(1-\gamma)-\beta\gamma}{\beta-\alpha}} \tag{67}$$

$$\frac{w_S^{TM}}{P_S^{TM\,\gamma}} = P_S^{TM\,\frac{-\alpha(1-\gamma)-\beta\gamma}{\beta-\alpha}} \tag{68}$$

where P_N^{TM} and P_S^{TM} are the prices of the skilled-intensive good in the tax migration case in North and South, respectively. Following the analysis in the autarky scenario, it is known that the equilibrium values of these prices can be written as follows:

$$P_N^{TM} = (\frac{L_N}{H_N})^{\beta-\alpha}(\frac{\alpha(1-\gamma)+\beta\gamma}{1-\alpha(1-\gamma)-\beta\gamma})^{\beta-\alpha} \tag{69}$$

$$P_S^{TM} = (\frac{L_S}{H_S})^{\beta-\alpha}(\frac{\alpha(1-\gamma)+\beta\gamma}{1-\alpha(1-\gamma)-\beta\gamma})^{\beta-\alpha} \tag{70}$$

where the definitions given in the free migration case also apply here: $L_N = \widehat{L_N} + M_{LN}$; $H_N = \widehat{H_N} + M_{HN}$; $L_S = \widehat{L_S} + M_{LS}$ and $H_S = \widehat{H_S} + M_{HS}$. In contrast with the free migration case, however, in this section the incentives for migration are exhausted even before real wages equalize across regions. In particular, the presence of a tax diminishes the benefit from migration, inducing unskilled workers from South to migrate only until $\frac{w_N^{TM}}{P_N^{TM\,\gamma}}(1-\phi)=\frac{w_S^{TM}}{P_S^{TM\,\gamma}}$, that is, only until the real wage net of the migration costs in North is equal to the real wage in South. In other words, the equilibrium condition in this section is different from the equilibrium condition considered in the free migration case of Section 8.

The combination of this new equilibrium condition with Equations (69)–(70) yields the following result:

$$P_N^{TM\,\frac{-\alpha(1-\gamma)-\beta\gamma}{\beta-\alpha}}(1-\phi)=P_S^{TM\,\frac{-\alpha(1-\gamma)-\beta\gamma}{\beta-\alpha}}\xrightarrow{yields}\frac{L_N}{H_N}=\frac{L_S}{H_S}(1-\phi) \qquad (71)$$

The migration tax introduces a wedge between real wages across countries and, therefore, between unskilled-to-skilled labor ratios. In particular, by discouraging unskilled migration, the tax reduces this ratio in North while increasing it in South. Along these lines, substituting Equation (71) in the world's full-employment conditions generates the following results:

$$\frac{L_S}{H_S}=\frac{1}{\left(1-\phi(1-\frac{H_S}{H_W})\right)}\left(\frac{L_W}{H_W}\right) \qquad (72)$$

$$\frac{L_N}{H_N}=\frac{(1-\phi)}{\left(1-\phi(1-\frac{H_S}{H_W})\right)}\left(\frac{L_W}{H_W}\right) \qquad (73)$$

From these expressions, it is easy to see that $P_S^{TM}<P_N^{FM}=P^{FT}<P_N^{TM}$; just as an imports tax, a tax on migration introduces a wedge between prices across countries, reducing this price in North with respect to the free migration case.

Once the change in the price of the skilled-intensive good is known, we can infer the welfare and redistributive impacts of the migration policy. Because the tax diminishes the price of the skilled-intensive good in North, it triggers welfare-reducing effects—it is easy to see this by using the graphical tools shown above.

Furthermore, the fall in the equilibrium price for the skilled-intensive good generates redistributive effects relative to the free international labor mobility equilibrium. The tax diminishes the number of unskilled immigrants, and thus the supply of unskilled labor increases to a lesser extent in North. This in turn makes the real unskilled wages greater than in the free migration regime, implying that the real skilled wage must fall for the zero-profit conditions to be satisfied. Hence, the migration tax increases the real return to unskilled workers and reduces the real return to skilled workers with respect to a free migration regime. Therefore, in this sense, it can be argued that it has some effects as an imports tax in the context of international trade. This result is crucial to understand why special interest groups may want to constrain migration and, therefore, to motivate the political economy analysis of Section 12.

11. TAX EQUIVALENCE

The analyses in previous sections have shown that a migration tax harms the abundant factor, benefits the scarce factor, and triggers welfare-reducing effects relative to the free migration scenario. Interestingly, these impacts go in the same direction as those obtained in a situation in which each region imposes a tariff import on the products originating in the other region. Thus, the present section derives a migration policy that replicates the same equilibrium characteristics in North as the mutual trade restriction scenario considered above.

As noted above, for that purpose, it suffices to find for each value of τ a value of 1-ϕ that implements the same relative price in North as in the mutual trade restrictions scenario, that is, P^{MTC}/τ. The implementation of the same relative price implies that the migration tax ϕ yields the same prices, real wages, and welfare as the mutual imposition of τ. To find this value, we divide the expression for P^{MTC} in Equation (52) by τ and equate the resulting expression to the price that arises from plugging (73) in the definition given in (69). This process yields the following "equivalent" migration tax (see Appendix 8 for a full derivation of this result):

$$\phi^{Eq} = \frac{\tau^{\beta}\left(\tau^{\frac{2}{\alpha-\beta}}H_N+\tau H_S\right)L_W-\tau^{\alpha+\frac{1}{\alpha-\beta}}H_W(L_N+\tau L_S)}{\tau^{\alpha+\frac{1}{\alpha-\beta}}(H_S-H_W)(L_N+\tau L_S)+\tau^{\beta}\left(\tau^{\frac{2}{\alpha-\beta}}H_N+\tau H_S\right)L_W} \tag{74}$$

12. POLITICAL ECONOMY ANALYSIS

The previous analysis has shown that immigration increases overall welfare but generates income redistribution effects. In this context, restricting migration may favor special interest groups. For the particular case analyzed in this chapter, a migration policy that restricts unskilled migration benefits unskilled workers in North at the costs of smaller welfare aggregate levels. More generally, this suggests that political economy concerns may have an influence on the design and implementation of migration policies in advanced economies.

Indeed, the premise that public policies can be influenced by special interest groups has a long tradition in both economic theory and empirical work. For the case of regulatory measures, Djankov et al. (2002) suggest that entry regulation generates rents that accrue to bureaucrats and administrative employees. Yet, bureaucrats, politicians and administrative employees may be tempted to implement regulation not only to obtain profits directly, but also to collect bribes and contributions from the relevant interest groups (see De Soto [1990]; McChesney [1987]; Shleifer and Vishny [1993]; and Tobal [2017] for the consequences on international trade).

In the domain of international trade policy, perhaps the most influential work is from Grossman and Helpman (1994). In their seminal paper, they show that lobbying groups have incentives for influencing the design of import tariffs. Along these lines, this chapter has shown that there is some equivalence between international trade and migration policies in terms of welfare and redistribution effects. Again, this suggests that, just as international trade policies, immigration policy may be influenced by interest groups.

In this section, we develop an extension of the factor proportion model presented previously with the goal of illustrating one among the several channels through which special interest groups may affect immigration policy. In contrast with several of the channels through which political economy concerns shape public policy in the literature, the extension we present does not rely on the existence of a government that attempts to extract private rents or to maximize political support. Instead, our extension shows that, even when a government is forward-looking and benevolent, it may have incentives to deviate from the migration policy associated with the first-best equilibrium.

As noted above, we consider the economy described by the factor proportion model presented in previous sections and set as our point of the departure the autarky equilibrium. To simplify, it is assumed that there is a single interest group representing unskilled workers, such as unions. This group can affect Congress' decisions, possibly because its actions influence media coverage and, through this channel, have an impact on public opinion. When many unskilled workers go on a strike, large media coverage frequently exerts pressure on the congress. For instance, if unskilled workers go on a strike, the pressure of the media forces the congress to reject the migratory reform proposed by the government, represented by the ϕ parameter.

More formally, assume that there is a probability that unskilled workers do not go on a strike $f(\phi)$ and that this probability fulfills the traditional Inada conditions: 1) $f(\phi = 0) = 0$: when free migration is proposed, unskilled workers always go on a strike; 2) $f(\phi)$ is continuously differentiable; (iii) $f(\phi)$ is strictly increasing in ϕ: the probability of going to strike falls with the severity of the policy proposed (i.e., the higher the tax on migration, the lower the probability of going on strike); 3) the second derivative is negative; 4) the limit of the first derivative of $f(\phi)$ is infinite when ϕ tends to 0; 5) the limit of the first derivative of $f(\phi)$ is 0 when ϕ tends to infinite.

In this environment, the government is interested in maximizing expected welfare. In the context of our extension, this welfare can be written as follows: $EW(\phi) = f(\phi)\, W_N(\phi) + (1 - f(\phi))\, W_N^{aut}$. At the same time, it is known from the factor proportion model that $W_N(\phi) > W_N^{aut}$ and that $\frac{\partial W_N(\phi)}{\partial \phi} < 0$.

Under these conditions, it is easy to show that the benevolent and forward-looking government never chooses a migration tax equal to zero (Appendix 9 provides a formal proof of this outcome). The intuition for this result goes as follows. Even though the government knows that choosing a zero tax would be optimal in the absence of political economy conflicts, it is also aware that doing so would lead the union to a strike and, consequently, Congress to reject the proposal. Under these conditions, the economy would remain in the autarky regime and reach the lowest possible welfare level. Hence, to avoid this situation, the benevolent and forward-looking government opts for proposing a positive migration tax and improve the probability that the reform gets accepted.

13. CONCLUSIONS

We have provided some theoretical tools that illustrate useful and interesting insights into the economic effects of migration, as well as on political factors that may affect the design of migration policy. To illustrate these points, we set a standard factor proportion model of international trade and used it to investigate the impacts of free trade, free migration, imports tariffs, and a tax on migration.

The analysis generates several interesting conclusions. First, free trade and free migration generate isomorphic results, precisely when the most relevant measure of welfare from a political economy perspective is taken into account. Both trade and migration increase aggregate welfare but have redistributive effects. Second, along these lines, it is shown that the welfare outcomes arising from an imports tax can be replicated by implementing the proper migration policy. In light of these results, we then conclude that migration policies may be influenced by political economy concerns. Thus, we develop an extension of our standard model to illustrate one of the many possible channels through which these concerns may affect the determination of migration policies.

From a more general point of view, the conclusion that should be taken from our analysis is that there is large room for using economists' tools to contribute to a now heated policy debate. Just as we already have a tool kit to analyze trade policy and its welfare, redistributive and political economy dimensions, we can easily extend this literature to analyze migration policy in these same dimensions.

APPENDIX 1
INDIRECT UTILITY FUNCTION: DERIVATION OF GENERAL RESULTS

This appendix demonstrates that the indirect utility function shown in (4) can be derived from the utility function shown in Equation (3). Using Equation (3), we know that the indirect utility function is given by $U_j = c_{js}^{*\,\gamma}(I_j, P_j)\, c_{ju}^{*\,1-\gamma}(I_j, P_j)$, where $c_{js}^{*}(I_j, P_j)$ and $c_{ju}^{*}(I_j, P_j)$ are the consumption levels of the skilled- and unskilled-intensive goods that result from the following maximization problem:

$$Max_{c_{js;}c_{ju}}\, U_j = c_{js}^{\gamma}\, c_{ju}^{1-\gamma}\ , \tag{A.1}$$

subject to:

$$I_j = P_j c_{js} + c_{ju},$$

where I_j and P_j are the income level and price of the skilled-intensive good in country j, respectively. Solving for the first order conditions of this problem we obtain the following Marshallian demands:

$$c_{js}^{*}(I_j, P_j) = \gamma \frac{I_j}{P_j}\,, \tag{A.2}$$

$$c_{ju}^{*}(I_j, P_j) = (1-\gamma) I_j. \tag{A.3}$$

Replacing these solutions in $U_j = c_{js}^{*\,\gamma}(I_j, P_j)\, c_{ju}^{*\,1-\gamma}(I_j, P_j)$ one obtains the following indirect utility function:

$$V_j = \gamma^{\gamma}(1-\gamma)^{1-\gamma} I_j P_j^{-\gamma}. \tag{A.4}$$

Note that this is the expression for the indirect utility function shown in Equation (4).

APPENDIX 2
REAL INCOME AS A FUNCTION OF P_j: DERIVATION OF GENERAL RESULTS

This appendix demonstrates that the function shown in (9) has a single critical point and that, abusing on the concavity properties of this function, we can illustrate it by using Figure 5. To show this, let us constrain our analysis to prices of the skilled-intensive good contained within the interval $(0, \infty)$, i.e., $P_j \exists (0, \infty)$, and take the first derivative of (9) with respect to P_j. This yields the following expression

$$\frac{\partial(I_j P_j^{-\gamma})}{\partial P_j} = \frac{P_j^{\frac{\beta}{\alpha-\beta}-\gamma}(P_j^{\frac{1}{\beta-\alpha}}(\widehat{H_J}(1-\alpha(1-\gamma)-\beta\gamma)-\widehat{L_J}(\alpha(1-\gamma)+\beta\gamma))}{\beta-\alpha}. \tag{A.5}$$

Simple algebra on this equation shows that $P_j^* = (\frac{\widehat{L_J}}{\widehat{H_J}})^{\beta-\alpha}(\frac{\alpha(1-\gamma)+\beta\gamma}{1-\alpha(1-\gamma)-\beta\gamma})^{\beta-\alpha}$ is the only critical point of $I_j P_j^{-\gamma}$, i.e., the only value of P_j at which $\partial(I_j P_j^{-\gamma})/\partial P_j = 0$. This is precisely the value of of P_j referred to Section 4.

Furthermore, it is easy to see in (A.5) that $\partial(I_j P_j^{-\gamma})/\partial P_j > 0$ for any $P_j \exists (P_j^*, \infty)$ and that $\partial(I_j P_j^{-\gamma})/\partial P_j < 0$ for any $P_j \exists (0, P_j^*)$. That is, within the set of prices considered real income, and thus welfare, is decreasing in P_j for any $P_j < P_j^*$ and is increasing in P_j for any $P_j < P_j^*$. This property is crucial to derive all of the welfare results of the model. This proves that, under the appropriate assumptions on concavity, Figure 5 properly represents the indirect utility function shown in (9).

APPENDIX 3
MARGINAL COSTS AND ZERO-PROFIT CONDITIONS: DERIVATION OF GENERAL RESULTS

This appendix shows the derivation of marginal costs that are subsequently used in the setup of the zero-profit conditions. Let us begin with the zero-profit condition of the skilled-intensive good shown in (10). To derive the marginal costs associated with the skilled-intensive good, we will use the production function shown in Equation (1). In particular, marginal costs are obtained from the cost function that results from solving the following optimization problem:

$$Min_{\,H_{js};L_{js}}\ C_{js} = q_j H_{js} + w_j L_{js}, \tag{A.6}$$

subject to:

$$\overline{Y_{Js}} = \varepsilon_s \left(H_{js}^{\beta} L_{js}^{1-\beta}\right),$$

Solving for the first order conditions of this problem we obtain the following output-constrained demands:

$$H_{js}^{*}(\overline{Y_{Js}}, q_j, w_j) = \beta(\frac{w_j}{q_j})^{1-\beta}\overline{Y_{Js}}, \quad (A.7)$$

$$L_{js}^{*}(\overline{Y_{Js}}, q_j, w_j) = (1-\beta)\left(\frac{w_j}{q_j}\right)^{-\beta}\overline{Y_{Js}}. \quad (A.8)$$

Substituting these solutions in the production function yields the following costs function:

$$C_{js}\left(\overline{Y_{Js}}, q_j, w_j\right) = q_j{}^{\beta} w_j{}^{1-\beta}\overline{Y_{Js}}, \quad (A.9)$$

The marginal cost associated with the skilled-intensive good is given by the partial derivative of this function with respect to $\overline{Y_{Js}}$ and is, therefore equal to:

$$MC_{js}\left(\overline{Y_{Js}}, q_j, w_j\right) = q_j{}^{\beta} w_j{}^{1-\beta}, \quad (A.10)$$

As for the zero-profits condition of the unskilled-intensive good, note that by analogy to (A.10) we can use Equation (2) and write:

$$MC_{ju}\left(\overline{Y_{Ju}}, q_j, w_j\right) = q_j{}^{\alpha} w_j{}^{1-\alpha}, \quad (A.11)$$

Using the marginal costs displayed in Equations (A.10) and (A.11), it is possible to write the zero-profit-conditions of country j as follows:

$$q_j^{\beta} w_j^{1-\beta} = P_j, \quad (A.12)$$

$$q_j{}^{\alpha} w_j{}^{1-\alpha} = 1 \quad (A.13)$$

Solving these system of two equations and two unknowns, we can write the unskilled and skilled wages as follows:

$$q_j = P_j^{\frac{1-\alpha}{\beta-\alpha}}, \quad (A.14)$$

$$w_j = P_j^{\frac{-\alpha}{\beta-\alpha}}. \quad (A.15)$$

These are precisely the same expressions that appear in Equations (7) and (8).

APPENDIX 4
LABOR MARKET CLEARING CONDITIONS: DERIVATION OF GENERAL RESULTS

The demands for skilled and unskilled labor depends only the technology used for production. As noted in Appendix 3, with the Cobb-Douglas functions shown in Equations (1) and (2), these labor demands for skilled labor are written as follows:

$$H_{js}^{*}(\overline{Y_{Js}}, q_j, w_j) = \beta(\frac{w_j}{q_j})^{1-\beta}\overline{Y_{Js}}\ , \tag{A.7'}$$

$$H_{ju}^{*}(\overline{Y_{Ju}}, q_j, w_j) = \alpha(\frac{w_j}{q_j})^{1-\alpha}\overline{Y_{Ju}}\ , \tag{A.16}$$

Using these demands, we can write the market-clearing condition for the skilled-intensive good as follows:

$$\beta(\frac{w_j}{q_j})^{1-\beta}\overline{Y_{Js}} + \alpha(\frac{w_j}{q_j})^{1-\alpha}\overline{Y_{Ju}} = H_j\ , \tag{A.17}$$

By the same token, the demands for unskilled labor are summarized by the following equations

$$L_{js}^{*}(\overline{Y_{Js}}, q_j, w_j) = (1-\beta)\left(\frac{w_j}{q_j}\right)^{-\beta}\overline{Y_{Js}}. \tag{A.8'}$$

$$L_{ju}^{*}(\overline{Y_{Ju}}, q_j, w_j) = (1-\alpha)\left(\frac{w_j}{q_j}\right)^{-\alpha}\overline{Y_{Ju}}. \tag{A.18}$$

Thus, the market-clearing condition for the unskilled-intensive good is given by the following equation:

$$(1-\beta)\left(\frac{w_j}{q_j}\right)^{-\beta}\overline{Y_{Js}} + (1-\alpha)\left(\frac{w_j}{q_j}\right)^{-\alpha}\overline{Y_{Ju}} = L_j\ , \tag{A.19}$$

Equations (A.13) and (A.15) form a system of two equations with a higher number of unknowns. Nonetheless, this number boils down to two as we impose the skill-premium to be given by $P_j^{\frac{1}{\beta-\alpha}}$, i.e., which is indeed the premium arising from the zero-profit conditions. As one imposes this conditions in (A.13) and (A.15), one is left with a system with two equations and two unknowns that solve for the following supplies of goods:

$$\overline{Y_{Js}} = P_j^{\frac{-\beta}{\beta-\alpha}}(H_j P_j^{\frac{1}{\beta-\alpha}}(1-\alpha) - L_j\alpha)/(\beta-\alpha), \quad \text{(A.20)}$$

$$\overline{Y_{Ju}} = P_j^{\frac{-\alpha}{\beta-\alpha}}(L_j\beta - H_j P_j^{\frac{1}{\beta-\alpha}}(1-\beta))/(\beta-\alpha). \quad \text{(A.21)}$$

APPENDIX 5
PRODUCT MARKET-CLEARING CONDITION: DERIVATION OF GENERAL RESULTS

As noted in the main body text, the equilibrium value of P_j is determined by the product market-clearing conditions. Nonetheless, depending on the particular scenario that is being taken under consideration, these conditions are set in a different manner (see Section 3 for a thorough discussion in this regard). Let us consider to this end the three groups referred to in Section 3:

- ✓ In autarky, there is neither migration nor international trade and, thus, P is determined only by market-clearing conditions and these conditions are defined at the local level. Thus, in autarky, the relevant supplies are given in Equations (17) and (18) for North. By using sub-indexes j rather than N to generalize, we can write:

$$Y_{js}^{aut} = P_j^{aut\,\frac{-\beta}{\beta-\alpha}}(H_j P_j^{aut\,\frac{1}{\beta-\alpha}}(1-\alpha) - L_j\alpha)/(\beta-\alpha), \quad \text{(A.22)}$$

$$Y_{ju}^{aut} = P_j^{aut\,\frac{-\alpha}{\beta-\alpha}}(L_j\beta - H_j P_j^{aut\,\frac{1}{\beta-\alpha}}(1-\beta))/(\beta-\alpha). \quad \text{(A.23)}$$

  Given that we consider the autarky case, the relevant demand for the good is defined at the local level. Maximization of the utility function shown in (3) yields a demand for the skilled-intensive good that can be obtained by appropriately interpreting Equation (A.2) in Appendix 1. In particular, the demands for the skilled-intensive good can be written as:

$$c_{js}^{*\,aut}(I_j^{aut}, P_j^{aut}) = \gamma \frac{I_j^{aut}}{P_j^{aut}}, \quad \text{(A.24)}$$

  where I_j^{aut} is defined as $Y_{js}^{aut} P_j^{aut} + Y_{ju}^{aut}$. Using (A.22)-(A.24) one can equate the demand for the skilled-intensive good to its supply. This yields the following price:

$$P_j^{aut} = (\frac{L_j}{H_j})^{\beta-\alpha}(\frac{\alpha(1-\gamma)+\beta\gamma}{1-\alpha(1-\gamma)-\beta\gamma})^{\beta-\alpha}. \tag{A.25}$$

This expression represents a generalization of the cases shown in Equations (19) and (22).

✓ In the free trade equilibrium, P is determined only by the product market-clearing conditions and these conditions are defined at the global level. Thus, the relevant supplies are given by Equations (27)-(30):

$$Y_{Ns}^{FT} = P^{FT\frac{-\beta}{\beta-\alpha}}(H_N P^{FT\frac{1}{\beta-\alpha}}(1-\alpha) - L_N\alpha)/(\beta-\alpha), \tag{A.26}$$

$$Y_{Nu}^{FT} = P^{FT\frac{-\alpha}{\beta-\alpha}}(L_N\beta - H_N P^{FT\frac{1}{\beta-\alpha}}(1-\beta))/(\beta-\alpha), \tag{A.27}$$

$$Y_{Ss}^{FT} = P^{FT\frac{-\beta}{\beta-\alpha}}(H_S P^{FT\frac{1}{\beta-\alpha}}(1-\alpha) - L_S\alpha)/(\beta-\alpha), \tag{A.28}$$

$$Y_{Su}^{FT} = P^{FT\frac{-\alpha}{\beta-\alpha}}(L_S\beta - H_S P^{FT\frac{1}{\beta-\alpha}}(1-\beta))/(\beta-\alpha). \tag{A.29}$$

The global supply of each good is obtained as the sum of supplies by Northern and Southern producers. Thus, the supply of the skilled-intensive good is given by the following expression:

$$Y_{worlss}^{FT} = Y_{Ns}^{FT} + Y_{Ss}^{FT} . \tag{A.30}$$

On the demand-side, the demand for each product is obtained as the sum of the demands for the good from Northern and Southern consumers. In the case of the skilled-intensive good, we can turn again to Equation (A.2) and write:

$$c_{world}^{*\,FT}(I_{world}^{FT}, P_{world}^{FT}) = \gamma\frac{I_N^{FT}}{P_N^{FT}} + \gamma\frac{I_S^{FT}}{P_S^{FT}} = \gamma\frac{I_{world}^{FT}}{P^{FT}} . \tag{A.31}$$

Equating the demand that appears in (A.24) and (A.25) yields the following equilibrium price:

$$P^{FT} = (\frac{L_W}{H_W})^{\beta-\alpha}(\frac{\alpha(1-\gamma)+\beta\gamma}{1-\alpha(1-\gamma)-\beta\gamma})^{\beta-\alpha} . \tag{A.32}$$

This is precisely the same expression that appears in Equation (31).

APPENDIX 6
LABOR MARKET CLEARING CONDITIONS: CASE OF MUTUAL TRADE RESTRICTIONS

This appendix derives the labor market clearing conditions for the scenario presented in Section 7. Note first that the demands for skilled and unskilled labor depends only the technology used for production and, therefore, the demands derived in Appendix 3 and subsequently used in Appendix 4 are still valid in the present appendix. In particular, the labor demands are given by the following expressions:

$$H_{js}^{*}(\overline{Y_{Js}}, q_j, w_j\,) = \beta(\frac{w_j}{q_j})^{1-\beta}\overline{Y_{Js}}, \qquad \text{(A.7')}$$

$$H_{ju}^{*}(\overline{Y_{Ju}}, q_j, w_j\,) = \alpha(\frac{w_j}{q_j})^{1-\alpha}\overline{Y_{Ju}}, \qquad \text{(A.16)}$$

$$L_{js}^{*}(\overline{Y_{Js}}, q_j, w_j) = (1-\beta)\left(\frac{w_j}{q_j}\right)^{-\beta}\overline{Y_{Js}}, \qquad \text{(A.8')}$$

$$L_{ju}^{*}(\overline{Y_{Ju}}, q_j, w_j) = (1-\alpha)\left(\frac{w_j}{q_j}\right)^{-\alpha}\overline{Y_{Ju}}. \qquad \text{(A.18)}$$

Given that in section 7 there is no migration, the supplies of skilled and unskilled labor remains unchanged relative to Appendix 4. Hence, we can still use the same expressions for the labor market clearing conditions:

$$\beta(\frac{w_j}{q_j})^{1-\beta}\overline{Y_{Js}} + \alpha(\frac{w_j}{q_j})^{1-\alpha}\overline{Y_{Ju}} = H_j, \qquad \text{(A.17)}$$

$$(1-\beta)\left(\frac{w_j}{q_j}\right)^{-\beta}\overline{Y_{Js}} + (1-\alpha)\left(\frac{w_j}{q_j}\right)^{-\alpha}\overline{Y_{Ju}} = L_j, \qquad \text{(A.19)}$$

All the equations so far presented reveal that labor market clearing requires the same conditions as in the case of free trade. Nonetheless, unlike in that case, the solution of the regime presented in Section 7 must consider the skill-premia that arise from Equations (38)–(41). As noted in Section 7, these skill-premia are equal to $(P^{MTR}/\tau)^{\frac{1}{\beta-\alpha}}$ in North and equal to $(P^{MTR}\tau)^{\frac{1}{\beta-\alpha}}$ in South. Using this information to solve for the system formed by (A.17) and (A.19) for North on the one hand and for South on the other hand, we obtain the following result:

$$Y_{Ns}^{MTR} = (P^{MTR}/\tau)^{\frac{-\beta}{\beta-\alpha}}(H_N(P^{MTR}/\tau))^{\frac{1}{\beta-\alpha}}(1-\alpha) - L_N\alpha)/(\beta-\alpha) \qquad \text{(A.33)}$$

$$Y_{Nu}^{MTR} = (P^{MTR}/\tau)^{\frac{-\alpha}{\beta-\alpha}}(L_N\beta - H_N(P^{MTR}/\tau)^{\frac{1}{\beta-\alpha}}(1-\beta))/(\beta-\alpha) \qquad \text{(A.34)}$$

$$Y_{Ss}^{MTR} = (P^{MTR}\tau)^{\frac{-\beta}{\beta-\alpha}}(H_S(P^{MTR}\tau)^{\frac{1}{\beta-\alpha}}(1-\alpha) - L_S\alpha)/(\beta-\alpha) \qquad \text{(A.35)}$$

$$Y_{Su}^{MTR} = (P^{MTR}\tau)^{\frac{-\alpha}{\beta-\alpha}}(L_S\beta - H_S(P^{MTR}\tau)^{\frac{1}{\beta-\alpha}}(1-\beta))/(\beta-\alpha) \qquad \text{(A.36)}$$

These are precisely the same expressions we have presented in Equation (46)-(49).

APPENDIX 7
PRODUCT MARKET-CLEARING CONDITION: CASE OF MUTUAL TRADE RESTRICTIONS

This appendix derives the equilibrium price of the skilled-intensive good in the mutual trade restrictions regime by solving the product market equilibrium conditions. The existence of an imports tariff of the iceberg form makes the setup of the product market clearing condition subtle. This setup must take into account that a fraction of an exported good is lost in transit and, therefore, consumption a good in the recipient country is smaller than its exports supply. Hence, for the particular case of the skilled-intensive good, which is exported by North, market clearing requires:

$$Y_{Ns}^{MTR} - c_N^{*\ MTR}(I_N^{MTR}, P^{MTR}, \tau) = \tau(c_S^{*\ MTR}(I_S^{MTR},\ \tau P^{MTR}, 1) - Y_{Ss}^{MTR}) \qquad \text{(A.37)}$$

Equation (A.31) states that the net supply of the skilled-intensive good by North must equal the net demand by South times the iceberg costs tariff. As for the different components in (A.37), both Y_{Ss}^{MTR} and Y_{Ss}^{MTR} have been calculated in Appendix 6 and are shown in (A.33) and (A.35). Thus, we only need to calculate the corresponding demands for the goods. Using the solution to the optimization problem shown in Appendix 1, it is known that the demand in North can be written as follows:

$$c_N^{*\ MTR}(I_N^{MTR}, P^{MTR}, \tau) = \gamma \frac{I_N^{MTR}}{P^{MTR}} \qquad \text{(A.38)}$$

where the income level is given by the following expression:

$$I_N^{MTR} = Y_{Ns}^{MTR} P^{MTR} + Y_{Nu}^{MTR} \tau = P^{MTR\frac{-\alpha}{\beta-\alpha}} \tau^{\frac{\beta}{\beta-\alpha}} (L_N + H_N P^{MTR\frac{1}{\beta-\alpha}} \tau^{\frac{-1}{\beta-\alpha}}) \qquad (A.39)$$

where Y_{Ns}^{MTR} and Y_{Nu}^{MTR} have been defined in Appendix 6. By the same token, the demand for the skilled-intensive in South is given by:

$$c_S^{*\,MTR}(I_N^{MTR}, P^{MTR}, \tau) = \gamma \frac{I_S^{MTR}}{P^{MTR}\tau} \qquad (A.40)$$

where the income level is given by the following expression

$$I_S^{MTR} = Y_{Ss}^{MTR} P^{MTR}\tau + Y_{Su}^{MTR} = P^{MTR\frac{-\alpha}{\beta-\alpha}} \tau^{\frac{-\alpha}{\beta-\alpha}} (L_N + H_N P^{MTR\frac{1}{\beta-\alpha}} \tau^{\frac{1}{\beta-\alpha}}) \qquad (A.41)$$

where Y_{Ss}^{MTR} and Y_{Su}^{MTR} have been defined in Appendix 6.

Substituting for $c_N^{*\,MTR}$ and $c_S^{*\,MTR}$ in (A.37) with (A.38)–(A.41) we obtain the following result:

$$P^{MTR} = \left(\frac{(\alpha(1-\gamma)+\beta\gamma)(L_N+\tau L_S)}{(1-\alpha(1-\gamma)-\beta\gamma)(H_N \tau^{\frac{1}{\alpha-\beta}} + \tau^{\frac{-1+\alpha+\beta}{\alpha-\beta}} H_S)}\right)^{\beta-\alpha} \qquad (A.42)$$

This is precisely the expression shown in Equation (52).

APPENDIX 8
TAX EQUIVALENCE

This appendix shows the equivalence between the imports tax presented in Section 7 and the migration policy. As noted above, for that purpose, we need to find for each τ a value of $1-\phi$ that implements exactly the same relative price P^{MTR}/τ and is, therefore, associated with the prices, real wages and welfare as in the import tax regime.

Let us first divide the expression for P^{MTR} in Equation (52) by τ and write

$$P^{MTR}/\tau = \left(\frac{(\alpha(1-\gamma)+\beta\gamma)(L_N+\tau L_S)\tau^{-\beta+\alpha}}{(1-\alpha(1-\gamma)-\beta\gamma)(H_N \tau^{\frac{1}{\alpha-\beta}} + \tau^{\frac{-1+\alpha+\beta}{\alpha-\beta}} H_S)}\right)^{\beta-\alpha} \qquad (A.43)$$

Let’s now take a look at the price in tax migration case lugging (73) in the definition given in (69):

$$P^{TM} = (\frac{(\alpha(1-\gamma)+\beta\gamma)}{(1-\alpha(1-\gamma)-\beta\gamma))}\frac{(1-\phi)}{\left(1-\phi(1-\frac{H_S}{H_W})\right)}(\frac{L_W}{H_W}))^{\beta-\alpha} \quad \text{(A.44)}$$

From these expressions, it is easy to see that to make P^{TM} equal to P^{MTC}/τ, it suffices to equate $\frac{(L_N+\tau L_S)\tau^{-\beta+\alpha}}{(H_N\tau^{\frac{1}{\alpha-\beta}}+\tau^{\frac{-1+\alpha+\beta}{\alpha-\beta}}H_S)}$ and $\frac{(1-\phi)}{\left(1-\phi(1-\frac{H_S}{H_W})\right)}(\frac{L_W}{H_W})$. Solving for the value of ϕ that produces this result, we obtain:

$$\phi^{Eq} = \frac{\tau^{\beta}(\tau^{\frac{2}{\alpha-\beta}}H_N+\tau H_S)L_W-\tau^{\alpha+\frac{1}{\alpha-\beta}}H_W(L_N+\tau L_S)}{\tau^{\alpha+\frac{1}{\alpha-\beta}}(H_S-H_W)(L_N+\tau L_S)+\tau^{\beta}(\tau^{\frac{2}{\alpha-\beta}}H_N+\tau H_S)L_W} \quad \text{(A. 45)}$$

This is precisely the expression for the index of migration that has been stated in the main body text of Section 11.

APPENDIX 9
POLITICAL ECONOMY ANALYSIS

This appendix shows that the forward-looking and benevolent agent chooses a positive migration tax. Note first that the expected payoff of the benevolent government is equal to:

$$Max_{\phi}\ EW(\phi) = f(\phi)\ W_N(\phi) + (1-f(\phi))\ W_N^{aut}$$

The desirable outcome for the government is associated with the proposed policy $\phi = 0$ while for the union the desirable outcome is realized when $\phi > 0$. Recall the probability of not going to strike is $f(\phi)$. The government determines the optimal level of ϕ that maximizes the expected welfare:

Having this mind, we implement a proof that goes in two steps:

It is easy to prove this in two steps:

1) Consider the first order conditions associated with the optimization problem: $\frac{\partial EW(\phi=0)}{\partial \phi} =$

$$\frac{\partial f(\phi=0)}{\partial \phi}W_N(\phi=0) + \frac{\partial W_N(\phi=0)}{\partial \phi}f(\phi=0) - \frac{\partial f(\phi=0)}{\partial \phi}\ W_N^{aut}$$

Note that $f(\phi = 0)$, $\frac{\partial f(\phi=0)}{\partial \phi}$ is infinite and $W_N(\phi = 0) = W_N^{FT} > W_N^{aut}$; hence $\frac{\partial EW(\phi=0)}{\partial \phi}$ always tends to infinite.

2) Infinite is greater than W_N^{aut};

Put differently, a benevolent and forward-looking government always proposes a positive migration tax so that the probability that it gets accepted is positive and expected welfare is maximized.

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