Towards a Better System for Immigration Control

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ABSTRACT. We study different methods of immigration control using a simple model of a congested world. Our main comparison involves quota, the predominant instrument of immigration control, and a proposed system of immigration tolls and emigration subsidies. We show that the equilibrium of the proposed system is Pareto superior to the quota system. This is consistent with the tolls and subsidies creating a market for international migrants. When countries are price–takers the market becomes perfect and the exploitation of gains from trade complete. From a normative perspective, an open–borders policy is preferred to both control methods but will meet political opposition because it hurts the residents of the rich country.

1. INTRODUCTION AND COMMENTARY

International borders are under the increasing stress of migration. Dramatic population growth in poor countries, higher mobility, international economic disparities and stable political conditions in rich countries create large migration flows directed toward the promise of a better life in another land. After the Immigration and Nationality Act in the sixties, over twenty million people came to the US, mostly from Latin America and Asia (Kennedy [13, 1996]). After the second world war, and excluding the mass ethnic resettlements forced between 1945 and 1950 by the Yalta and Potsdam agreements, some fourteen million people entered the EU countries from Eastern Europe alone (Fassmann and Münz [9, 1994]). Immigration has obviously played a central role in the economies of the developed countries.

Currently, there is potential for much more economic migration.\footnote{1} It is also clear that migration has not closed the gap in real incomes, let alone in the quality of life, across international borders. For example, Mexico and the US have the largest real

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\footnote{1} Although recently increasing rates of immigration in the EU countries can be attributed to the collapse of communism in Eastern Europe, a further immigration potential of five to twenty–five million eastern Europeans over the next decade has been proposed by different sources (Fassmann and Münz [9, 1994]). These calculations must be augmented to take into account the other main sources of EU immigration, esp. North Africa, the Near East and the Far East.
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The income difference between any two contiguous countries in the world to-day (Kennedy [13, 1996]), while the real income difference between Eastern Europe and the EU is about tenfold (Wellisch and Wildasin [21, 1996]). At the same time the rich economies now appear to be congested, and there is a widely held belief in the receiving countries that unskilled immigrants impose a social cost on them. Such negative perceptions are reinforced because the cost of public sector programmes increase with population, because illegal immigration has become a significant part of total immigration and because the ethnic composition of immigrants has changed to create visible minority groups with strong cultural cohesiveness in the receiving countries. Consequently, the restrictionist side is gaining momentum even in countries with traditionally liberal attitudes to immigration. For example, both the Canadian Alliance Party (formerly the Reform Party) and the National Front in France have included more restrictive immigration policies as an important plank of their political platform.

The control of legal immigration is still dominated by a single direct method, the quota system, whereby countries place an upper limit on the number of immigrants they will accept. As we explain later on, the quota system is unsatisfactory. Furthermore, in response to the increasing pressure along their borders, the rich countries have applied several strong policies and some new ideas to guard against illegal immigration.\(^2\) However, illegal immigration continues to grow. Black markets, both for trafficking and smuggling human beings, thrive in the western world.\(^3\) Untold thousands of destitutes are prepared to pay up-front the equivalent of years’ work in their countries of origin, and even to put their lives on the line, for the uncertain

\(^2\) “Western Europe has reacted to the new wave of immigration [after the collapse of communism in Eastern Europe] with a mixture of fear, rejection and massive administrative measures, including the deployment of specialized police and military along the borders, at ports and airports.” (Fassman and Münz [9, 1994, p. 534].) Measures against illegal immigration have also increased in the US after the 1986 Immigration Reform and Control Act which provided for sanctions against employers hiring illegals, conditional amnesty for those already living in the US, and stronger direct enforcement along the southern border. (Enforcement includes walls build in the vicinity of major American cities. Extending them along the entire border has been proposed by Pat Buchanan during the 1996 Republican presidential nomination campaign.) Perhaps the most controversial type of legislation along these lines is California Proposition 187, which aimed to discourage illegal entry and to encourage the return of illegal residents by denying them explicitly the use of redistributive public services such as public health and education. Improving conditions in Haiti or supporting the peso currency represent US policies aimed to curb illegal immigration through international transfers that improve conditions at the origin—rather than through wall-building at destination. Finally, NAFTA can be interpreted as an international migration policy because it is expected to slow down flows in the long-run by reducing wage differentials among the countries involved (Freeman [10, 1992]).

\(^3\) Trafficking refers to people engaged by black-market agents into some kind of indentured servitude upon passage. Smuggling refers to people who pay a fee to black-market agents for passage.
promise of an illegal entry to what they perceive as a better world.⁴

Our objective is to sketch the rudiments of a new, potentially superior, immigration control system for legal economic immigration. The basis of our proposal is provided by the use of immigration tolls and emigration subsidies, which can be designed to allow for exploitation of gains from trade. In regard to immigration tolls, most countries have application fees and landing fees for immigrants, which are still typically small but of growing importance. Canada, for example, has introduced a thousand-dollar immigration fee in its 1995–96 federal budget. It also uses for some time now an entrepreneurial immigration rule whereby an individual receives the right of residency in exchange for a certain minimum capital investment. More generally, the idea that immigrants must pay an entrance price for their right of citizenship appears to be gaining ground. Becker [1, 1992], for example, has argued that the United States and other rich countries should move from a system of immigration quota to a system where citizenship is conferred to those willing to pay an immigration toll. The very idea of a rich country selling the right of entry to poor immigrants may seem repulsive at first glance. And since our proposal includes immigration tolls, one could reject it right away as a bad one. We show, however, that the proposed system of immigration tolls and emigration subsidies (henceforth “toll/subsidy system”) can provide real benefit to all parties involved—including immigrants and those who remain in the poor country. At the same time, it can provide a partial answer to the black-market problem.⁵

We start with the model description of an open-borders policy (section two) on which we impose in succession immigration quota (section three) and immigration tolls without emigration subsidies (section four). Comparing the efficiency and equity characteristics of those types, as well as their structural advantages and disadvantages, naturally leads to our proposal for a new immigration control system (sections five and beyond).

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⁴ According to the United Nation’s World Development report for 1999/2000, the 1998 per capita GNP in China and India was US$750 and US$430 respectively. These represent 2.6% and 1.5% of the American per capita GNP. The smuggling fee for recent illegal Chinese immigrants to the North American West Coast was up to US$40,000 (“Canada Deports 90 More Chinese ‘Boat People’” Canadian Press News Service, 2000). In other words, some people in China were willing to pay a 50-year GNP equivalent for an illegal passage to North America.

⁵ Early contributions to the idea of immigration tolls were Chiswick [6, 1982] and Simon [19, 1989, chapter 16]. (See Simon for further references.) To the best of our knowledge, the equilibrium incentive for emigration subsidies by the sending country has gone unnoticed in the literature. This may stem from the tendency to simplify theoretical models on international migration by disregarding the public sector of the sending country (see, for example, models of national self-interest in international trade). Or, it may stem from the fact that emigration subsidies do not make sense under a quota system of immigration control. But the idea should be familiar to researchers in regional science and local public economics, as emigration subsidies simply represent a very targeted type of interregional transfer (see Myers [16, 1990] and Krelow [14, 1992]).
In order to develop our arguments with as much clarity as possible, we overlay alternative immigration control systems on a very simple model. We assume that a single consumption good is produced competitively in each of two countries from resident labour and a locationally fixed resource under identical technologies which exhibit diminishing marginal and average products of labour. There is no physical cost of movement between the two countries, but immigration can be restricted by national governments. Individuals move when migration increases utility and it is not prohibited. National governments control the fixed resource, distribute rents to residents with head subsidies, impose immigration restrictions and are concerned only with the well-being of their original residents. Under national self-sufficiency, after-subsidy consumption in each country is given by the average product of labour.

Since our proposal is about policy-making, one could become suspicious of strong results based on such a simple model. For this reason we discuss at the end ways in which our framework could be extended along a number of directions. Even though such extensions could qualify some of our strong results here, we believe that our proposal will remain clearly superior to the quota system in more general contexts. Furthermore, even though our model is simple, it retains all elements we deem essential in any policy-oriented study of immigration control. Namely, it allows for (1) congestion; (2) a fixed national resource; (3) a complete specification of all endowments, preferences, and instruments; and (4) the determination of an equilibrium.

(1) Through diminishing average products, we create a starkly congested world consistent with the currently observed, widespread tendency of raising barriers against economic immigration. Potential benefits from freer migration exist through the possibility of labour flows from low- to high-marginal-product countries.

(2) The concept of a country itself, through its geography and history, implies important productive national resources. On the one hand, geography implies fixed factors such as land which are mostly in private hands. History, on the other hand, implies publicly controlled productive factors such as transportation infrastructure, a body of law, a set of traditions, and the system of governance itself. When studying immigration control, there is a significant distinction to be made between the

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6In appendix D, for example, we prove that the nature of our results is immune to extensions involving heterogeneous workers, a class of immobile landowners, or mobile landowning workers. The intuition will be made clear later on, where we show that tolls and subsidies combined can eliminate the usual conflicting interests among different domestic residents which arise from immigration.

7To our knowledge, no paper in the existing literature about international migration control accommodates all four. References in the international migration literature include Usher [20, 1977], Chiswick [6, 1982], the special issue of the Journal of International Economics [Vol. 14, No. 3/4, 1983], Simon [19, 1989], Borjas [2, 1990], Greenwood [11, 1994], and Wellisch and Wildasin [21, 1996], to name only a few.
utility of citizenship and a citizen’s earned income. For example, while the utility of an American worker depends on earned income, it also depends on all the rights, privileges, and responsibilities of citizenship. A non-exhaustive list of citizenship benefits would include consumption of personal and national security, a livable environment, an accountable legislature and judiciary, as well as publicly subsidised access to transportation, education, and health care. The current flows of these productive factors/consumptions do not arise primarily out of current expenditure, but rather as flows from what might best be thought of as a stock of national resources accumulated over the life of a country. We use a head subsidy, financed out of a publicly controlled productive resource, as our highly simplified proxy for the distinction between a citizen’s earned income and the value of citizenship.¹⁸

(3) Assuming a complete set of lump-sum taxes as is often done to avoid distributional issues is inappropriate for some types of immigration control, including a quota system. We therefore impose that governments use appropriately restricted tax instruments. Furthermore, in the presence of international migration, national endowments of factors (e.g. labour and capital endowments) can change.⁹ We therefore detail individual endowments.

(4) Because the underlying model is simple enough, we are able to characterise outcomes in which all governments and individuals are doing as well as they can—given feasibility and the behaviour of others. Modelling both governments is essential for us because both immigration tolls and emigration subsidies are necessary for our results.

With an homogeneous population and without immigration control, our model predicts an efficient migration equilibrium characterised by equal utility across countries (section two). The open-borders policy here implies that immigration reduces the equilibrium utility level in the rich country. The very prospect of such an adverse congestion effect must generate a strong incentive for immigration control. With quota alone as a control instrument the receiving country incurs the congestion cost without any direct benefit from immigration. Unsurprisingly, then, we find a complete prohibition of movement under a pure quota system (section three), so that the two countries are left at the inefficient initial allocation. This can be interpreted as reflecting the truth that legal economic immigrants to-day constitute a rather insignificant portion of the corresponding total volume.¹⁰

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¹⁸As noted above, we model the case of privately held fixed factors (land) in appendix D. This does not alter the central message of our paper. For a discussion of the problems associated with disregarding immobile national factors in models of international migration (e.g. the buy-out results) see Kuhn and Wooton ([15, 1987]).

⁹See Helpman and Krugman [12, 1985, p.204].

¹⁰Total immigration can be partitioned among economic, political refugee, and family reunification categories. The share of political refugee cases and, especially, of family reunification has grown
In our model, a rich and congested country will allow immigration only if it can share at least some of the gains that emigration bestows upon immigrants and the poor country. Since immigration tolls provide a natural mechanism for exploiting those gains, they can represent an important and provocative policy innovation. We incorporate tolls in the context of a simple game to undertake a more formal evaluation of the recent proposals along these lines (section four). In this game the poor country does not make emigration subsidies so, other than distributing its public resource rents to residents, it is passive. We restrict governments to treat their homogeneous original residents equally and have them maximise the utility of a representative original resident (e.g. median voter). We do not allow governments to force migration—if agents move they do so in their own interest. In the first stage governments simultaneously choose their subsidy and toll instruments knowing perfectly well the consequences of their choices on migration. The second stage is a general equilibrium model where individuals move if it is beneficial. We obtain two main results from this game. Firstly, that the switch in policy from quota to tolls may not induce migration—hence it may not promote efficiency. Secondly, we find that whenever the rich country allows some Pareto–improving migration, it is never enough from an efficiency perspective. The reason underlying this inefficiency is that the rich country uses its toll to manipulate the international terms of trade for migrants.

The results in sections three and four hinge upon the passive nature of the poor country. But is such behaviour in the interest of a poor country? If our assumption that rich countries are congested is reasonable, it seems doubly so for poor countries; and if poor countries are seriously congested, they will have a strong incentive to act to reduce congestion through emigration. More emigration would be beneficial, both for the migrants who become citizens of the rich country and for those who remain at home but who gain from the reduced congestion (e.g. better labour market conditions). Based on these observations, we allow the government of the poor country to offer an emigration subsidy to those who wish to emigrate if it improves the living standard in that country (section five). Modifying our model toward this direction leads to strong results. Firstly, changing from a pure quota system to a toll/subsidy system promotes efficiency because the equilibrium outcome necessarily involves migration from the poor to the rich country. Secondly, although the equilibrium remains inefficient as both countries want to manipulate the terms of trade, this change represents a strict Pareto improvement because it makes all citizens of both countries better off.

In section six we compare the efficient competitive equilibrium allocation of a significantly in recent years at the expense of economic migrants. In the United States, for example, family reunification has represented over ninety per cent of the total immigration volume in some years. Writing in 1988, Chiswick [7] reports 22,000 economic migrants out of 600,000.
market where price-taking countries buy and sell migrants to maximise national income, with the equilibrium allocation of the non-cooperative game of section five. We prove equivalence if the countries in the toll/subsidy game take the terms of trade for migrants as given. We show that the immigration toll, in the absence of an incentive to manipulate the terms of trade, is equal to the full unearned benefits of citizenship and that the emigration subsidy is equal to the unearned benefits of citizenship in the poor country. That is, the poor country pays part of the immigration toll faced by its emigrants. So, in the end, all a legal immigrant gains is a better job.

When there is no incentive to manipulate the terms of trade, such equivalence has a set of implications. On the one hand, it makes it clear that the problem with the quota system is that it involves a self-imposed price ceiling of zero on the market for citizenship, with the obvious implications for the amount of equilibrium trade. It also makes it clear that the reason why moving from a quota system to a toll/subsidy system leads to Pareto improvements is that a market is created, and if market trade is voluntary it must be mutually beneficial. On the other hand, the equivalence implies that a proponent of the toll/subsidy system implicitly supports a bizarre competitive market. Finally, by the generality of the first welfare theorem with respect to numbers of goods and market participants, the equivalence result provides intuition as to why we can extend our results to heterogeneous population types.

In a sense the heart of our paper is section seven, where we discuss the policy implications of our model from the perspective of international efficiency and distributive justice. We begin by showing that in our simple model there is a strong normative ranking of immigration control systems. The toll/subsidy system normatively dominates the quota system and is itself dominated by open borders. After all, open borders represent a true free-trade regime. But even more importantly, unlike free trade in goods, the removal of immigration control replaces accidents of birth with a freedom of choice which promotes a fundamental tenant of social justice. Namely, it promotes horizontal equity in a strong and robust way.

But an open-borders policy in our simple model also makes the citizens of the rich country worse-off. Clearly, this is consistent with an almost total lack of political support for open borders in the rich countries of our congested world.

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11 This is a market for human beings with all the obvious restrictions on personal freedom.
12 For example, when terms of trade cannot be manipulated, we show that all a legal immigrant gains under a toll/subsidy system with or without heterogeneous labour, immobile landowners, or worker/landowners, is a better job.
13 This is stronger than factor-price equalisation. In the process of ranking immigration control systems we point out that nationalism, as a basis for making ethical judgements, violates anonymity—a fundamental axiom of social choice. For this reason nationalism falls into the same category as sexism and racism.
In the rest of section seven and in section eight we attempt to leave our simple model behind and generate realistic normative arguments which could support the use of a quota system. We examine arguments that we have been collecting over the years and largely reject them. We close by considering positive arguments which could support the use of a quota system and do provide one rent-seeking example.

2. Open Borders

We begin with the description of our basic model. There is a mobile population and an immobile resource, both of fixed total size, partitioned between two countries which form a closed system. Initially, country one is rich and country two is poor. The population partition is denoted by \((N_1, N_2)\) with \(N_1 + N_2 = N\) and \(N_i \geq 0\). The fixed resource partition is denoted by \((T_1, T_2)\). We assume that the fixed resource of each country is controlled by its government. The initial population partition is denoted by \((N_1^0, N_2^0)\), where a superscript ‘o’ specifies variables at the initial stage of the system. We assume that the initial population partition is inefficient and that \(N_i^0 > 0\).

Individuals are identical with respect to both ability and tastes. They inelastically supply one unit of labour in the country where they live, and they derive utility from the consumption of a single good which we make the numéraire. We further assume that utility is linear in the good. Labour and resource available in each country are combined by competitive firms to produce the good under an identical, linear homogeneous and concave technology \(X[N_i, T_i]\) for \(i = 1, 2\). Consequently, labour and resource are paid their marginal product denoted \(y_i\) and \(r_i\) respectively, while firms earn zero profits:

\[
X_i = N_i y_i + R_i \tag{1}
\]

where \(R_i \equiv T_i r_i\).

Since an open–borders policy implies no direct or indirect control on either emigration or immigration, the government of each country has only one instrument—a residence–based uniform head subsidy \(s_i\).\(^{14}\) Thus the budget constraint of government \(i\) is given by

\[
N_i s_i = R_i \tag{2}
\]

while consumption is simply after–subsidy income

\[
x_i = y_i + s_i \tag{3}
\]

\(^{14}\)Tax discrimination based on original residence is inadmissible both under open borders or a quota system as it amounts to allowing an immigration toll. Thus assuming there is no tax discrimination in this model (the population is homogeneous) does not represent a simplifying assumption. Rather, it is a requirement for maintaining consistency with “real world” immigration regimes. Later on, when we discuss extensions to populations with heterogeneous characteristics, we shall consider the possibility of discrimination on the basis of original residence.
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Combining (2) and (3) to eliminate the head subsidy and invoking (1), we obtain

\[ x_i = \bar{x}_i, \quad (4) \]

where \( \bar{x}_i \) denotes the average product of labour in \( i \).\(^{15}\) In the migration equilibrium, individuals locate to equalise average products (utility) which, given identical technologies, equalises marginal products yielding the equal-utility, efficient migration equilibrium.\(^{16}\)

3. Immigration Quota

The analysis of a quota system is equally simple in this model. Once governments have the ability to prevent immigration by imposing quota they will do so. In particular, under a pure quota system, governments may not discriminate against individuals on the basis of their original residence. Therefore since the only tax instrument available is a residence-based head subsidy \( s_i \) as in section two, (4) holds under a pure quota system; and since \( \bar{x}_1 \) decreases with \( N_1 \), immigration is damaging to the rich country one. Consequently country one prohibits immigration by imposing a zero quota level, which implies that the inefficient equilibrium allocation is given by \( (N_1^o, N_2^o) \) and \( (\bar{x}_1^o, \bar{x}_2^o) \).

4. Immigration Tolls

We consider the following simple game between an active rich country (one) and a passive poor country (two). First, national governments choose their policy instruments simultaneously. Then, given these policies, there is a general equilibrium model where individuals choose a residence, production takes place, policies are implemented and consumption occurs. We assume governments know perfectly well the consequences of their choices on migration behaviour. Since \( y_1^* > y_2^* \) by assumption, we have \( \bar{x}_1^o > \bar{x}_2^o \) and \( N_1^o < N_1^* \), where a superscript \( * \) denotes variables at an efficient allocation. For simplicity we assume from now on that \( N_1^* < N \).

We assume that the government of the rich country sells citizenship to immigrants. The benefits of citizenship are the earned benefits worth \( y_1 \) and the unearned benefits worth \( s_1 \). The immigration toll is \( t_{21} \). Thus the budget constraint of the rich government is given by

\[ N_1 s_1 = R_1 + M t_{21} \quad (5) \]

\(^{15}\) Notice that a government’s objective to maximise utility is not equivalent to maximising national income in our context. Such equivalence requires a complete set of lump-sum taxes, which is inconsistent with both an open-borders or a quota regime.

\(^{16}\) This result extends to differing technologies. We shall return to this issue in section eight, where we introduce heterogeneous populations.
where $M \equiv N_1 - N_0^1 = N_0^2 - N_2$ denotes the net number of migrants. The consumption of an original resident in that country is after-subsidy income

$$x_1 = y_1 + s_1$$

as before, while the consumption of an immigrant is

$$x_{21} = y_1 + s_1 - t_{21}.$$  

The description of country two follows exactly section two. Consequently

$$x_2 = y_2 + s_2.$$  

Migration will occur only if the immigration toll set by government one is such that $x_{21} > x_2$. Using (7) and (8), this implies

$$y_1^e - y_2^e > t_{21} - s_1 + s_2.$$  

If (9) does not hold, an immigration tolls policy in our model generates the same inefficient equilibrium as an immigration quota policy does. If it holds, migration into country one will proceed. The migration process will be stable as $x_{21} - x_2$ is decreasing in $N_1$ by the concavity of the production function. Thus migration will continue until either utility is equalised for all original residents of the poor country,

$$y_1^e + s_1 - t_{21} = y_2^e + s_2,$$  

or until the poor country is depopulated, in which case $x_{21}^e|_{N_1=N} > x_2^e|_{N_2=0}$, where a superscript ‘$e$’ denotes variables at equilibrium. The latter cannot happen because, with $N_1 = N > N_1^*$, $x_{21}^e|_{N_1=N} > x_2^e|_{N_2=0}$ would require $t_{21} < 0$. In this case the rich country is hurt by the immigration through increased congestion and through payments to immigrants. Then the solution will involve either no migration or (10).

The government of country one maximises the utility of its original residents by choosing $(s_1, t_{21})$, treating $s_2$ as given and subject to its budget constraint, while taking fully into account the internal migration equilibrium. In appendix A we show that, if there is migration, the rich country chooses

$$t_{21}^e - s_1^e = -M^e y_2^e,$$  

where $y_i' \equiv \partial y_i / \partial N_i$. Notice that $t_{21}^e > s_1^e$ because $M^e > 0$ and $y_i' < 0$ by concavity. Therefore the equilibrium toll is greater than the unearned benefits of citizenship in the rich country. The poor country, which is passive, also uses $s_2$ to balance its budget:

$$s_2^e = R_2^e / N_2^e.$$  

Replacing (11) and (12) in (10) determines $N_1^e$.17

If we replace once again (11) and (12) in (10), and taking into account that we have $y_1^e - y_2^e > y_1^e - x_2^e = -M_y y_2^e > 0$ because $M_y > 0$, one concludes that immigration tolls do not lead to a full exploitation of gains from trade. In fact, we find that replacing quota with tolls need not promote efficiency since no migration will occur unless $y_1^e > x_2^e$. As we let $M_y \to 0$ we have $t_{21}^e \to s_1^e$ and $s_2^e \to R_2^e/N_2^e$, so that (9) is violated when $y_1^e < x_2^e$. Thus $M_y = 0$ will be an equilibrium outcome if $y_1^e < x_2^e$. This happens because the value of an immigrant to country one is $y_1$, but a resident of country two requires at least $x_2$ in order to emigrate. In consequence, there are two reasons for inefficiency. First, the unearned benefits of citizenship in the poor country distort migration incentives. Second, in order to attract an additional migrant, country one must lower the entrance toll charged to all inframarginal immigrants. Hence the rich country has an incentive to manipulate the terms of trade for migrants, using its entrance toll in the same way a monopolist sells less than the efficient level of a good to increase its price.

5. IMMIGRATION TOLLS AND EMIGRATION SUBSIDIES

The results in section four hinge upon the passive nature of the poor country—it was a game of solitaire. In this section we add the possibility of an emigration subsidy for that country, thus making both countries active. Although no country can send people into exile, a country may now encourage some people to emigrate by making it in their self-interest. Everything else remains as in section four.

For country one both the national budget constraint and the consumption of an original resident are still given by (5) and (6) respectively. However, since an emigrant now receives an emigration subsidy $s_{21}$, (7) is modified as

$$x_{21} = y_1 + s_1 - t_{21} + s_{21}. \quad (13)$$

The budget constraint of the poor government is given by

$$N_2 s_2 + M s_{21} = R_2 \quad (14)$$

while, as previously, consumption in that country is given by (8). Combining (8) with (13), we obtain

$$y_1^o - y_2^o > t_{21} - s_1 + s_2 - s_{21} \quad (15)$$

as required for migration. If (15) is satisfied, and since the migration process is still stable, migration will continue until

$$y_1^o + s_1 - t_{21} + s_{21} = y_2^o + s_2 \quad (16)$$

17 Uniqueness problems could arise when the equal-utility constraint is nonlinear in $N_1$. However, substitution of (11) and (12) in (10) in the case of a quadratic production function yields an expression which is linear in $N_1$ and an equilibrium solution which is unique for all variables. Such numerical examples are available upon request.
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or until the poor country is depopulated, in which case \( x_{21}^{e} \mid N_{i}=N > x_{2}^{e} \mid N_{2}=0 \). Given that (15) holds we proceed by solving for the equilibrium conditional on the existence of an internal solution, from now on conditional equilibrium. Later on we shall verify that a country cannot find it unilaterally profitable to deviate from this solution and therefore prove that the conditional equilibrium is a Nash equilibrium.

The optimisation problem for country one remains as before, and in appendix B we show that it leads once again to (11). For country two, the government maximises the utility of its residents by choosing \( (s_{2}, s_{21}) \), treating \( (t_{21}, s_{1}) \) as given subject to its budget constraint, while taking fully into account the second-stage internal migration equilibrium. Under these circumstances we show in appendix B that

\[ s_{21}^{e} - s_{2}^{e} = M^{e} y_{1}^{e} \]

which yields \( s_{21}^{e} < s_{2}^{e} \). Therefore the equilibrium exit subsidy is smaller than the unearned benefits of citizenship in the poor country. Replacing (11) and (17) in (16) we find that \( y_{1}^{e} - y_{2}^{e} = -M^{e} (y_{1}^{e} + y_{2}^{e}) > 0 \), or \( N_{1}^{e} < N_{1}^{o} \). This happens because, now, the two countries use their immigration tolls and emigration subsidies for manipulating the terms of trade to their favour. Nevertheless, even though the conditional equilibrium is not efficient, switching from quota to the toll/subsidy system has two beneficial implications. First, it promotes efficiency in the sense of increasing the economy’s output. Second, and this is our main result here, it leads to a strict Pareto improvement.

(1) Efficiency is promoted because \( N_{1}^{e} > N_{1}^{o} > N_{1}^{m} \) given that (15) holds. From (11) and (17) we find that as \( M \to 0, t_{21} \to s_{1} \) and \( s_{2} \to s_{21} \), so that (15) is necessarily satisfied. The logic is that the incentive to manipulate the terms of trade in migrants disappears as that trade disappears, and in economies where \( y_{1}^{e} < \bar{x}_{2}^{o} \) migration is induced and gains from trade exploited by \( s_{21} > 0 \). As \( M \to 0 \), using (14), \( s_{2} \to s_{21} \to R_{2}/N_{2}^{o} > 0 \).

(2) In order to establish that switching from quota to tolls and subsidies represents a strict Pareto improvement, we begin by solving for the national income \( N_{1}^{o} x_{1}^{e} \) that goes to the original residents of the rich country. Subtracting \( M^{e} s_{1}^{e} \) from both sides of (5), using (6) to eliminate \( s_{1}^{e} \) from the LHS, adding and subtracting \( N_{1}^{e} y_{1}^{e} \) on the RHS, and using the zero-profit condition (1), we find that \( N_{1}^{o} x_{1}^{e} = X_{1}^{e} - M^{e} (y_{1}^{e} + s_{1}^{e} - t_{21}^{e}) \): the national income of original residents is output minus (domestic) payments to (originally) foreign factors. Given \( M^{e} > 0 \), hence \( t_{21}^{e} > s_{1}^{e} \), a sufficient condition for \( x_{1}^{e} > x_{1}^{m} \) is \( X_{1}^{e} - X_{1}^{m} > M^{e} y_{1}^{e} \). Since the LHS of the inequality is the whole area under the marginal product function between \( N_{1}^{o} \) and \( N_{1}^{e} \) while the RHS is just part of this area under \( y_{1}^{e} \), we conclude that switching from quota to tolls and subsidies is indeed beneficial to the original residents of the rich country. Following a similar approach for the original residents of the poor country, we arrive at \( N_{2}^{o} x_{2}^{e} = X_{2}^{e} + M^{e} (y_{1}^{e} + s_{1}^{e} - t_{21}^{e}) \):
the national income is output plus (foreign) payments to (originally) domestic factors. By (16), this can be written as $N_2^o x_2^e = X_2^e + M^e (y_2^e + s_2^e - s_{21}^e)$. Given $M^e > 0$, hence $s_2^e - s_{21}^e > 0$, a sufficient condition for $x_2^e > x_2^o$ is $M^e y_2^e > X_2^o - X_2^e$. The LHS is the whole area under $y_2^e$ between $N_2^e$ and $N_2^o$ while the RHS is just part of this area under the marginal product function. Therefore switching from quota to tolls and subsidies is also beneficial to all original residents of the poor country (recall $x_2^e = x_2^o$ by (16)).

We close this section by establishing that the conditional equilibrium allocation is a Nash equilibrium allocation. We show that there are no profitable unilateral deviations to policy choices which lead to a corner solution in terms of migration. The strict Pareto improvement implies that neither country would prefer to deviate unilaterally from the conditional equilibrium and prohibit migration. The other corner solution, where the poor country is depopulated, also represents an unprofitable unilateral deviation because we assume an empty country two implies no exit subsidy since there are no people left to pay for it; and if there is no exit subsidy, country one must set a negative immigration toll in order to achieve a population larger than $N_1^*$. 

6. A Competitive–Like Market for Migrants

In this section we show that if the two countries take the economy’s after–tax–return to migration as given then the Nash equilibrium of section five is equivalent to a competitive market for migrants.

We first describe the competitive market. Imagine a world in which the two countries can buy and sell migrants taking the price $p$ as given. Country $i$ chooses the volume of net imports $M_i$ in order to maximise national income $\Pi_i$, specified as the national output minus the payment for net imports of immigrants. By definition

$$\Pi_i = X_i - pM_i.$$  
(18)

The first–order conditions imply

$$y_i = p^c$$  
(19)

where a superscript ‘c’ denotes variables at the competitive equilibrium. It follows that the equilibrium partition is the efficient partition, i.e. $N_i^c = N_i^*$. Since in the competitive equilibrium supply equals demand, we also have

$$\sum M_i^c = 0.$$  
(20)

Thus the country which initially has the higher (lower) marginal product buys (sells) $M_i^c = N_i^* - N_i^o$ migrants at a price $p^c = y^*$.\(^{18}\)

\(^{18}\)It is clear that the same implications hold when there are many countries and that this framework can be extended to many types of migrants differing by labour type with one market for each type.
If we divide both sides of (18) by $N_i^o$, we observe that a government which maximises (18) and ensures equal consumption for each of its original residents also maximises the utility of its representative original resident. Using the zero–profit condition (1) to evaluate (18) divided by $N_i^o$ at the competitive equilibrium, we obtain

$$x_i^c = y^* + \frac{R_i^*}{N_i^o}.$$  \hfill (21)

Since $x_{21}^c = x_2^c$, (21) specifies the consumption of the representative original resident for country $i$.

We next describe the equilibrium allocation of section five in the special case where the two countries take the economy’s after–tax–return to migration as given. In that case (16) becomes

$$y_1^{ce} + s_1 - t_{21} + s_{21} = Y \quad (a)$$

$$y_2^{ce} + s_2 = Y \quad (b)$$

where the constant $Y$ is the after–tax–return to migration and the superscript “ce” denotes variables at the Nash equilibrium of the special case. In appendix C we prove that

$$t_{21}^{ce} = s_1^{ce} \text{ and } s_{21}^{ce} = s_2^{ce}. \hfill (23)$$

Upon substitution of (23) in (22) we find that $y_1^{ce} = y_2^{ce}$, hence that $N_1^{ce} = N_1^*$. Furthermore, in conjunction with (14) and (17), (23) implies $s_2^{ce} = R_2^*/N_2^o$. Using $t_{21}^{ce} = s_1^{ce}$ on (5) and (6), as well as $s_2^{ce} = R_2^*/N_2^o$ on (8), we arrive at

$$x_i^{ce} = y^* + \frac{R_i^*}{N_i^o}. \hfill (24)$$

Comparing (21) with (24) we conclude that the competitive equilibrium allocation is equivalent to the equilibrium allocation of the toll/subsidy system if countries are price takers. The rich country charges an immigration toll equal to the unearned benefits of citizenship $t_{21}^{ce} = s_1^{ce}$ which, by (5), is $R_1^*/N_1^o$. The poor country participates by paying an emigration subsidy equal to the unearned benefits of citizenship in the poor country $s_{21}^{ce} = s_2^{ce}$ which by (14) is $R_2^*/N_2^o$. That is, the poor country pays part of the immigration toll faced by its emigrants.\(^{19}\) So, in the end, although the rich country sells the immigrant citizenship, all the immigrant gains is a better job worth the efficient marginal product of labour $y^*$. Notice that both tolls and subsidies are required for the market analogy. Also notice that, in the more realistic case where

\(^{19}\) The subsidy is only partial as $R_1^*/N_1^o > R_1^*/N_1^* = R_2^*/N_2^* > R_2^*/N_2^o$ by identical technologies and $N_1^* > N_1^o$ and $N_2^* < N_2^o$. 

countries are not price takers, denying access to the rich country’s public sector does not represent a sufficient toll from the perspective of the rich country. Finally notice that, with or without price taking, denying access to the rich country’s public sector is not sufficient if we move to a more realistic model where the unearned benefits of citizenship are more than simply an amount of the single good, for example, if the benefits were partially non-rival or non-excludable in nature.

7. Policy Issues
We consider policy prescription in the context of our model from the perspective of international efficiency and distribution. We have shown that the proposed toll/subsidy system is Pareto superior to a pure quota policy. But we also know that an open-borders policy is both efficient and egalitarian, hence it has much to recommend it over the alternative system. More precisely, given the policy instruments of section five and the identical nature of individuals in our model, the international utility-possibility frontier is characterised by the maximum feasible world output \( X^*_1 + X^*_2 \) and any distribution of that output between residents of the two countries.\(^{20}\) It has slope \(-N^*_1/N^*_2\) in \(\{x_1, x_2 = x_{21}\}\) space. Because it is symmetric around the equal consumption line (once relative population sizes are taken into account), using any individualist welfare function which does not exhibit a preference for inequality and does not give more social weight to individuals on the basis of their birthplace, one would conclude that open borders are socially preferred to either immigration control policy. The usual “normative” defense of restrictive immigration control policies is nationalism, which is precisely expressing a social preference over individuals on the basis of an ethically arbitrary characteristic such as birthplace.\(^{21}\)

Even though an open-borders policy is superior from a normative point of view, its implementation seems difficult from a positive political perspective because it is not a Pareto improvement over immigration control.\(^{22}\) Since rich countries can do better by controlling immigration, it is not puzzling why they impose controls on economic

\(^{20}\)For example, to implement the extreme efficient allocation where the original residents of country one receive nothing, set \(s_1 = -y^*_1, s_2 = (X^*_1 + X^*_2)/N^*_2 - y^*_2, t_{21} = y^*_1 + s_1 - X^*_1/M^*\) and \(s_{21} = (X^*_1 + X^*_2)/N^*_2 - X^*_1/M^*\). This policy yields the efficient allocation where the original residents of country two consume \((X^*_1 + X^*_2)/N^*_2\) irrespectively of final residence and all budgets are balanced.

\(^{21}\)The anonymity axiom, which eliminates different social weightings based on ethically arbitrary characteristics such as name, sex, race or birthplace, is basic in social choice. As an ethical criterion, it seems there is little to choose among nationalism, sexism and racism. This result, however, does not mean that an increase in nationalism could not be associated with better social outcomes. But if this happens, it happens through expanding what is feasible—not because it is a good ethical criterion. And as caveats, the same could be true of racism or sexism, any of which could just as well reduce what is feasible.

\(^{22}\)But maybe not impossible. There are examples where richer countries (Germany) have implemented an open-borders policy with poorer countries (Portugal) in wider agreements (Treaty of Rome).
immigrants. However, from an economic viewpoint, our results suggest that it is puzzling why quota, rather than tolls, have been the predominant instrument of such control. So, as one moves away from our highly simplified model, it seems useful to consider what elements of reality can explain the predominance of quota to-day.

Is there something which could lead to the normative dominance of quota? One argument against moving to a system involving tolls is that only those already rich in poor countries could afford the net cost of entry. However, it seems reasonable to expect that the individuals who most want to come are those who can gain the most, and these are the poor rather than the rich who already are privileged. The poor could borrow against future income streams, if not in private markets, from the rich country’s government. The loan could then be paid back through higher income taxes.

A second argument, which we might call the ‘Statue of Liberty’ argument, is based on the notion that it is wrong for the government of a country to discriminate against someone who has already been accepted as a citizen of that country. In this context, a pure quota policy is preferable to a policy involving tolls because, unlike tolls, quota do not discriminate among citizens of the same nation. This argument involves putting more social weight on the well-being of individuals as they cross a national border. However, changing your concern for the well-being of someone because he or she has crossed an arbitrary geographical border has no ethical foundation. If anything, from an ethical perspective, an argument against discrimination is not an argument for quota—it is an argument for open borders.

A third one, the ‘bleak-world’ argument, maintains that tolls are bad since they create an underclass subjected to economic discrimination in the rich country. However, the same underclass exists with quota or tolls, the difference being that under quota the poor are poorer and contained in the poor country.

The idea of charging a price for admission runs contrary to the humanitarian intent suggested by the very existence of nonzero quota in a congested world. Many would maintain that acquiring citizenship should not be costly. But as Becker [1, 1992] notes, “...this objection is ignorant of history. The fact is that most immigrants in the past paid dearly for the right to enter. They paid indirectly by enduring the burdens of a long and arduous journey and directly by meeting the enormous costs of transportation. (The fare for crossing the Atlantic from Europe during the early 19th century equaled about a year’s earnings in the U.S.)” This objection is questionable also on the grounds that, as our paper indicates, charging a price for admission instead of imposing strict quota can lead to a socially preferred outcome.

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23 Recall that our paper is focused on economic immigrants—not political refugees or family re-unification.

24 Another argument against tolls relates to their distributional consequences when the population is heterogeneous. We will address, and largely reject, that argument in the next section.
Finally there is an argument which is more difficult to dismiss. It seems possible to us that a “good citizen” refers to something which is created and nurtured—not born. In other words, welcoming an immigrant as a equal citizen may create a different quality of citizen, with different values and preferences than when, through an entrance price, an immigrant clearly differs from the natives. However, such an argument seems to be largely beyond current economics because, even though individuals have values and preferences in economic models, they are typically exogenous. And although this is likely something worth consideration, excluding someone very poor (and thus already well-versed in exclusion) because of a concern for his or her psychological well-being seems weak.\footnote{Also note that this is not an argument for quota, based on the possible implication that tolls create bad immigrant–citizens and, therefore, damage the well-being of indigenous residents of the rich country. The reason being that this implication represents just another form of congestion, and thus it is simply an argument for a higher toll.}

8. LIMITATIONS AND EXTENSIONS

Our model assumes costless migration of identical individuals between two countries within a strongly congested world.

Adding different forms of congestion and/or migration costs will change both the characteristics of equilibrium and efficiency, but we believe these would not change the qualitative character of our results because we already have one type of congestion and one type of non-technological migration cost (immigration tolls). Besides abstracting from the costs of migration, we have also abstracted from the costs of immigration control. Even a cursory look at the immigration pressure on the Mexican/American or on the East European/West European border, makes it clear that this is a strong assumption worth exploring.\footnote{See Ethier [8, 1986], Chiswick [7, 1988], and Myers and Papageorgiou [17, 2000] on the control of illegal immigration.} But one could well argue that adding illegal immigration would simply lead to stronger normative arguments for tolls/subsidies, and to even stronger arguments for open borders over quota (a price ceiling).

Since the publicly provided good in our model is purely rival (and a perfect substitute for the private good), one natural extension would be to a corresponding imperfectly rival good. This would add some complexity, which we wished to avoid, but we are confident that it does not change the central message of our paper. We have already mentioned one important aspect it would add at the end of section six. In addition, making the publicly–provided good non-rival would reduce congestion in the model. With sufficient economies of scale in consumption it could remove congestion altogether, but since reality suggests a congested world for at least some labour types, such an assumption would be going too far. Modelling public goods would also make transparent the strong relationship that exists between the literature on
clubs and a model of immigration with entrance tolls. The publicly provided good is offered by a club manager (national government) to those willing to pay an entrance price (immigration toll). Such analogy would allow the application of well-developed results in the clubs literature to problems of immigration, and it would lead to many familiar notions from that literature as, for example, that a manager (national government) attempting to sell club membership (citizenship) has an incentive to be technically efficient in providing a desirable product (good government). One way in which the analogy does not fit is that, while in the clubs literature individuals are initially footloose, individuals in an immigration model are initially landlocked. It was this particular difference, together with the inability of a country to freely dispose of its excess initial population, that led to an emigration subsidy instrument in our model—a necessity which does not apply in the clubs literature.27

Results for extending our model to an heterogeneous population in the case of open borders exist in the literature. Consider different labour types \( a \) and \( b \) (e.g. skilled and unskilled labour). First, the result that open borders lead to a full Pareto-efficient allocation does not extend to the heterogeneous case (see Burbidge and Myers [5, 1994] and Bucovetsky [4, 1995]). The problem (according to Burbidge and Myers) is that governments distort migration decisions with unequal residence-based taxation in their attempt to play favourites (e.g. a right-wing government favouring skilled workers versus a left-wing government favouring the poorer unskilled). This is supported by the result that if governments do not have the incentive to play favourites, in other words, if they have the same objective function over utilities of the two types (same type of median voter) then a Pareto-efficient allocation is a Nash equilibrium even if there are externalities or congestion, and interregional transfers are required for the Pareto-efficient allocation. This is an extension of the incentive-equivalence result of Myers [16]. Bucovetsky provides a strong example of exactly what can go wrong with open borders. There is one labour type, but the population is heterogeneous in that each person born in a region owns an equal share of the land in their region of birth. Governments maximise the utility of only their indigenous residents (play favourites in a natural way) and distort migration with unequal residence-based taxation.28 So the conclusion is that, from an efficiency perspective, there may be little to choose between a toll/subsidy system and open borders once population

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27 See Scotchmer [18, 1994] for an insightful discussion of this literature.

28 While the notion of perfect incentive equivalence disappears with an heterogeneous population, the idea that open borders partially tie together incentives does not. Many authors, including policy makers, have argued that American support for the peso during its crisis is partially explained as preventing increased illegal immigration. Under open borders what would happen? Would powerful, developed countries allow tin-pot dictators to ravage their own people if the developed countries knew that they would have to pay the immigration price? To some extent, migration still implies that helping (hurting) your neighbour is helping (hurting) yourself.
becomes heterogeneous. On the other hand, the idea that open borders promotes horizontal equity fully extends to an heterogeneous population.

Something else which changes with heterogeneity in our model is that discrimination against immigrants, even though still illegal in a strict sense, becomes possible under both open borders and the quota system. For example, you can put higher tax rates (or lower expenditure rates) on personal characteristics that are positively correlated with foreign place of birth. A primary point in Bucovetsky is that, given his land-ownership assumption, the government can, and will, discriminate perfectly against immigrants. Thus taxation or subsidisation of land and labour becomes as good as a toll. But, of course, reality lacks such perfect indicators so that your ability to discriminate indirectly is imperfect. As a result, perverse distortionary consequences follow from the attempt. And we are left with still another argument for replacing the quota system with the direct (and honest) discrimination device of immigration tolls and emigration subsidies.

Congestion occurs when immigrants decrease the well-being of those in the receiving country, in other words, when they become a fiscal burden by consuming more than what they produce with what they own. So, without the compensating factor of discrimination (a toll), binding quota would be imposed by a country concerned with the well-being of its own population. With some public ownership of land, oil etc., or with some good government and not too much increasing returns, homogeneity of the population and budget balance yields congestion as in our model where \( y + s > y \) because \( s > 0 \). Because we view congestion, in at least one population type, as essential for consistency with the situation we observe in the world under its quota system (why do we not let them all in?), we built congestion in our simple model. However, this model need not be congested for all population types once the population is heterogeneous. To see this simply note that \( s_i^\alpha \) need not be

\[29\] Bucovetsky is about migration within a country (open borders) and as such it has a different focus than our paper. But because it models both governments and because of the perfect tax discrimination against immigrants, it is likely the most closely related paper to ours. However, it has no congestion (everything is privately owned and there is no distinction between earned income and the value of citizenship) and it does not discuss emigration subsidies.

\[30\] For example, it is undoubtedly the case that some indigenous residents of every developed country in the world are endowed with nothing much but their labour. And these are likely the most important indigenous types when it comes to considering the consequences of international migration in a congested world, and the billion or so Chinese and Indians who would like to come to the developed world if they were allowed to do so.

Myers and Papageorgiou [17, 2000] allows for illegal immigration with landowners and workers, and provides another perverse policy example in the case of a government which can only discriminate indirectly. A government wants to allow immigration of workers only if it can discriminate. It cannot discriminate against legal immigrant workers but it can discriminate against illegal immigrants because they are illegal. So the government sets immigration quota to zero and lets in illegal immigrants by not enforcing it.
positive, even with a large population–wide uniform benefit from a good government, once \( s_a \) is understood to be the net interaction with the government, in other words, to include taxation. Maybe type \( a \) is rich and pays a high income tax which is then redistributed to the poor type \( b \).

Let us now extend the model to heterogeneous labour types. For simplicity, assume that migration is directed to country one for both types and that it is stable. Also assume that governments care only about their indigenous populations, and that they choose type–dependent entrance tolls and exit subsidies (markets by type) in order to maximise a non–decreasing function of the utilities corresponding to types \( i = a, b \). In appendix D we prove that

\[
\begin{align*}
t^{i}_{21} - s^{i}_{1} &= -M^{i} y^{i}_{2} - M^{j} y^{ij}_{2} \quad \text{for} \quad i = a, b \text{ and } i \neq j \quad (a) \\
s^{i}_{21} - s^{i}_{2} &= M^{i} y^{ii}_{1} + M^{j} y^{ij}_{1} \quad \text{for} \quad i = a, b \text{ and } i \neq j \quad (b)
\end{align*}
\]

which extend (11) and (17), where ‘\( e \)’ has been dropped so that superscripts now indicate the variable by type and where \( y^{ij}_{h} \equiv \partial y^{i}_{h} / \partial N^{j}_{h} \). When there is no complementarity between labour types (i.e. \( y^{ij}_{h} = 0 \) for \( i \neq j \)) then (11) and (17) still apply, one for each type. Under complementarity or substitutability in its manipulation of terms of trade, when each government chooses a toll or subsidy on one type, it must now also consider the effects of migration on toll revenue or subsidy cost of the other type. In appendix D we add a class of landowners in each country and show that it leads to (25) as well. We also model mobile landowning workers to get (25) once again. The extension and the intuition for the generality of these results are exactly as discussed in section six. For price–taking countries an individual buys citizenship, but because of the immigration toll and the emigration subsidy all the individual gains is the better job. Notice that the standard distributional affects of allowing entry to unskilled workers (landowners/capitalists benefit and indigenous unskilled workers hurt) need not apply. Any government’s objective function which does not decrease in the utilities would not give less to an indigenous resident. This happens precisely because the set of tolls and subsidies available allows each government to separate its product–maximising objective from its distributional objective.\textsuperscript{31}

Since a type may not be congested, there are various possibilities to explore. First consider the case of an equilibrium immigration subsidy (e.g. the case of land grants in North America during the 19th century, or the case of a rich country paying the migration cost of immigrants in the 1970s). With \( s^{a}_{1} < 0 \), for example, it becomes

\textsuperscript{31}This is fundamentally about introducing tolls and subsidies, but it is also about having lump–sum taxes to handle redistributional incentives. Undoubtedly, since the marginal cost of public funds is greater than unity, extending results to remove lump–sum taxes could weaken the conclusion. But whether it does or not is really an open issue. With the change in regimes from quota to tolls and subsidies, countries have new sources of revenue but also new costs.
possible in the model to have an equilibrium immigration subsidy. With $s_2^0 < 0$ it also becomes possible to have an emigration toll. These are interesting possibilities, and notice that they raise standard issues from the brain-drain literature. For example, the migration of “brains” from poor countries may hurt those left behind in the absence of an emigration toll. But, in comparing quota with tolls and subsidies, also notice that they play only a small role because the potential for these instruments already exist under quota. For example, the brain-drain issue identified above is already an issue under our current quota system.

There are information problems in choosing immigrants as well. This is another type of congestion and would involve a higher toll to make it beneficial for the rich country. Asymmetric information issues should also be explored.

Objecting to a toll system on economic migration out of concern for political refugees and family reunification may be legitimate. But recall that migration and tolls make the rich country richer, so that if help for political refugees and family reunification are normal goods then the rich country will consume more.

An interesting explanation as to why we use quota may be the positive argument that citizens who are recent immigrants themselves, and who identify with potential immigrants from their home country, apply focused political pressure to assure positive quotas for their preferred group. Under quota, the only ones who benefit from migration in the rich country are the immigrants themselves. This would change under tolls. But also notice that the right of entry under the quota system is a big unpriced prize to the lucky recipient and, as such, it becomes similar to classic rent-seeking cases (e.g. a publicly-awarded monopoly license). By the standard rent-seeking arguments, you not only lose due to low levels of economic immigration under quota—you could also expect to lose much of the migration productivity gains from any immigration that does occur. The productive value of the entry in equilibrium is dissipated by completely wasteful expenditures in seeking the prize. You hire immigration lawyers or lobbyists (who would otherwise spend their time doing something productive) possibly to the full value of the prize.

Several of those extensions and others would undoubtedly qualify the strong results in our simple model. But it is equally clear that a normative justification of the quota system, and its zero implicit immigration toll, will be difficult in the face of immigration tolls and emigration subsidies which support a market for migrants.

A. Appendix A: Proof of (11) and (12)

Through (10) for migration equilibrium, $N_1^e$ becomes an implicit function of the instruments. Totally differentiating this equation and using $dN_1^e = -dN_2^e$ allows us

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32 We thank a referee for this argument.
to derive the migration responses as

$$\frac{\partial N_1^e}{\partial t_{21}} = -\frac{\partial N_1^e}{\partial s_1} = -\frac{\partial N_2^e}{\partial s_2} = \frac{1}{y'_1 + y'_2} < 0.$$  \hspace{1cm} (26)

The problem of country one is

$$\max_{\{s_1, t_{21}\}} L_1 = y_1 + s_1 + \lambda_1(R_1 - N_1 s_1 + (N_1 - N_1^o) t_{21})$$  \hspace{1cm} (27)

with first–order conditions given by

$$\frac{\partial L_1}{\partial N_1^e} \frac{\partial N_1^e}{\partial s_1} + 1 - \lambda_1^e N_1^e = 0 \hspace{1cm} (a)$$

$$\frac{\partial L_1}{\partial N_1^e} \frac{\partial N_1^e}{\partial t_{21}} + \lambda_1^e (N_1^e - N_1^o) = 0 \hspace{1cm} (b)$$

and the budget constraint. Taking the partial derivative of $L_1$ with respect to $N_1^e$ we find

$$\frac{\partial L_1}{\partial N_1^e} = y'_1 + \lambda_1^e [R'_1 - s_1 + t_{21}].$$  \hspace{1cm} (29)

Replacing (26) and (29) in (28), and using $N_1^e y'_1 = -R'_1$ yields $\lambda_1^e = 1/N_1^o$ and (11).

We can use a similar procedure for country two’s problem, where the budget constraint is given by (2) for $i = 2$. The first–order condition with respect to $s_2$ determines $\lambda_2^e$ and the budget constraint yields (12).

**B. Appendix B: Proof of (17)**

Through (16) for migration equilibrium, $N_1^e$ becomes an implicit function of the instruments including the emigration subsidy. Totally differentiating this equation and using $dN_1^e = -dN_2^e$ allows us to derive the migration responses as

$$\frac{\partial N_1^e}{\partial t_{21}} = -\frac{\partial N_1^e}{\partial s_1} = -\frac{\partial N_2^e}{\partial s_2} = \frac{\partial N_2^e}{\partial s_{21}} = \frac{1}{y'_1 + y'_2} < 0.$$  \hspace{1cm} (30)

Since the problem for country one remains that of appendix A, (27), (28) and (29) hold thereby leading to (11). However, because $s_{21}$ is introduced, the problem for country two changes to

$$\max_{\{s_2, s_{21}\}} L_2 = y_2 + s_2 + \lambda_2(R_2 - N_2 s_2 - (N_2^o - N_2) s_{21}).$$  \hspace{1cm} (31)
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The first–order conditions for this problem are given by

\[ \frac{\partial L_2}{\partial N_2^e} \frac{\partial N_2^e}{\partial N_2^e} + 1 - \lambda_2^e N_2^e = 0 \quad (a) \]

\[ \frac{\partial L_2}{\partial N_2^e} \frac{\partial N_2^e}{\partial s_2} - \lambda_2^e (N_2^o - N_2^e) = 0 \quad (b) \]

and the budget constraint. Taking the partial derivative of \( L_2 \) with respect to \( N_2^e \) we find

\[ \frac{\partial L_2}{\partial N_2^e} = y_2^e + \lambda_2^e [R_2^e - s_2 + s_{21}] \]

Replacing (30) and (33) in (32) and using \( N_2^e y_2^e = -R_2^e \) yields \( \lambda_2^e = 1/N_2^o \) and (17).

C. Appendix C: Proof of (23)
The problems and first–order conditions for both countries remain unchanged, that is, (27)–(29) and (31)–(33) hold. What changes is how the countries perceive the migration responses. Totally diﬀerentiating (22), the migration responses become

\[ \frac{\partial N_1^e}{\partial t_{21}} = \frac{\partial N_2^e}{\partial s_1} = \frac{\partial N_2^e}{\partial s_{21}} = \frac{1}{y_1^e} < 0 \quad \text{and} \quad \frac{\partial N_2^e}{\partial s_2} = -\frac{1}{y_2^e} > 0. \quad (34) \]

Using (34) and (29) in (28) with \( N_1^e y_1^e = -R_1^e \) yields \( \lambda_1^e = 1/N_1^o \) and \( t_{21} = s_1 \). Replacing (34) and (33) in (32) with \( N_2^e y_2^e = -R_2^e \) yields \( \lambda_2^e = y_2^e/(N_2^e y_2^e + (N_2^o - N_2^e)y_1^e) > 0 \) and \( s_{21} = s_2 \), thereby verifying (23).

D. Appendix D: Extension to Heterogeneous Populations

D.1. Heterogeneous Labour. The migration equilibrium conditions for two labour types are

\[ y_i^1 + s_i^1 - t_i^1 + s_i^j = y_i^j + s_i^j \quad \text{for} \quad i = a, b. \]

Through migration equilibrium conditions, \( N_i^j \) becomes an implicit function of the instruments. Totally diﬀerentiating these equations and using \( dN_1^i = -dN_2^i \) allows us to derive the migration responses as

\[ \frac{\partial N_1^i}{\partial t_{21}} = \frac{\partial N_2^j}{\partial s_1} = -\frac{\partial N_1^i}{\partial s_{21}} = -\frac{\partial N_2^j}{\partial s_2} = \begin{cases} \frac{y_{ih}^j}{A} & \text{if} \ i = j \ \text{and} \ i \neq h \\ \frac{y_{ij}}{A} & \text{if} \ i \neq j \end{cases} \]

where \( y_{ih}^j = \partial y_h^i / \partial N_h^i \) and \( y_{ij}^j = y_{i1}^j + y_{21}^j \) and where \( A = y_{aa} y_{bb} - (y_{ab})^2 \) > 0 for stability.
The problem of country one is

$$\max_{\{s_1^i, s_{21}^i\}} L_1 = \sum_i N_1^{i_0}(y_1^i + s_1^i) + \lambda_1 (R_1 + \sum_i ((N_1^i - N_1^{i_0}) t_{21}^i - N_1^i s_1^i))$$

(36)

with first–order conditions given by

$$\sum_j \left( \frac{\partial L_1}{\partial N_1^j} \frac{\partial N_1^j}{\partial s_1^i} \right) + N_1^{i_0} - \lambda_1 N_1^i = 0 \text{ for } i = a, b \quad (a)$$

$$\sum_j \left( \frac{\partial L_1}{\partial N_1^j} \frac{\partial N_1^j}{\partial t_{21}^i} \right) + \lambda_1 (N_1^i - N_1^{i_0}) = 0 \text{ for } i = a, b \quad (b)$$

(37)

and the budget constraint. Taking the partial derivative of $L_1$ with respect to $N_1^i$ we find

$$\frac{\partial L_1}{\partial N_1^i} = \sum_j (N_1^{i_0} y_1^j) + \lambda_1 [R_1^i - s_1^i + t_{21}^i] \text{ for } i = a, b.$$ 

(38)

Using (35) yields

$$\sum_j \left( \frac{\partial L_1}{\partial N_1^j} \frac{\partial N_1^j}{\partial s_1^i} \right) = - \sum_j \left( \frac{\partial L_1}{\partial N_1^j} \frac{\partial N_1^j}{\partial t_{21}^i} \right).$$

(39)

If we introduce this equality in (37) to solve for $\lambda_1$, we get $\lambda_1 = 1$. Simplifying (38) with $\lambda_1 = 1$ and

$$\sum_j (N_1^j y_1^j) = -R_1^i \text{ for } i = a, b$$

(40)

yields

$$\frac{\partial L_1}{\partial N_1^i} = \sum_j (-M_1^j y_1^j) - s_1^i + t_{21}^i \text{ for } i = a, b.$$ 

(41)

Substituting this, (35), the definition of $A$, and (25(a)) into (37) proves that $\{(25(a)) \text{ and } \lambda_1 = 1\}$ solves the system.

The problem for country two is

$$\max_{\{s_2^i, s_{21}^i\}} L_2 = \sum_i N_2^{i_0}(y_2^i + s_2^i) + \lambda_2 (R_2 - \sum_i (N_2^i s_2^i + (N_2^{i_0} - N_2^i) s_{21}^i)).$$

(42)
The first–order conditions for this problem are given by

$$\sum_j \left( \frac{\partial L_2}{\partial N_2} \frac{\partial N_2^j}{\partial s_2^i} \right) + N_2^{i0} - \lambda_2 N_2^j = 0 \quad \text{for } i = a, b \quad (a)$$

$$\sum_j \left( \frac{\partial L_2}{\partial N_2} \frac{\partial N_2^j}{\partial s_2^{i1}} \right) - \lambda_2 (N_2^{i0} - N_2^j) = 0 \quad \text{for } i = a, b \quad (b)$$

and the budget constraint. Taking the partial derivative of $L_2$ with respect to $N_i^j$ we find

$$\frac{\partial L_2}{\partial N_2^j} = \sum_j (N_2^{i0} y_2^{ij}) + \lambda_2 [R_2^i - s_2^i + s_2^{i1}] \quad \text{for } i = a, b \quad (44)$$

Using (35) yields

$$\sum_j \left( \frac{\partial L_2}{\partial N_2} \frac{\partial N_2^j}{\partial s_2^i} \right) = - \sum_j \left( \frac{\partial L_2}{\partial N_2^j} \frac{\partial N_2^j}{\partial s_2^{i1}} \right). \quad (45)$$

If we introduce this equality in (43) to solve for $\lambda_2$, we get $\lambda_2 = 1$. Simplifying (44) with $\lambda_2 = 1$ and

$$\sum_j (N_2^{i0} y_2^{ij}) = -R_2^i \quad \text{for } i = a, b \quad (46)$$

yields

$$\frac{\partial L_2}{\partial N_2^j} = \sum_j (M_2^{i} y_2^{ij}) - s_2^i + s_2^{i1} \quad \text{for } i = a, b. \quad (47)$$

Substituting this, (35), the definition of $A$, and (25(b)) into (43) proves that $\{25(b)\}$ and $\lambda_2 = 1$ solves the system.

It should be clear how to extend to any finite number of labour types. This would also work with a national objective function based on the utilities of the indigenous population. What is being maximised above is total consumption (income) for the indigenous population, which is a necessary condition for maximising a national objective function based on the utilities of the indigenous population given the instrument set.\footnote{In order to maximise national income, there are more instruments than you actually need in the above problem: setting $s_1^a = 0$ would still allow you to prove that $\lambda_1 = 1$. But once you start maximising a function of utilities, you would typically need all instruments to implement the distributional aim implied by the objective function.}

D.2. Private Land Ownership.
An Immobile Land–Owning Class. Assume there is land in the model owned by \( N_i^c \equiv N_i^{co} \) for \( i = 1, 2 \) immobile landowners, each owning one unit of land, and that land is paid its marginal product \( y_i^c \) by firms. The governments subsidise (tax) them at the rate \( s_i^c \). The migration equilibrium conditions are unchanged. The problem for country 1 becomes

\[
\max_{\{s_1^c, t_{21}^a, s_1^o\}} L_1 = \sum_i (N_i^{io}(y_i^1 + s_1^i)) + N_1^{co} y_1^c + \lambda_1 (R_1 - N_1^{co} s_1^c + \sum_i ((N_i^1 - N_i^{io})t_{21}^i - N_i^1 s_1^i))
\]

The first order conditions are given by (37),

\[
N_1^{co}(1 - \lambda_1) = 0
\]

and the budget constraint. Equation (38) is unchanged, but note that \( j \) in the summation is indexed over \( j = a, b, c \). The simplifications and cancellation procedure is identical except that, in the simplification of (38) using (40), the \( N_1^c y_1^{ic} \) cancels out because \( N_1^c = N_1^{co} \) and thus the solution is as before. The underlying logic is that any change in \( y_i^c \) is captured by the landowners. Given this, and the trivial way landownership changes the problem, it is clear that adding land and immobile landowners to country two’s problem leads to (25(b)). The fact that (25) remains unchanged does not mean that the equilibrium values for variables do not change. For example, you might imagine that if more immigrants increase \( y_i^c \), and that then this was shared with workers through an increase in \( s_1^i \), that \( t_{21}^i \) would also increase in equilibrium and the reverse would happen in country two.

Workers Own the Land. Assume that each worker of type \( a \) owns one unit of land in their country of origin. The income of type \( a \) is \( y_i^a + y_i^c \), where \( y_i^a \) represents as before the return to land—but now going to type \( a \). The migration equilibrium conditions remain unchanged because \( y_2^c \) cancels out from both sides and, with \( t_{21}^a \) and \( s_{21}^a \), the governments already have the all instruments they need to discriminate against migrants.\(^{34}\) The problem of country one becomes

\[
\max_{\{s_1^i, t_{21}^a\}} L_1 = \sum_i (N_i^{io}(y_i^1 + s_1^i)) + N_1^{ao} y_1^c + \lambda_1 (R_1 + \sum_i ((N_i^1 - N_i^{io})t_{21}^i - N_i^1 s_1^i))
\]

The first order conditions are given by (37) and the budget constraint.

\(^{34}\)The one difference here is that the population being determined directly by the migration equilibrium condition for type \( a \) labour is the number of type \( a \) originating in country 2 who migrate to 1.
Equation (38) is unchanged, other than adding $N_{1}^{ao}y_{1}^{ic}$ to the summation. The simplifications and cancellation procedure is identical, except that the simplification of (38) uses $N_{1}^{ia}y_{1}^{ia} + N_{1}^{ib}y_{1}^{ib} + N_{1}^{ao}y_{1}^{ic} = -R_{1}^{i}$ for $i = a, b$, and thus $N_{1}^{ao}y_{1}^{ic}$ cancels out because immigrants do not receive land rents in country one. Consequently (25(a)) obtains once again. The result for country two uses exactly the same approach as above, except you add $N_{2}^{ao}y_{2}^{ic}$ to the summation in (44) which then cancels out with the use of $N_{2}^{ia}y_{2}^{ia} + N_{2}^{ib}y_{2}^{ib} + N_{2}^{ao}y_{2}^{ic} = -R_{2}^{i}$ because type $a$ emigrants still receive land rents originating in country 2. Consequently (25(b)) obtains again.

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