Tradable Immigration Quotas*

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Abstract

International migration is maybe the single most effective way to alleviate poverty at a global level. When a given host country allows more immigrants in, this creates costs and benefits for that particular country as well as a positive externality for all those (individuals and governments) who care about world poverty. This implies that the existing international migration regime is inefficient as it fails to internalize such externality. In addition, host countries quite often restrict immigration due to its apparently unbearable social and political costs, however these costs are never measured and made comparable across countries. In this paper we first discuss theoretically how tradable immigration quotas (TIQs) can reveal information on such costs and, once coupled with a matching mechanism taking into account migrants' preferences, can generate substantial welfare gains for all the parties involved. We then propose two relatively small-scale applications: a market for the resettlement of international refugees, and an extension of the US diversity lottery program to a larger set of host countries. Both applications are seen as allowing for considerable experimentation and as possible precursors to a full implementation of a TIQs system.

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> I am distressed by the sight of poverty; I am benefited by its alleviation; but I am benefited equally whether I or someone else pays for its alleviation (Milton Friedman, "Capitalism and Freedom", 1962, page 191)

1 Introduction

The aim of this paper is to build the case for a tradable immigration quotas (TIQs) system. The sequence of our argument is as follows.

Poverty reduction has the dimension of a public good: people care about poverty out of altruism (i.e., genuine concern for others' well-being) and self-interest, because they fear for their security, health, and property. To the same extent that poverty alleviation has the dimension of a public good, international poverty alleviation has the dimension of an international public good. Whenever a given country increases its foreign aid to one of the countries where many of the world poor live, this generates a positive externality for all those in the world (individuals and governments) who care about international poverty reduction (assuming foreign aid is effective in reducing poverty). Whenever a given country increases the number of immigration visas granted to nationals of one of the countries where many of the world poor live, this generates a positive externality for all those in the world (individuals and governments) who care about international poverty reduction (assuming international migration is effective in reducing poverty). In both cases and given the public good nature of poverty alleviation, free riding is likely to prevail and result in global under-provision of foreign aid, debt relief programs, or immigration visas. While the international community has established international organizations and set up institutions to coordinate foreign aid and debt relief efforts, no such institutional setting is present for international migration.

Our first task, therefore, is to demonstrate that international migration contributes to substantial poverty alleviation at a global level and that the existing international migration regime, where host countries set their immigration policies non-cooperatively, is inefficient as it fails to internalize the positive externality generated when an individual country allows more immigrants to come. The second of our tasks is to show theoretically that TIQs coupled with a matching mechanism can elicit information revelation on both the migrants and host countries sides and generate substantial welfare gains. Finally, a third task is to demonstrate the feasibility of such a mechanism. To this end we advocate an incrementalist approach and propose two small-scale initial applications: a market for the resettlement of international refugees, and an extension of the US diversity lottery program. Both applications are seen as possible precursors to a full implementation of a TIQs system.

1.1 Going for the real gains

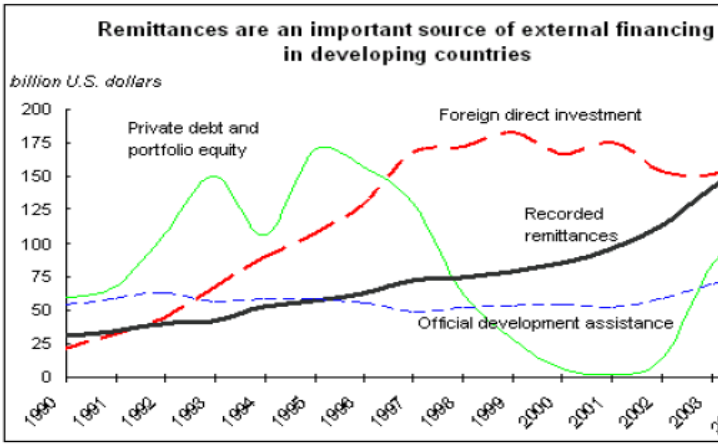
Globalization is quite advanced for goods and capital but still very imperfect for labor mobility. Partly due to this asymmetry in the extents of globalization at different margins, the potential gains from even a small liberalization of international migration are orders of magnitude higher than, say, a full liberalization of trade in goods and services, a comprehensive full debt relief program, or a doubling of official development aid (Pritchett, 2006, 2010). For example, a recent World Bank study (Walmsley, Winters and Ahmed, 2009) develops a bilateral migration model to simulate the welfare gains from an increase in South-North migration representing 3 percent of the former's labor force and being filled by workers from developing countries in proportion to their traditional supplies to each developed economy; according to their computations, this *modest liberalization of international migration* would increase global GDP by US$ 288 billion, a surplus shared more or less equally between the migrants, home country residents and host country residents thanks to the induced remittances. This is to be compared to a previous study by the same authors where the gains from a *full liberalization of trade* increases world output by just 65 billions. In the words of Rodrik (2007, p. 240), allowing for more international mobility of workers today is really "going for the real gains". And indeed, allowing for more international migration is almost certainly the single most powerful measure one can think of to decrease world poverty. To demonstrate this, we first consider the income gains for the migrants themselves, and then the developmental impact of migration on source countries.

The extent of the income gains accruing to migrants as a result of migration has long been a controversial issue due to methodological difficulties. However the estimates of the gains range from "huge" to "big". The main difficulty in measuring such gains is to produce sensible counterfactuals of domestic earnings for migrants, accounting not just for their observable characteristics but also for unobservable characteristics such motivation at work, attitudes toward risk, cognitive ability, etc. McKenzie, Gibson and Stillman (2010) use the New Zealand migration lottery program to "clean" income gains for migrants from such self-selection effects; comparing lottery-winning migrants to lottery-losing non-migrants they find migration increases migrants' earnings by a factor of four (from NZ$ 104 to 424 for weekly wages). This is consistent with the non-experimental results of Clemens, Montenegro and Pritchett (2008) who compare workers in developing countries to workers from the same countries working in the United States. After controlling for workers' characteristics, migration is found to raise real wages by 200%, 250% and 680% respectively for Guatemalans, Filipinos and Haitians. These income gains would seem to exceed the potential gains of any *in situ* development policy by orders of magnitude; for example, they calculate that the total present value of access to a lifetime of micro-credit is equivalent to the wage difference of just four weeks work of the same worker in the USA versus in Bangladesh, or that the present value of a lifetime wage increment of one additional year of schooling (obtained at no cost) is equivalent to 11 weeks work of the same worker in the USA versus in Bolivia.

Are we certain, however, that making migrant workers richer effectively contributes to reduce poverty at the world level? The effects of migration on poverty reduction through direct extraction of migrants out of poverty are maybe best illustrated using figures put together by Clemens and Pritchett (2008) using three poverty standards at US$1, 2 and 10 per day (in PPP). Respectively 50, 75 and 93 percent of all Haitian "naturals" (people born in Haiti) live below the $1, 2 and 10 poverty lines. Out of the 25% of all Haitians between the first two lines, 26% are US immigrants. Out of the 18% between the last two lines, 82% are US immigrants. By the latter measure, among the 56% of all Mexicans between the last two lines, 43% are US immigrants. While it would be an abuse of language to interpret these figures as indicative of the share of people escaping poverty thanks to migration, they are clearly suggestive of large direct effects of migration on poverty reduction. In addition, these figures may be seen as conservative. For example, in the case of Mexico, they neglect the induced effects of migration on poverty through increased wages for low-skill workers (Mishra, 2007), consumption of remittance income, and the fact that there is evidence of negative selection into migration both on observables and unobservables, meaning that migrants would on average earn less in Mexico if they had not migrated than those who did not migrate (Fernández-Huertas Moraga, 2010). More generally, we know that while migrants initially tend to come from the middle of the income and wealth distribution, network and other dynamic effects act to reduce migration costs, therefore making migration relatively more attractive for low-skill people and more affordable for people further down on the income ladder. This generates poverty and inequality reducing effects both directly, through migrants' self-selection patterns, and indirectly, through general equilibrium effects and distributional effects of remittances gradually reaching poorer households (McKenzie and Rapoport, 2007, 2010, Shen et al., 2010).

1.2 Alternative strategies to poverty reduction: comparing foreign aid to migration

If asked about what should rich countries governments do to reduce poverty in poor countries, most people would answer "increase aid and development assistance". Probably a very small minority would suggest letting more migrants in. In the 1980s, the slogan "trade, not aid" symbolized developing countries' call for better access to rich countries' markets. Will the 2010s see the emergence of a "visas, not aid" motto? A quick look at the global figures on aid and remittances suggests this could well be the case. Officially recorded remittances to developing countries have more than tripled over the last decade, rising from US$85 billion in 2000 to US$305 billion in 2008 (see Figure 1). While foreign aid was double the size of remittances in 1990, by 2008 remittances were triple the size of foreign aid. Moreover, remittances have been celebrated as a much more effective source of foreign exchange for development and poverty alleviation thanks to its private, highly decentralized nature, and to migrants' comparative



advantage in targeting recipients.[1] As noted above, migration and the induced remittances have been a powerful force in the fight against global poverty while the contribution of foreign aid to poverty reduction is at best controversial (Easterly, 2001).

Our main point, however, is elsewhere. To the same extent that the international community has called repeatedly for the rich nations to contribution to official aid and assistance on a fair basis, often setting quantitative objectives such as "one percent of GDP", one may ask whether some rich nations contribute more to development through their welcoming more immigrants originating from poor countries than others. Table 1 provides the answer. As can be seen from the Table, on average the OECD high-income countries contribute .3 percent of their GDP to foreign aid. The only countries which approach or reach the one percent threshold are Denmark, Luxembourg, Norway and Sweden. Note that all these countries have a higher GDP per capita than the United States. The United States, on the other hand, contributes just .2 percent of its GDP to ODA, one of the lowest figures among countries with comparable GDP per capita. However, the US, with a GDP representing one third of the total GDP of OECD high-income countries is host to more than 50 percent of the immigrants from low-income countries (LICs) in 2000 and has received more than 57 percent of the flow of immigrants from LICs between 1990 and 2000. Countries such as Australia, Canada or the UK welcome a more than twice as much immigrants from poor countries as what their share in terms of OECD high-income countries' GDP would predict, and conversely for countries such as Germany or Italy (less than 50%). Maybe the most extreme case is that of Japan with 12 percent of the group's output and less than 2 percent of its immigrants from poor countries.

[1] See also Rapoport and Docquier (2006) for a comprehensive survey on migrants remittances.

Table 1: OECD high-income countries' respective contribution to Foreign Aid and to immigration from Low-income countries.

Countries	GDP per capita in 2008 (US=100)	GDP in 2008 (share of total)	ODA in 2008 (share of total)	Migrant Stock in 2000 (share of total)	Migrant Stock from LICs in 2000 (share of total)	Net migration from LICs in 199 (share of tota
Australia	102	2.5	2.4	7.1	5.1	4.7
Austria	107	1.0	1.4	1.4	0.1	0.2
Belgium	102	1.2	1.9	1.6	1.6	0.5
Canada	97	3.7	3.9	8.1	8.2	7.6
Czech Republic	45	0.5	0.2	0.7	0.3	0.1
Denmark	134	0.8	2.3	0.4	0.4	0.7
Finland	111	0.7	0.9	0.2	0.2	0.3
France	96	7.0	8.9	6.5	8.1	4.9
Germany	96	8.9	11.2	8.2	3.6	3.5
Greece	68	0.9	0.6	0.8	0.2	0.0
Hungary	33	0.4	0.1	0.2	0.0	0.0
Iceland	113	0.0	0.0	0.0	0.1	0.1
Ireland	130	0.7	1.1	0.5	0.1	0.1
Italy	83	5.6	4.0	1.6	1.7	1.6
Japan	83	12.0	7.8	1.7	1.7	1.7
South Korea	41	2.3	0.7	0.2	0.3	0.0
Luxembourg	237	0.1	0.3	0.2	0.0	0.0
Netherlands	114	2.1	5.6	3.1	1.5	1.2
New Zealand	66	0.3	0.3	0.9	0.4	0.4
Norway	204	1.1	3.2	0.4	0.5	0.6
Portugal	49	0.6	0.5	0.3	0.4	0.6
Slovak Republic	39	0.2	0.1	0.1	0.0	0.0
Spain	76	3.9	5.6	2.8	0.8	1.0
Sweden	112	1.2	3.8	1.3	0.9	1.2
Switzerland	139	1.2	1.6	2.6	0.7	0.5
UK	94	6.5	9.3	6.2	13.0	11.2
USA	100	34.5	22.2	42.7	50.2	57.3
Sum		100.0	100.0	100.0	100.0	100.0
Total		$41 trillion	$124 billion	57 million people	4 million people	2 million peo
Source	WDI	WDI	OECD	Docquier-Marfouk	Docquier-Marfouk	Docquier-Marf

Note: Migration figures are from Docquier and Marfouk (2006) and refer to immigrants 25 and older, LICs stand for Low Income Countries according to the

1.3 Related literature

As explained, under-provision of immigration visas is likely when countries decide unilaterally how many immigrants to receive and fail to internalize the externality arising when people care not just about their own poor but also about others' poor. The source of the externality can lie in a genuine concern for for the fate of the poor wherever they are or from other concerns (such as

international security and stability) that, as for domestic poverty, found the public good nature of international poverty reduction. Hence, a case can be made that i) there is an under-provision of immigration visas to rich countries at a global level due to failure to internalize the externality at hand and ii) the current "contribution" of rich countries to international poverty alleviation through immigration is not shared fairly as some countries are home to a substantial number of international migrants originating from poor countries while others are virtually closed to such immigration. As for trade, countries can tax themselves and fail to seize the full surplus from exchange. Restrictive immigration policies are often explained by non-economic costs such as threats to social cohesion and national identity, which translate into negative attitudes toward immigration and constitute a political barrier to freer labor mobility (Mayda, 2008; Facchini and Mayda, 2008; Hanson, Scheve and Slaughter, 2007; O'Rourke and Sinnott, 2006). Differences in the perceived costs from immigration across countries may come from different demographic structures (e.g., dependency ratios), histories of previous immigration, or just preferences for ethnic, religious and cultural diversity.

In this paper we do not discuss (dispute) preferences over immigration policies on moral grounds. Preferences (e.g., being altruistic toward a poor person as long as that person remains in her home country, but becoming xenophobic from the moment that person enters the boundaries of my nation state) are taken as given. However, the proposed TIQs system will result in xenophobic countries compensating more immigration-friendly ones for their higher direct contribution to international poverty reduction through immigration, and this can be seen as morally right in addition to being economically efficient. From a dynamic perspective one can also envision that once the consequences of xenophobic preferences are internalized, people may have incentives to become less xenophobic. As for any tradable quotas, the essence of the argument is about information revelation on the true costs and benefits of letting more migrants in.

Our paper is not first to address the inefficiencies arising from the presence of externalities in migration policies setting. To the best of our knowledge, the idea of tradable immigration quotas was first discussed in the case of refugees by scholars in the fields of law and philosophy (Schuck, 1997, Hathaway and Neve, 1997). De la Croix and Gosseries (2007) mention the possibility of tradable migration quotas for unskilled migrants. However they do this without a model and consider temporary migration only. They couple this proposal with a source country market for emigration rights among skilled migrants, which can be considered a new version of a Bhagwati tax (Bhagwati and Hamada, 1974). Similarly, Pritchett (2006) discusses a number of variants of guest-worker programs, where migration is temporary and workers have no political rights (this is not "immigration", using his own wording). In contrast, what we discuss is truly about immigration, i.e. permanent settlement of people entitled to full citizens rights, maybe after some cooling-off (observation) period. Hence, our paper is first to make a comprehensive case for tradable immigration quotas (TIQs), even though the idea has been around for some time, in particular, in

the refugee protection literature (see section 3.1 for a short review of this specific literature).

De la Croix and Docquier (2010)'s paper is certainly closest to ours and we will therefore discuss it in more length. They also stress how a higher level of low-skill immigration than what it is currently observed would contribute to the reduction of world poverty, and propose a tax-subsidy scheme to encourage rich countries to accept more low-skill immigrants than they would unilaterally admit in an incentive compatible way. The tax would consist of contributions to a global fund that would then be refunded through a subsidy as countries accept more immigrants. Their focus is on incentive compatibility rather than on efficiency to ensure the political feasibility of their proposal. However, political feasibility crucially depends on a correct determination of the appropriate tax and subsidy levels, for which the informational requirements of their model might be excessive. For example, in the quantitative assessment of the model, they ask participating countries for contributions to the global migration fund in a range going from 0.1 to 0.2 percent of GDP that countries would recover if the tax and subsidy levels are correctly designed but could generate big losses on particular countries otherwise.

Our paper is less demanding in terms of its informational requirements since the revelation of the true net costs of migration that countries face is precisely one of its main advantages. Differently from De la Croix and Docquier (2010), we leave incentive compatibility outside of the model.[2] Political feasibility, on the other hand, is seen as a likely result from the incrementalist approach we are advocating; indeed, the initially modest applications we envision should allow for considerable learning-by-doing and, in turn, for gradual extensions of the mechanism over time. We do not strive for an first best solution, the proposed mechanism ensures a cost-minimizing way of attaining a higher, Pareto-improving level of migration than what is currently observed.

The paper is organized as follows. In section 2, we start by introducing the simple theory behind the idea of a market for TIQs. Section 3 presents a first application to the resettlement of refugees. Section 4 presents a second application in the form of a proposal to extend the current US diversity lottery program. Finally, section 5 concludes.

2 The Model

Each individual country i faces a decision about how many immigrants to receive (m_i) in its own territory and perceives a net cost of receiving these immigrants: $c_i(m_i)$. This cost function is a reduced form taking into account diverse components such as the direct cost of receiving the immigrants, administrative costs of processing their visa applications, social costs inherent to a possible conflict with local population, political cost associated with xenophobic sentiment, as

[2] Our model can be made incentive compatible through the manipulation of initial quotas. However, this would require the knowledge of the net cost of migration for all the countries, an information which is unknown ex-ante (but can be revealed over time through the market).

well as all the economic and social benefits that migrants may bring about, e.g. the immigration surplus, net fiscal contribution. It will be assumed that $c_i(m_i)$ is a convex differentiable function in the number of migrants with an interior positive minimum. Nothing is said about the sign of the cost function to allow for the possibility that immigrants are considered either a burden (positive cost) or positively valued (negative cost) by the destination country.

As a first step we will assume immigrants are indifferent between going to any of N possible destination countries,[3] an assumption that will be relaxed in the next section. Another important assumption is that destination countries can effectively choose the number of immigrants they want to accept. In this sense, a destination country i would be solving the following cost minimization problem:

$$\min_{m_i} c_i(m_i)$$

The optimal solution is:

$$c_i'\left(m_i^{NC}\right) = 0$$

where NC stands for the non-cooperative solution. As explained in the previous section, immigration to one country generates a positive externality on the others. Hence, the non-cooperative equilibrium does not satisfy a general optimal level M^*.

$$\sum_{i=1}^{N} m_i^{NC} \equiv M^{NC} < M^*$$

The externality is not modeled explicitly here in order to simplify the presentation[4].

Now, assume that N countries sign a multilateral agreement, or a central authority steps in, to coordinate these countries towards a higher level of total international migration M (decided outside the model) such that:

$$M^{NC} < M < M^*$$

That is, the agreement would go part of the way towards achieving an optimal global level of international migration.

The total minimum cost problem that must be solved by this central authority can be stated as:

$$\min_{\{m_i\}_{i=1}^{N}} \sum_{i=1}^{N} c_i(m_i)$$

[3] Note that immigrants are considered "homogeneous" from the point of view of the receiving country (they impose the same cost). The net cost of an immigrant can be interpreted as the expected net cost of a typical or average individual.

[4] For an explicit modeling of the externality in the case of refugee protection, see Barbou des Places and Deffains (2004), Hatton (2004), Hatton and Williamson (2004) or Bubb, Kremer and Levine (2009). In the case of immigration, see De la Croix and Docquier (2010).

$$s.t. \qquad \sum_{i=1}^{N} m_i \geq M$$

The first order conditions are:

$$c_i' \left(m_i^{TMC} \right) = \lambda \qquad \forall i = 1...N$$

where λ is the multiplier associated to the constraint. It must also be true that:

$$\lambda \left(M - \sum_{i=1}^{N} m_i^{TMC} \right) = 0$$

Since $\sum_{i=1}^{N} m_i^{NC} = M^{NC} < M$ because of the assumption that a positive externality exists, we can then be sure that $\lambda > 0$, so that:

$$M = \sum_{i=1}^{N} m_i^{TMC}$$

The optimal solution for the total minimum cost problem equalizes the marginal cost of accepting one additional immigrant across destination countries for a given number of immigrants M.

Let us now assume that we try to implement the above solution by creating a market for immigration quotas that would open for a limited time, after which immigrants would receive visas for their final destinations.

Each country is assigned an initial quota of immigrants m_{i0} that can then be traded in a market in which the price for accepting one additional immigrant will be represented by p:

$$M = \sum_{i=1}^{N} m_{i0}$$

The initial distribution of quotas must be agreed upon by the countries participating in the multilateral agreement or established by a central authority. It is assumed that the cost functions are expressed in monetary units and that the market is competitive so that all countries behave as price-takers[5]. The problem that each country must solve in this case will be:

$$\min_{m_i} c_i \left(m_i \right) - p \left(m_i - m_{i0} \right)$$

If the market is competitive, the first order condition will be:

$$c_i' \left(m_i^M \right) = p$$

[5] We discuss the possibility of manipulation of prices by big players in our applications. We follow Casella (1999) in arguing for a market design that alleviates these concerns.

The marginal costs of accepting one additional immigrant will then be equalized through the market. In addition, the market must clear:

$$M = \sum_{i=1}^{N} m_{i0} = \sum_{i=1}^{N} m_i^M$$

The market solution will be efficient ($m_i^M = m_i^{TMC}$) as long as it can be proved that $p = \lambda$. To see that this is the case, suppose $p \neq \lambda$. There are two possibilities then:

- $p < \lambda$. From the first order conditions in both problems, this implies: $c_i'\left(m_i^M\right) < c_i'\left(m_i^{TMC}\right)$ so that $m_i^M < m_i^{TMC}$ for all i because of the convexity of $c_i\left(m_i\right)$. But then $M = \sum_{i=1}^{N} m_i^M < \sum_{i=1}^{N} m_i^{TMC}$ which would imply $\lambda = 0$, a contradiction.

- $p > \lambda$. Following the same reasoning, this implies $m_i^M > m_i^{TMC}$ for all i so that $M = \sum_{i=1}^{N} m_i^M > \sum_{i=1}^{N} m_i^{TMC}$, contradicting the constraint in the total minimum cost problem.

It is clear, therefore, that a TIQs system is able to replicate the total minimum cost solution and that the initial distribution of quotas only has redistributive consequences as long as the market is competitive.

A natural question that arises is why the market should be used to solve the externality problem instead of any other mechanism such as taxation. The answer follows the reasoning of Baumol and Oates (1995). The market for tradable quotas and an appropriate Pigouvian tax/subsidy are equivalent in an environment of perfect certainty. However, if we assume that the cost functions of individual countries are only known to the countries themselves, the market for tradable quotas is superior to a Pigouvian tax/subsidy since the tax would only ensure a certain level of marginal cost whereas the market makes sure that the final objective (achieving the agreed upon number of immigrants M) is attained[6]. From a Coasian perspective (Coase, 1960), we must also assume that transaction costs (e.g. negotiation costs, the costs of setting a bureaucratic apparatus in charge of implementing the mechanism) are sufficiently low, which is quite realistic given the huge potential welfare gains detailed in section 1.

It could appear that the problem is solved very simply this way (abstracting from the issue of making sure that the market is competitive). However, as emphasized in the introduction, the preferences of immigrants must also be taken into account, which is what we address in the next section.

[6] According to Weitzman's (1974) terminology, the marginal benefit of the externality is perfectly inelastic so that the quantitative restriction (the market) is preferred over the price restriction (Pigouvian tax).

2.1 The Market and the Matching Mechanism: Taking Immigrant Preferences into Consideration

Suppose that an international agency determines that M immigrants must be distributed and N countries agree host them. Suppose that a market like the one described above operates among the N possible destination countries, among which the quotas have been distributed according to some unmodeled rule. At this point, we have a sequence $\left\{m_i^M\right\}_{i=1}^N$ of immigrant assignments for each of the potential destination countries. The abstract theoretical problem is now how to assign indivisible items (rights for a migrant to enter one destination country that will be termed visas) to agents (migrants) taking into account the preferences of the migrants. In this sense, the problem is exactly analogous to assigning houses to tenants (Abdulkadiroglu and Sonmez, 1999)[7].

The solution proposed by Abdulkadiroglu and Sonmez (1999) is the use of the top trading cycles mechanism, which, in our case, where no immigrant has previous rights to enter a particular country, is equivalent to a random serial dictatorship. The application of the top trading cycles mechanism to the problem would work as follows:

1. Each immigrant ranks all potential destination countries, specifying those to which she would not want to go at all.

2. An ordering of immigrants is randomly chosen from a given distribution of orderings.

3. For any given ranking of countries done by the immigrants and ordering of immigrants, assign the first immigrant her first choice, the second immigrant her first choice and so on until an immigrant chooses a country whose quota is filled. In that case, assign that immigrant her second choice or, if that one is also filled, her third choice and so on. If all the quotas are filled for the countries for which the immigrant would be willing to go, that particular immigrant is taken out of the system and substituted for another one initially out of the total number M.

The described mechanism is individually rational, as it assures every immigrant a visa that is at least as good as the possibility of staying in her original country. It is also incentive compatible (no immigrant has an incentive to misrepresent her preferences whatever the strategies others use) and Pareto efficient.

If such a matching mechanism is taken into account, the problem that a central authority would need to solve in order to minimize the total costs of distributing M migrants over N destination countries is completely equivalent

[7] There is no reason to keep existing immigrants out of the mechanism so that the right of the immigrant to stay in their current location can be considered as their current "house". In that case, the mechanism would be equivalent to assigning houses to tenants with existing rights (Abdulkadiroglu and Sonmez, 1999). See the application on refugee resettlement, where staying in a refugee camp is considered an existing right, for an extended explanation of this case.

to the simple model of the previous section. The solution would just equalize marginal costs of accepting an additional immigrants across countries.

There can only be problems if one of the participating N destination countries is such an undesirable destination that none of the potential immigrants willing to apply for a visa would consider going there. If a central planner took this information into account and never assigned migrants to undesired destinations, we would run into the problem of the truthful revelation of migrant preferences. An immigrant could increase the chances of entering her top preferred destination by simply declaring that she does not want to go to non-preferred options. To avoid this behavior, which in reality would be quite mitigated by the possibility in step 3 of adding immigrants to the mechanism until quotas are filled, the mechanism must allow for the possibility that the overall number M is not realized. This would act as a kind of overall penalty to elicit the truthful revelation of preferences from potential immigrants.

The exact formulation of this particular problem would be:

$$\min_{\{m_i\}_{i=1}^N} \sum_{i=1}^{N} c_i\left(m_i^*\right)$$

$$\begin{aligned} s.t. \qquad \sum_{i=1}^{N} m_i &\geq M \\ m_i^* &= F_i\left(m_1, m_2, ..., m_N\right) \qquad \forall i = 1...N \end{aligned}$$

The last set of constraints embeds the matching mechanism. The sequence $\{F_i\}_{i=1}^N$ of functions $F_i : [0, M]^N \to [0, M]$ transforms an allocation of visas $\{m_i\}_{i=1}^N$ decided by the central planner as if countries were homogenous from the migrants' perspective into another allocation $\{m_i^*\}_{i=1}^N$ that does take into account migrant preferences through the matching mechanism. Notice that it will be the case that $m_i^* \leq m_i$. This comes from the description of the mechanism. This would imply that $\sum_{i=1}^N m_i^* \leq M$.

The functions in the sequence $\{F_i\}_{i=1}^N$ can be approximated by differentiable functions. In such a case, the solution to the total minimum cost problem above can be obtained from the following first order conditions:

$$\sum_{j=1}^{N} \frac{\partial F_j}{\partial m_i} c_j'\left(m_j^*\right) - \lambda = 0 \qquad \forall i = 1...N$$

where λ, as before, is the multiplier associated with the first constraint. The solution to this problem is much less intuitive and it does no longer guarantee the equalization of marginal costs across countries unless $m_i^* = m_i^{TMC}$, which can follow from:

$$\begin{aligned} \frac{\partial F_j}{\partial m_i} &= 0 \qquad \forall i \neq j \\ \frac{\partial F_i}{\partial m_i} &= 1 \end{aligned}$$

Does the matching mechanism affect the ability of the market to replicate the solution to the total minimum cost problem? In order to answer this question, we look at the problem a representative country i would face:

$$\min_{m_i} c_i\left(m_i^*\right) - p\left(m_i^* - m_{i0}\right)$$

$$s.t. \qquad m_i^* = F_i\left(m_1, m_2, ..., m_N\right)$$

The first order condition associated with this problem is:

$$\frac{\partial F_i}{\partial m_i}\left(c_i'\left(m_i^*\right) - p\right) = 0$$

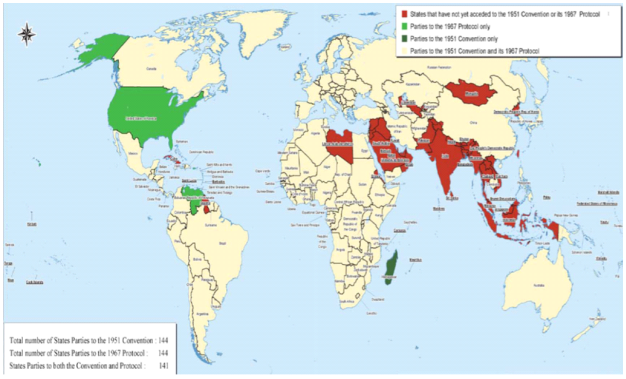
It is clear that at least one of the competitive solutions ($c_i'\left(m_i^*\right) = p$) would replicate the total minimum cost solution when there are no countries for which no migrants would be willing to go. However, the central planner solution would not generally be replicated because individual countries would not take into account the effects of their decisions on the matching mechanism for other countries (another source of externality).

3 A Market for Tradable Refugee Quotas: Application to Resettlement

3.1 An introduction to the refugee problem

The idea of setting up a market for tradable immigration quotas was first advanced in the shape of a market for tradable refugee quotas in the context of a proposal to reform the refugee protection system. The reason is that the existence of the refugee protection system itself is an example of the consideration of the protection of refugees as an international public good (Bubb, Kremer and Levine, 2009). This section develops this original proposal in combination with a matching mechanism that ensures that the fundamental rights of refugees are taken into account as reflected in the Geneva Convention on Refugees.

The Geneva Refugee Convention was adopted on 28 July 1951 (UNHCR, 1996). Its Article 1 defines a refugee as "a person who is outside his/her country of nationality or habitual residence; has a well founded fear of persecution because of his/her race, religion, nationality, membership in a particular social group or political opinion; and is unable or unwilling to avail himself/herself of the protection of that country, or to return there for fear of persecution".



The 145 countries that signed the 1951 Geneva Convention and/or its extension in the 1967 Protocol (see Figure 2 to see the countries included) must admit every refugee satisfying the previous definition who asks for asylum and grant her some basic human rights. A look a Figure 2 shows that most of the world must satisfy these requirements or, in other words, most of the world agrees on considering the protection of refugees as an international public good.

The evolution of refugee numbers (total population of concern to the United Nations High Commissioner for Refugees) and its composition in the period 1997-2008 can be seen in figure 2. We can see there that less than a third of the population of concern is composed of refugees, who total around 10 million for the past 10 years. Among the other categories, that of internally displaced persons is gaining more importance.

The mechanism proposed in this section is justified in two ways. First, the Convention itself considers in its preamble that "the grant of asylum may place unduly heavy burdens on certain countries, and that a satisfactory solution of a problem of which the United Nations has recognized the international scope and nature cannot therefore be achieved without international cooperation". In spite of this, different studies show how the refugee "burden" falls disproportionately on countries with low capacity to assume it. As an example, UNHCR (2002) ranked asylum countries by the number of refugees they host relative to their GDP, surface and local population. The combined sum of these ranks gives a crude measure of the refugee burden according to which the five countries that bear the highest relative burden are: Iran, Burundi, Guinea, Tanzania and Gambia. The first OECD country is the Netherlands in the eighth place whereas Germany is thirteenth and the United States take place sixty-nine.

Second, the need for a reform can be justified by the existence of a negative externality (Neumayer, 2004) not taken into account by the current system. This externality exists in addition to the "free-rider" problem in the provision of an international public good already discussed for the general immigration case. Developed countries claim that the "refugee door" is used by economic migrants as a way to circumvent their restrictive migratory policies. As a result, they

tighten their recognition of asylum seekers by imposing even more restrictive policies and precluding the access of people that the Convention would recognize as refugees[8]. This increases the direct burden on the neighboring countries of those who generate refugee crises and lead to situations in which they even close their borders (this is what Tanzania did in December of 1996 during the Rwanda refugee crisis). It is a "race to the bottom" in refugees' acceptance standards that ends up creating a suboptimal equilibrium from the point of view of individual country preferences themselves. This problem can only be corrected through coordinated action among countries (Barbou des Places and Deffains, 2004).

These problems were already present in the second half of the 90's and opened a debate on the need to strengthen the 1951 Convention. In the law literature, Schuck (1997) and Hathaway and Neve (1997) suggested similar solutions. According to Schuck (1997), "... the proposal consists of two main elements. First, a group of states would (...) arrange for an existing or newly-established international agency to assign to each participating state a refugee protection quota. (...) Second, the participating states would then be permitted to trade their quotas by paying others to fulfill their obligations...".

This section extends Schuck's bilateral negotiation process by actually creating a market for resettlement quotas. Also, to ensure that refugee preferences are fully taken into account without any room for further improvement, a matching mechanism is incorporated to assign refugees to the appropriate destination countries. Unlike the law literature, the market mechanism is limited here to the issue of resettlement since implementing a market for general refugee flights presents serious problems that will be discussed below.

The fundamental rights of the refugees must at every time be preserved. For modeling purposes, this amounts to take refugee preferences into account in the functioning of the market, as it was done for immigrants in the previous section.

There are several instances in which this market mechanism could potentially be of help. The first one would just represent a slight improvement over existing resettlement quotas by allowing countries to trade them. This would imply a lower cost of resettling the exact same number of refugees that are resettled nowadays but it could also open the door to resettle more refugees if countries decide to keep the current expenditure level. The reason is that the market would reach the cooperative solution, which is Pareto superior to the non cooperative solution attained in the absence of the market.

However, the current numbers of refugees that are resettled and the number of countries that offer resettlement quotas is still quite limited (see Table 2).

Table 2: Resettlement Arrivals of Refugees (2008). Source: www.uhcr.org

[8] Hatton (2004) explains how European asylum policy has tightened in the last twenty years.

Country of arrival	Total
Argentina	42
Australia	11,006
Brazil	19
Canada	10,804
Chile	161
Denmark	552
Finland	749
France	37
Iceland	31
Ireland	101
Netherlands	693
New Zealand	741
Norway	741
Sweden	2,209
United Kingdom	722
United States*	60,192
Grand Total	88,800

*United States: refers to US Fiscal Year.

A second more ambitious step in which the market could be applied is for the resettlement of refugees in protracted refugee status. A situation of protracted refugee status is defined as "... one in which refugees find themselves in a long-lasting and intractable state of limbo." (UNHCR, 2004b). The idea is to view "...resettlement as an area of activity where multilateral agreements between States have the potential to achieve a significant impact on solving protracted refugee situations and thereby facilitate solutions for a greater number of refugees." (UNHCR, 2004a). At the end of 2003, this category comprised approximately 6.2 million refugees[9], which represented 62% of total refugees. Why do we concentrate on individuals in protracted refugee status rather than other categories? There are two reasons for this. First, refugee protection is assumed to be temporary in nature. Refugees are supposed to return to their homes as soon as the original cause that produced the flight disappears and they can be safe there. However, there are some cases in which the possibility of return vanishes with time so that alternative measures such as resettlement must be taken into account. There is thus a clear distinction between temporary and protracted refugee situations, which require different durable solutions among which resettlement must be considered.

A second reason to concentrate on protracted refugee situations is that it is easy to distinguish between "genuine" refugees and regular economic migrants in those cases. The inability to differentiate these two groups is the main argument exposed by developed countries to justify the tightening of their refugee

[9] This is a crude measure of refugee populations of 25,000 persons or more who have been in exile for five or more years in developing countries (UNHCR, 2004b).

protection policies (Hatton, 2004).

These two arguments can also be raised to explain why it is more appropriate to concentrate on resettlement rather than in general refugee flights, as Schuck (1997) and Hathaway and Neve (1997) suggested.

3.2 A market for tradable refugee quotas

Suppose that an international agency (say UNHCR) determines that M refugees[10] must be resettled and N countries agree to become resettlement countries. It is assumed that all these M refugees are already outside the country they are fleeing and kept in several refugee camps in possibly several different countries. Suppose that a market like the one described above operates among the N possible destination countries, among which the quotas have been distributed according to some burden sharing rule. The problem is exactly analogous to assigning houses to tenants with existing rights (Abdulkadiroglu and Sonmez, 1999). Since the refugees must always be given the possibility of staying in their country of first asylum (no individual can be forced into an undesired destination), the right of the refugee to stay in their original location can be considered as their current "house".

In this case, the top trading cycles mechanism does not necessarily coincide with the random serial dictatorship. The application of the top trading cycles mechanism to the refugee problem would work as follows:

1. Each refugee ranks all potential destination countries, specifying those to which she would not want to be resettled at all.

2. An ordering of refugees is randomly chosen from a given distribution of orderings.

3. For any given ranking of countries done by the refugees and ordering of refugees, the outcome is obtained using the following algorithm:

   (a) Assign the first refugee (from the ordering obtained in step 2) her top choice, the second refugee her top choice among the remaining visas, and so on, until someone requests a visa for which the quota (resulting from the market) is filled. It is as if the first refugee with a visa in that quota is requested to exchange her visa[11][12].

[10] The selection of the subset of refugees to be resettled is discussed below.

[11] How can this situation take place? For example, suppose that there are 10 refugees to be resettled. 5 of them stay in a refugee camp in country A and 5 in another refugee camp in country B. Suppose the market assigns 3 refugees to A, 5 to B and 2 to a third country C. This information is summarized in:

Countries	A	B	C
Initial situation	5	5	0
Market	3	5	2

Suppose the first refugee to choose is staying in country A and decides to request a visa for country B. It is as if she has requested one of the visas that one of the refugees (the second in the ordering in step 2) is already holding.

[12] Notice that when the country of first asylum is unique, the top trading cycles mechanism is equivalent to the random serial dictatorship.

(b) If at that point, the refugee whose visa is requested has already chosen before, then go to the second refugee in that quota. If this one has also chosen, go to the third and so on. If the quota is filled with refugees who have already chosen before, then do not disturb the procedure (there is no room for Pareto improvement). Otherwise, modify the remainder of the ordering by inserting the refugee who did not choose yet to the top of the line and go on with the procedure[13].

(c) Similarly, insert any refugee who is not already served at the top of the line once her visa (to stay in her first asylum country) is requested.

(d) If at any point a loop forms, it is formed exclusively by refugees with a visa each of them requesting the visa of the refugee who is next in the loop (a loop is an ordered list of refugees $(j_1, j_2, ..., j_k)$ where refugee j_1 requests the visa of refugee j_2, refugee j_2 requests the visa of refugee j_3..., refugee j_k requests the visa of refugee j_1). In such cases, remove all refugees in the loop by assigning them the visas they request and continue the procedure.

A key ingredient of this mechanism is that a refugee whose visa is requested is upgraded to the first place at the remaining of the line before her visa is allocated. As a result, the top trading cycles mechanism is individually rational, as it assures every refugee a visa that is at least as good as the possibility of staying in her first-asylum country. It is also incentive compatible (no refugee has an incentive to misrepresent her preferences whatever the strategies others use) and Pareto efficient.

So far, this is a direct application of Abdulkadiroglu and Sonmez (1999) following directly the exposition in Chen and Sonmez (2002) and substituting word by word house for visa and refugee for tenant. The relevant point for the case of refugees studied here is the possibility that the final allocation determined by the market might not be achieved. This can be seen in the following example:

Example 1 *Suppose the international community decides* 3 *refugees must be resettled. There are three countries willing to host them: A, B and C. The country of first asylum is country A for the first two refugees and country C for the last one. Suppose that the original distribution of quotas is the following:*

$$m_A^0 = 1; \qquad m_B^0 = 1; \qquad m_C^0 = 1$$

Now, the market opens, trade takes place and the following distribution of quotas is attained:

$$m_A^M = 0; \qquad m_B^M = 2; \qquad m_C^M = 1$$

There are 216 different refugee preference profiles that will generate different outcomes once the matching mechanism is applied. As an illustration, six of

[13] Following the previous example, the first refugee in country B is now at the top of the list and can choose before the previous one does so that there is a possibility that her position is freed if she chooses country A or C.

these preference profiles will be considered by fixing the preferences of the third refugee and assuming that the first two refugees have identical preferences:

1	*Preferences*	*First Asylum*	*Final Resettlement*		
					$m_A^* = 2 > m_A^M$
Refugee 1	$A \succ B \succ C$	A	A	$\Longrightarrow$	$m_B^* = 1 < m_B^M$
Refugee 2	$A \succ B \succ C$	A	A		$m_C^* = 0 < m_C^M$
Refugee 3	$A \succ B \succ C$	C	B		

The ordering of the refugees is taken randomly, as suggested in the step 1 of the top trading cycles mechanism. In this first example, refugees 1 and 2 prefer to stay in their first asylum country A whereas 3 chooses to move to country B, where there are two visas available.

2	*Preferences*	*First Asylum*	*Final Resettlement*		
					$m_A^* = 2 > m_A^M$
Refugee 1	$A \succ C \succ B$	A	A	$\Longrightarrow$	$m_B^* = 1 < m_B^M$
Refugee 2	$A \succ C \succ B$	A	A		$m_C^* = 0 < m_C^M$
Refugee 3	$A \succ B \succ C$	C	B		

This second case works the same way as the first one.

3	*Preferences*	*First Asylum*	*Final Resettlement*		
					$m_A^* = 0 = m_A^M$
Refugee 1	$B \succ A \succ C$	A	B	$\Longrightarrow$	$m_B^* = 2 = m_B^M$
Refugee 2	$B \succ A \succ C$	A	B		$m_C^* = 1 = m_C^M$
Refugee 3	$A \succ B \succ C$	C	C		

In this third preference profile, refugees 1 and 2 take the two visas that country B offers so that refugee 3 has to stay in country C. The market allocation is maintained under the matching mechanism in this case.

4	*Preferences*	*First Asylum*	*Final Resettlement*		
					$m_A^* = 0 = m_A^M$
Refugee 1	$B \succ C \succ A$	A	B	$\Longrightarrow$	$m_B^* = 2 = m_B^M$
Refugee 2	$B \succ C \succ A$	A	B		$m_C^* = 1 = m_C^M$
Refugee 3	$A \succ B \succ C$	C	C		

The fourth preference profile is also compatible with the market allocation.

5	*Preferences*	*First Asylum*	*Final Resettlement*		
					$m_A^* = 1 > m_A^M$
Refugee 1	$C \succ A \succ B$	A	C	$\Longrightarrow$	$m_B^* = 1 < m_B^M$
Refugee 2	$C \succ A \succ B$	A	A		$m_C^* = 1 = m_C^M$
Refugee 3	$A \succ B \succ C$	C	B		

In this case, refugee 1 demands the only visa available for country C. Since this visa belongs to refugee 3, refugee 3 gets to choose first. Refugee 3 chooses one of the two visas available for country B since there is no visa available for country A, her most preferred one. Then, refugee 1 can choose and take the visa for country C that has become available. Finally, refugee 2 can choose to go to country B, where there is still one visa available, or to remain in country A, which is her selected option.

6	*Preferences*	*First Asylum*	*Final Resettlement*		
					$m_A^* = 1 > m_A^M$
Refugee 1	$C \succ B \succ A$	A	C	$\Longrightarrow$	$m_B^* = 1 < m_B^M$
Refugee 2	$C \succ B \succ A$	A	A		$m_C^* = 1 = m_C^M$
Refugee 3	$A \succ B \succ C$	C	B		

The reasoning in this case is the same as in the previous one so that the market allocation is not reached.

A more extreme example can be considered in which the matching mechanism distorts the allocation initially established by the market. Suppose that the preferences of refugees are such that, even though they would be willing to go to other countries (suppose $m_i^a = M$ for all $i = 1...N$), they prefer the neighboring country of first asylum (country n). As long as $M > m_n^M$, it is clear that the cost minimizing allocation suggested by the market won't be realized. As a result, we have to differentiate the market allocation $\left\{m_i^M\right\}_{i=1}^N$ from the realized allocation once the matching mechanism comes into place: $\{m_i^*\}_{i=1}^N$. Both allocations will be different whenever $m_n^* > m_n^M$, which implies that $m_h^* < m_h^M$ for some $h \neq n$. Notice that it cannot be the case that the realized allocation implies taking more refugees than those allocated for the market for any country who is not the first asylum country, that is $\nexists i \neq n \qquad s.t. \qquad m_i^* > m_i^M$. This is the main difference with the general immigration case presented in the previous section. Since the original refugee camps are included as potential destinations, we allow for the possibility that the allocation of the matching mechanism ends up assigning a larger number of refugees to a particular country (where a refugee camp is located) than that resulting from the market.

In such cases, it is clear that costs are not minimized for countries n and h. However, the relevant comparison is not with the market unfeasible (in that case) solution but with an alternative system or lack of system like the one that is prevalent nowadays by which most of the refugees stay in the first-asylum country in very poor conditions without this country being compensated (at least it would be compensated under the market system by the refugees in excess of its market quota times the market price). Also, it can be said that country h is punished with a higher cost for not being a desirable enough destination for refugees. In this sense, the initial distribution of quotas ($\{m_{i0}\}_{i=1}^N$) is crucial to avoid that low capacity countries are forced to pay an excessive price for participating in the system.

If the matching mechanism is taken into account, the problem that a central authority would need to solve in order to minimize the total costs of resettling M refugees in N different countries is the following:

$$\min_{\{m_i\}_{i=1}^N} \sum_{i=1}^{N} c_i\left(m_i^*\right)$$

$$
\begin{aligned}
s.t. \qquad \sum_{i=1}^{N} m_i^* &\geq M \\
m_i^* &= F_i\left(m_1, m_2, ..., m_N\right) \qquad \forall i = 1...N
\end{aligned}
$$

Notice the difference with the general market for immigration quotas. Since the original refugee camps are included in the mechanism, the first constraint is $\sum_{i=1}^{N} m_i^* \geq M$ rather than $\sum_{i=1}^{N} m_i \geq M$.

The solution to the total minimum cost problem above can be obtained from the following first order conditions:

$$
\sum_{j=1}^{N} \frac{\partial F_j}{\partial m_i} \left(c_j'\left(m_j^*\right) - \lambda\right) = 0 \qquad \forall i = 1...N
$$

where λ, as before, is the multiplier associated with the first constraint.

In the case of the market, the problem a representative country i would face is exactly the same as in the previous section:

$$
\min_{m_i} c_i\left(m_i^*\right) - p\left(m_i^* - m_{i0}\right)
$$

$$
s.t. \qquad m_i^* = F_i\left(m_1, m_2, ..., m_N\right)
$$

The first order condition, as before, is:

$$
\frac{\partial F_i}{\partial m_i}\left(c_i'\left(m_i^*\right) - p\right) = 0
$$

It is clear that at least one of the competitive solutions ($c_i'\left(m_i^*\right) = p$) would replicate the total minimum cost solution.

3.3 Implementation

In this subsection, the way in which this proposal should be applied will be outlined and discussed, emphasizing the differences with the current resettlement system. To this end, a description about the current resettlement system becomes relevant.

Around the month of June of each year, global resettlement policy and quotas are discussed in Geneva during the Annual Tripartite Consultations. This is a series of meetings that includes the countries taking resettlement quotas, the European Commission, non-governmental organizations involved in resettlement activities and the International Organization for Migration.

It is around these Annual Tripartite Consultations that the market could be set in motion. Resettlement countries and UNHCR would agree on resettlement quotas for the year ahead in exactly the same way that they do now but this time allowing for the possibility of opening a market to trade these quotas at a future

date. The possibility of future trades would allow countries to establish higher initial resettlement quotas than they would if these were fixed. One important question is how quotas should be initially distributed among participating countries. The ideal solution would be to set a global resettlement quota and then distribute it through some burden sharing rule. Hatton and Williamson (2004) propose (for the European Union) contributions to the European Refugee Fund in proportion to the countries' GDP and resettlement quotas in proportion to the countries' population. This could be a reasonable basis that could also be modified through negotiations since some countries could be more prone to host refugees than others.

Once the global limit (M in the theoretical model) and the initial distribution of quotas ($\{m_{i0}\}_{i=1}^{N}$) are agreed upon among the N participating resettlement countries ($N = 16$ in 2008), the subset of refugees that will actually be resettled has to be decided. This is critical since the number of refugees countries are likely to agree upon for resettlement is notably lower than the total number of refugees. UNHCR should be the appropriate agent to select the group of refugees to be resettled, possibly with the help of some NGOs[14].

At this point, there are two possibilities about how the market should work. The first one is to open one big centralized market where all refugees selected by UNHCR are treated alike and global quotas are negotiated for a limited amount of time (say two weeks or one month). The second possibility is to open different markets for different groups of refugees. For example, a market could be established for each country of origin of refugees to ensure that the quotas negotiated in each of the markets are really homogeneous.

How would the market or markets work? To make sure that they are competitive, Casella's (1999) reasoning is followed in proposing a computerized continuous double auction to organize trades. This departs notably from the original idea of Schuck (1997) and Hathaway and Neve (1997) who proposed bilateral negotiation processes in which the relative strength of the parties was likely to play a more decisive role.

Market participants should be the involved countries but there is no reason to prevent other organizations, such and NGOs involved in resettlement to negotiate in the market. For example, they could be willing to pay some country so that they allow in more refugees than they were initially willing to accept for resettlement.

The timing of the market is another important issue. Ideally, one would like the market to be open continuously throughout the year to allow for the maximum flexibility so that countries can get to discover their own cost functions as they start receiving refugees. However, the rights of refugees should be taken into account here and the final distribution of quotas needs to be known ahead of time so that the matching mechanism can be employed. In this sense, the market for refugee quotas should open for a limited time (two weeks or one month) before each year.

[14] This would be different from the current situation, by which each country decides which specific subset of refugees it wants to host.

Finally, UNHCR should be the agency in charge of sending the refugees to their final destination country by applying the matching mechanism. To this end, the refugees selected for resettlement would have to be asked about their preferences directly in some processing center installed inside refugee camps. Again, the pure abstract mechanism should be modified here to allow for families to be sent together to their final destination countries, following at this point the more applied work of Roth (2002).

4 A Market for Tradable Immigration Quotas: Application Extending the US Diversity Visa

A legitimate concern with a general market for tradable immigration quotas has to do with its political feasibility. After all, the US has been unable to reach a national consensus on reforming immigration policy in the last few years and anti-immigration political parties have become very popular in some European countries. However, there is an existing migration policy tool that could be used as an inspiration for a first step towards the creation of a market for tradable immigration quotas: the US Diversity visa.

4.1 Background: the US Diversity visa

Each year, 50,000[15] immigrant visas are made available through a lottery to people who come from countries with low rates of immigration (less than 50,000 immigrants to the US in the previous five years) to the US. These visas are termed Diversity Visas and the lottery is known as the Green Card Lottery Program. Any individuals from non-excluded countries are eligible if they have at least "a high school education or its equivalent or have, within the past five years, two years of work experience in an occupation requiring at least two years' training or experience". If you receive a visa through the Diversity Visa Lottery Program you will be authorized to live and work permanently in the United States. You will also be allowed to bring your spouse and any unmarried children under the age of 21 to the United States.

For example, the application process for the 2010 Diversity Lottery program took place between October and November in 2008. The only excluded countries were: Brazil, Canada, China (mainland-born, excluding Hong Kong S.A.R., and Taiwan), Colombia, Dominican Republic, Ecuador, El Salvador, Guatemala, Haiti, India, Jamaica, Mexico, Pakistan, Peru, the Philippines, Poland, South Korea, United Kingdom (except Northern Ireland) and its dependent territories, and Vietnam. There were a total of 13,6 million applications that entered the lottery, out of which the Department of State randomly selected 102,800: a 0.76

[15] The Nicaraguan and Central American Relief Act (NACARA) passed by Congress in November 1997 stipulated that up to 5,000 of the 55,000 annually-allocated diversity visas be made available for use under the NACARA program. The reduction of the limit of available visas to 50,000 began with DV-2000.

percent average probability of winning the lottery although the actual probabilities differ by country, favoring natives of small-size countries. Still in 2010, Nigeria was the country with the highest number of registered applicants (lottery winners) with 6,006, closely followed by Bangladesh (6,001) and Ethiopia (5,200). The final 50,000 visas will come out of these since many applicants will not complete the visa process: "applicants are not provided any type of assistance such as airfare, housing assistance, or subsidies. If you are selected, you will be required to provide evidence that you will not become a public charge in the United States before being issued a visa. This evidence may be in the form of a combination of your personal assets, an Affidavit of Support (Form I-134) from a relative or friend residing in the United States, and/or an offer of employment from an employer in the United States".

4.2 A Market for Tradable Immigration Quotas: an OECD Poverty Reduction Visa

Our proposal would extend the US Diversity Visa Program to high-income countries in the OECD (see Table 1). Each country would be assigned a number of visas (initial quotas) and would then be allowed to trade in a centralized market for TIQs. Since the main final objective of the program would be poverty reduction, it would make sense to reduce the number of eligible countries to those classified by the World Bank as Low Income Countries.

In our case, any individual from a Low Income Country would be eligible for the lottery. In their application process, they would be asked about their preferences over potential destinations, an information that would later be used to run the matching mechanism. To avoid preference manipulation, trading of visas among migrants would not be allowed. However, selected applicants would be allowed to participate in the lottery on consecutive years. For example, an individual assigned to Germany could reapply to the lottery and, if selected, might move to a more desirable destination (the top trading cycles mechanism would be used for matching on those cases).

In the case of the US Diversity Visa, the US Department of State screens applicants both for economic and for security reasons (to prevent potential terrorists from entering the country through this program). In an OECD visa, there are several possibilities in terms of the screening procedure. First, there could be scope for a new international organization that would approve selected applicants. This organization could also run the market. Second, in case participating countries refuse to give up this kind of sovereignity, there would be the possibility of having every selected applicant approved by all countries. Finally, a third solution would be to have countries screen only the applicants selected by the lottery and the matching mechanism to go there. To avoid the incentive of individual countries to select their "ideal" candidates, the number of "rejections" could be penalized by increasing their initial quota, on which we comment below, in the following years.

The success of the OECD Poverty Reduction Visa would crucially depend on two issues: making sure that the market for TIQs is competitive to as to reap

large enough efficiency gains from the system (large enough to compensate for the administrative costs); and setting a mechanism to determine initial quotas that is perceived as "fair" by participating countries. On the first issue, we follow again Casella (1999) in proposing a computerized continuous double auction to organize trades. On the second, since the objective is poverty reduction, we start with a proposal by which each country would be assigned an initial quota in proportion to its economic size. This is equivalent to the proposals urging rich countries to donate 0.7 percent of their GDP to less developed countries. In our case, as mentioned above, the GDP criterion could be modified by others such as: proportion of selected applicants rejected in previous years of the programs, total number of immigrants received through other channels (in particular, illegal immigration), ODA contributions, etc.

4.3 Simulating a A Market for TIQs with an OECD Poverty Reduction Visa

We present a simple numerical representation of the distribution of visas across participating countries that would come out of a market for TIQs such as the one proposed above. We concentrate on the GDP criterion as the mechanism to assign initial quotas by fixing the total number of visas that the US would award at the current size of the US Diversity Program: 50,000 visas. Since the US GDP represented 34.5 percent of the high-income OECD countries in 2008 (see Table 1), this entails that the total number of visas awarded would amount to 145,099 (see Table 2 for the distribution).

One of the main functions of our proposed mechanism is to help countries discover the real shape of their country-specific cost functions: $c_i(m_i)$ in our model. However, for this simulation we need to start from assuming a particular arbitrary function. De la Croix and Docquier (2010), for example, choose the function $\frac{\gamma_i}{2}\left(\frac{m_i}{n_i}\right)^2$ [16], where n_i is the number of natives in country i and γ_i is a country-specific parameter that can be interpreted as the degree of "dislike" for immigrants. They calibrate it to match the observed distribution of migration stocks across rich countries. In our simulation, we prefer the following formulation:

$$c_i(m_i) = \frac{\gamma_i}{2}\frac{m_i^2}{pop_i}$$

[16] In De la Croix and Docquier (2010), countries maximize the following national utility function:

$$U_i = u(C_i) + \beta u(C_o) - \frac{\gamma_i}{2}\left(\frac{m_i}{n_i}\right)^2$$

where C_i is the consumption level of country i inhabitants, C_o is the consumption level of poor country individuals (positively affected by migration and β is a parameter that denotes altruism towards poor country individuals when positive. Positive values of β are one possible way of formalizing the externality we have left unmodeled throughout the paper.

Defining pop_i as the total population of country i, this allows us to write marginal costs as a linear function of the new migration share:

$$c_i'(m_i) = \gamma_i \frac{m_i}{pop_i}$$

This simple marginal cost function would imply that countries do not want to receive any more migrants than they currently have. We can assume that this means that countries do not want to receive any more immigrants through a newly created visa category, which is arguably more realistic, at least in the case of low-skill immigration.

We present two different simulations of a market for TIQs. In the first one, we assign to γ_i the following values from the 2003 ISSP National Identity Module (Facchini and Mayda, 2008): share of respondents who believe immigration should be reduced a lot (see Table 3). We interpret this as a proxy for anti-immigration attitudes. Since the numbers we are going to calculate are just illustrative, we are not concerned about what the right measure of anti-immigration sentiment should be. We take the first of the five answers so that it provides us with sufficient variability to generate gains from trading.

Countries	Initial quotas	Anti-Immigration Sentiment 1: ISSP 2003	Market Quota 1	Cost Reduction 1 with respect to initial quota	Anti-Immigration Sentiment 2: inverse of 1990-2000 flows over total population	Market Quota 2	Cost Reduction 2 with respect to initial quota
Australia	3,602	16.8	4,168	2%	243	6,877	83%
Austria	1,467	32.7	832	19%	2844	229	71%
Belgium	1,789	26.0	1,345	6%	1154	724	35%
Canada	5,326	10.2	10,655	100%	236	11,000	113%
Czech Republic	765	26.2	1,300	49%	9924	82	80%
Denmark	1,211	25.9	693	18%	416	1,032	2%
Finland	967	15.8	1,096	2%	1009	411	33%
France	10,134	35.4	5,750	19%	686	7,084	9%
Germany	12,948	44.3	6,054	28%	1279	5,012	38%
Greece	1,263	26.0	1,411	1%	57502	15	98%
Hungary	549	34.4	953	54%	115381	7	98%
Iceland	59	26.0	40	11%	262	94	36%
Ireland	949	27.7	523	20%	1933	179	66%
Italy	8,171	26.0	7,515	1%	1998	2,338	51%
Japan	17,423	20.2	20,697	4%	3975	2,508	73%
South Korea	3,296	9.1	17,386	1827%	40087951	0	100%
Luxembourg	191	26.0	61	46%	908	42	61%
Netherlands	3,090	37.8	1,419	29%	718	1,787	18%
New Zealand	461	26.8	520	2%	582	573	6%
Norway	1,603	36.4	428	54%	422	883	20%
Portugal	864	19.1	1,817	122%	968	857	0%
Slovak Republic	349	26.4	670	84%	11857	36	81%
Spain	5,691	13.2	11,270	96%	2520	1,411	57%
Sweden	1,699	25.6	1,178	9%	403	1,787	0%
Switzerland	1,745	16.9	1,477	2%	781	764	32%
UK	9,487	50.9	3,942	34%	295	16,275	51%
USA	50,000	23.7	41,897	3%	286	83,090	44%
Total	145,099	26.2	145,099	24.17%	2008946	145,099	99.87%
Quotas traded			22%			16%	

Note: buyers in the market in bold figures

The results can be observed in column 3. The countries with relatively low GDP and relatively low anti-immigration sentiment would be those who would become quota buyers in the market, receiving a monetary compensation in return: South Korea, Spain, Canada and Japan would all host at least one thousand immigrants in excess of those initially assigned. On the other side of the market, the US, Germany, the UK, France, the Netherlands and Norway would be willing to sell more than one thousand of their assigned quotas, paying to avoiding hosting more immigrants. All in all, 22 percent of the total number of quotas would be traded, generating an efficiency gain of 24 percent of the total cost according to the initial quota allocation.

In our second parameterization, we identify γ_i with the inverse of the 1990-

2000 net migration flows from low-income countries received by country i (from Docquier and Marfouk, 2006, dataset; see Table 1) to population in country i. The intuition behind this measure is that the acceptance of immigrants during the 1990-2000 is a de facto measure of the degree of anti-immigration sentiment. The more positive the attitudes towards immigrants from low income countries, the higher the ratio of their accepted numbers to population is assumed to be (the inverse of the second measure that we present in Table 2). The direct interpretation of this measure is the total number of inhabitants per immigrant from LICs accepted in the 1990-2000 period[17].

The results of a market for TIQs assuming our second measure of anti-immigration sentiment can also be read from Table 3. This time, the quota buyers coincide with the traditional immigrant-receiving countries: the US, the UK, Canada and Australia are the main buyers with more than one thousand extra immigrants received in exchange for substantial cost reductions with respect to their original quotas (between 113 percent for Canada and 44 percent for the US). The main sellers, those who pay for accepting less immigrants than they are initially assigned, would be Japan, Germany, Italy, Spain, South Korea and France in this order, all with more than three thousand quotas sold. In summary, the cost reduction would be very close to 100 percent (although the inflated Korean cost function dominates this result) and the traded quotas would amount to 16 percent of the total.

5 Conclusion

Providing international migration opportunities (visas) for poor country inhabitants contributes to reducing world poverty, an international public good. However, the provision of visas is suboptimal due to a free-rider problem. We propose a market for tradable immigration quotas (TIQs) to alleviate this externality, allocating a larger overall number of international migrants at a lower total cost. Countries with high marginal costs for receiving additional immigrants would pay countries with low marginal costs to host them. In addition, our proposal would take into account migrants' preferences by using a matching mechanism to assign them to their preferred destinations.

The main advantage of TIQs over alternative proposals to increase international migration flows rests on its ability to elicit information on the true country-specific costs of hosting additional migrants. Whereas other proposals require substantive knowledge about these costs, TIQs would actually serve as an information-revelation mechanism. To strengthen this advantage, we propose a learning-by-doing approach, applying the TIQs first on a small scale before thinking about more general programs.

Specifically, we consider two particular situations in which TIQs are both feasible and a logical extension of existing policies. First, a market for resettle-

[17] To avoid the negative Korean number, we renormalize this measure by adding 87 (-86 was the actual net migration flow to LICs countries in 1990-2000) to all flows. This is why the value for South Korea is exactly equal to the total South Korean population.

ment quotas could be developed in the context of the existing Annual Tripartite Consultations by which the UNHCR currently agrees to resettle around 100,000 refugees yearly through different rich destination countries. Second, we propose an extension of the US Diversity Visa program to High Income OECD countries. We go on to simulate our second proposal by distributing initial quotas according to GDP levels so that we fix the initial US quota at the current size of the Diversity Visa program (50,000 visas). This would create a market for TIQs assigning almost 150,000 immigrants overall.

We would like to conclude by stressing the feasibility of our proposal on two fronts. On the one hand, we are aware that it may take time for the mechanism to be accepted as morally legitimate. For example, tradable pollution quotas are now widely accepted but were fustigated when first proposed. However, procreation entitlements as proposed by De la Croix and Gosseries (2009) may seem more unrealistic and can be expected to cause a much larger public outrage. TIQs are probably somewhere in between, and this is why it is important to start modestly. On the other hand, a modest start is also an answer to the concern about technical feasibility. We have to adopt an experimental, learning by doing approach. The list of difficulties one may face implementing the system is probably very long and we cannot figure out all the problems that will arise due to strategic behavior on the sides of governments or immigrants or simply due to technical difficulties in maintaining the system. Hence the modest, experimental and evolutionary approach we advocate.

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