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Abstract

This paper revisits the puzzle of immigration policy: standard economic theory predicts that free immigration improves natives' welfare, but (with few historical exceptions) an open door policy is never implemented in practice. What rationalizes the puzzle? We first review the model of immigration policy where the policy maker maximizes national income of natives net of the tax burden of immigration (Borjas, 1995). We show that this model fails to provide realistic policy outcomes when the receiving region's technology is described by a standard Cobb-Douglas or CES function, as the optimal policy imposes a complete ban on immigration or implies an unrealistically large number of immigrants relative to natives. Then the paper describes three extensions of this basic model that reconcile the theory with the evidence. The first introduces a cost of integration of the immigrant community in the destination country; the second takes into account the policy maker's redistributive concern across different social groups; the last extension considers positive spillover effects of (skilled) migrants on the receiving economy.

Keywords: Costs and benefits from immigration, immigration policy.

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1 Introduction

At the risk of some oversimplification, we can isolate two features that generally characterize immigration policy. First, while immigration restrictions vary (sometimes to a large extent) across countries, virtually all countries impose at least some limits to the entry of foreign citizens and very few impose a complete ban on immigration.[1] In other words, when optimally choosing immigration policy, countries avoid the "corner solutions" of fully closing or fully opening the door to foreign workers and prefer the "interior solution" of limited entry. Second, the number of foreign citizens is always a (relatively low) fraction of the population of natives in the receiving country.[2] A positive theory of immigration policy should be consistent with these stylized facts.

Economists have developed a simple framework to study the welfare effects of immigration from the perspective of a receiving economy (see Borjas (1994) and Borjas (1995) for a survey of the economics literature on immigration). In the baseline model, with a standard constant-return-to-scale (CRS) technology in labor and capital, the effect of immigration on natives' welfare is captured via changes in labor supply, while keeping (native-owned) capital fixed. It is easy to prove that, on net, foreign workers unambiguously raise national welfare as they increase the benefits accruing to native capitalists by more than the costs they impose on native workers. This positive difference between benefits and costs is usually called *immigration surplus.* The optimal immigration policy is then an "open door" policy. However, as we do never observe "open door"

[1] No OECD country completely bans legal immigration nor has a free immigration policy. Free (or even subsidized) immigration was common in the New World at the beginning of the First Global Century (1820-1915). Even then, however, there was a gradual and persistent increase of restrictions to immigration after the 1880s (see Hatton and Williamson, 2005).

[2] In OECD countries, the average of foreign born population over total native population varied between 10.6 percent in 1995 and 11.6 percent in 2004. In countries where the figures where highest, Luxemburg, Australia and Switzerland, the stock of immigrants was respectively of 33.1, 23.6 and 23.5 percent of the native population for the year 2004 (OECD data).

policies across receiving countries, the theory presents us with a clear *policy puzzle*.[3]

Quite intuitively, there must be some additional cost of immigration which is not taken into consideration in the framework above and which may reconcile the theory with observed immigration policies. Accordingly, an important branch of the literature argues that, in presence of welfare programs enacted in receiving countries, this cost may be the fiscal burden that immigrants impose on native taxpayers. In other words, as immigrants may rely on public expenditures more than they contribute to the tax system, immigration may lower natives' welfare by increasing net tax payments.

This approach suggests a simple solution for the optimal immigration policy of a receiving economy: the policy maker should set restrictions to optimally trade off the economic benefits (i.e., immigration surplus) and costs (in terms of welfare state) of immigration. In the words of Borjas (1995, p. 18):

> If we are willing to maintain the hypothesis that immigration policy should increase the national income of natives, the government's objective function in setting immigration policy is well defined: maximize the immigration surplus net of the fiscal burden imposed by immigrants on native taxpayers. The optimal size and skill composition of the immigrant flow would equate the increase in the immigration surplus resulting from admitting one more immigrant to the marginal cost of the immigrant.

In this paper we show that this argument suffers of a fundamental problem and, therefore, does not (by itself) solve the immigration policy puzzle. If the production technology has a standard

[3] In a more general framework, where both natives and foreigners are heterogenous in their capital endowments and where the latter can bring capital with them when migrating, Benhabib (1996) shows that the immigration policy chosen by any native type (an thus also by the average representative type) is also a corner solution, where the capital-labor ratio is either maximized or minimized. See also footnote 5.

form (Cobb-Douglas or, more generally, CES), then this framework delivers a policy prediction that is inconsistent with the stylized facts described above. Namely, depending on parameter values, the optimal immigration policy is either a corner solution (i.e. closed or open door), or it implies an interior solution which allows for unrealistically high levels of immigration - for instance, the optimal number of immigrants is higher than the entire native population in the case of a Cobb-Douglas technology. The reason for this result is that, with the above standard technologies, the immigration surplus not only increases with the number of migrants but tends to *increase at an increasing rate*, and *linear* fiscal costs do not guarantee that the optimal immigration policy is an interior of the maximization problem. In short, this family of models fails to provide a positive theory of immigration policy.

The next question is, obviously, whether the approach above may still provide the foundation for a positive theory of immigration policy. In other words, we are interested in the conditions under which the economic model with standard technology delivers solutions that are consistent with the stylized facts of immigration. Without the pretension of being exhaustive, we focus on three "solutions" to the puzzle. First, we introduce congestion effects of immigration due to the rising cost of integrating an enlarging community of foreign workers in the receiving society. Second, we provide a political economy extension of the model where the government weighs differently different groups of natives in society (e.g. workers versus capitalists). Finally, we allow for positive externalities of (skilled) foreign workers on the technology of the receiving economy.

The paper is organized as follows. The next section introduces the basic model and presents the immigration policy puzzle. Section 3 analyzes the solutions to the puzzle. Concluding remarks follow.

2 The Immigration Policy Puzzle

We begin by introducing the general structure of the economic model of immigration policy as surveyed by Borjas (1995). The economy of the receiving country produces competitively one final good via a CRS technology in capital (K) and labor (L)

$$Y = F(K, L), \tag{1}$$

where $\partial F/\partial K > 0$, $\partial F/\partial L > 0$ and $\partial^2 F/\partial K^2, \partial^2 F/\partial L^2 < 0$. The final good is the numeraire in this economy, and its price is normalized to one. As the product market is competitive, input factors are paid their marginal productivities:

$$w_H = \frac{\partial Y}{\partial L} \text{ and } r_H = \frac{\partial Y}{\partial K}.$$

Capital is in fixed amount and is only owned by a fraction of natives (called capitalists), while labor is the sum of native (L_H) and foreign (L_F) labor, $L = L_F + L_H$. Agents use their income to purchase the final good and have a linear utility function in consumption.

We define immigration policy as the choice of the exact number L_F of foreign workers to be admitted. This feature of the model can be easily generalized by introducing endogenous foreign labor supply responding to immigration policy (see for instance Giordani-Ruta, 2009). Also assume that $L_F \in [0, \bar{L}_F]$. It is then easy to interpret $L_F = 0$ and $L_F = \bar{L}_F$ as the two extreme immigration policies, which we call respectively "closed door" and "open door" policies.

In this setting, we can equivalently define aggregate welfare in this economy (i) as the sum of factor payments to *natives*:

$$\Pi_H \equiv w_H\left(L_F\right) \cdot L_H + r_H\left(L_F\right) \cdot K, \tag{2}$$

and (ii) as the difference between total production in the economy and the fraction of it which accrues to immigrants:

$$\Pi_H \equiv F\left(K, L\right) - L_F w_H. \tag{3}$$

We will conveniently use either of these definitions in what follows.

Let us initially focus on (3). It is a well known result that, in this simple setting (without fiscal costs of immigration), the optimal immigration policy is an "open door" policy. In fact, it is

$$\frac{\partial \Pi_H}{\partial L_F} = -L_F \frac{\partial w_H}{\partial L_F} > 0 \ \forall L_F > 0, \tag{4}$$

and is equal to zero only when $L_F = 0$. As a result, the welfare function is everywhere increasing in L, and the optimal policy is $L_F = \bar{L}_F$. In this setting migrants increase national income by more than it costs to employ them. The net positive effect is generally referred to as the *immigration surplus*. Namely, immigration increases labor supply in the destination country, thus lowering the equilibrium wage ($\partial w_H / \partial L_F < 0$). The negative effect on native workers is more than compensated by the increase in the income of capitalists - via a higher rental rate of capital ($\partial r_H / \partial L_F > 0$). As a result, in this case there is no economic rationale for imposing any limit to the entry of foreign workers -or, to put it differently, observed immigration restrictions represent a puzzle.

2.1 The Optimal Immigration Policy

We introduce next the *fiscal cost of immigration.* In order to focus ideas, we assume that a social policy exists in our economy, which redistributes income from capitalists to workers. In particular, suppose that this policy consists of a fixed lump-sum transfer γ to both native and foreign workers, which is financed through a proportional tax $\tau \in [0, 1]$ on the capital rent.[4] In presence of immigration, the (balanced) budget of this policy is equal to

$$\tau r_H K = \gamma \left(L_H + L_F \right),$$

that is, the tax inflow is equal to the lump-sum transfer times the number of both native and foreign workers. As a result, τ is an increasing function of L_F, which incorporates the idea that immigrants may constitute a fiscal burden for the receiving economy.

In this case, net aggregate welfare can now be defined as

$$N\Pi_H = F\left(K, L\right) - L_F \left(w_H + \gamma\right), \tag{5}$$

which includes the fiscal cost of immigration to natives.

To characterize the optimal number of foreign workers L_F^* in this economy, the necessary first order condition (FOC) writes as

$$\frac{\partial N\Pi_H}{\partial L_F} = -L_F \frac{\partial w_H}{\partial L_F} - \gamma = 0,$$

which implies that a candidate interior solution for optimal immigration policy must be such that

[4] Naturally, one can model the social policy in the receiving country in a number of different ways. Independently of the modeling details, the key feature of the economic framework of immigration policy is that policies in the receiving country imply a net transfer of resources from natives to (unskilled) foreign workers.

the marginal benefit on natives' income from admitting an additional foreign worker (i.e. the increase in the immigration surplus, $-L_F\left(\partial w_H/\partial L_F\right)$) needs to be equal to the marginal cost of the immigrant for the welfare system (γ), as in the quote from Borjas (1995) in the Introduction.

In order for any L_F^* solving the equation above to be - at least a local - maximum, the net welfare function (5) needs to be concave in L_F^*. The second derivative of the welfare function writes as

$$\frac{\partial^2 N\Pi_H}{\partial L_F^2} = -\left(\frac{\partial w_H}{\partial L_F} + L_F \frac{\partial^2 w_H}{\partial L_F^2}\right). \tag{6}$$

Notice that $\partial^2 N\Pi_H/\partial L_F^2$ may be higher or lower than zero (remember that $\partial w_H/\partial L_F$ is negative). As a result, the concavity of the welfare function is not generally assured, which implies that a solution to the FOC can either be a maximum or a minimum. Whether the welfare function is concave or not crucially depends on the specific technology assumed for the economy. In what follows we will show that, for the Cobb-Douglas production function, the welfare function is convex for all plausible values of L_F (the CES technology case is discussed in appendix). In other words, the gains from immigration increase at an *increasing rate*, and hence *linear* fiscal costs do not guarantee that the optimal policy is an interior solution to the maximum problem.[5]

2.2 The Optimal Policy under a Cobb-Douglas Technology

Assume now that the economy produces the final good competitively via a simple Cobb-Douglas technology:

$$Y = K^\alpha L^{1-\alpha}.$$

[5] In his more general framework but without social policy, Benhabib (1996) proves that the income function of any native agent (and thus, as a particular case, also the welfare function) is *locally* convex in the only candidate solution of the maximum problem (which is then a minimum). The equivalent (but less meaningful) result in our model would be that, when $\gamma = 0$, the welfare function is locally convex around the only candidate solution, which is $L_F = 0$. This is immediate to verify when one looks at (6), recalling that $\partial w_H/\partial L_F < 0$. The point $L_F = 0$ is in fact a minimum. Here, however, we study the concavity along the whole domain of the welfare function.

Let us characterize the optimal number of foreign workers L_F^* in the presence of social policy γ. Substituting the Cobb-Douglas expression into (5) and differentiating w.r.t. L_F, we obtain the first order condition as

$$\frac{\partial N\Pi_H}{\partial L_F} = \alpha\,(1-\alpha)\left(\frac{K}{L}\right)^{\alpha}\frac{L_F}{L} - \gamma = 0. \tag{7}$$

Let us now study the concavity of the welfare function by computing the second derivative. After some algebra we obtain

$$\frac{\partial^2 N\Pi_H}{\partial L_F^2} = \alpha\,(1-\alpha)\left(\frac{K}{L}\right)^{\alpha}\frac{1}{L}\left(\frac{L_H}{L} - \alpha\frac{L_F}{L}\right) < 0 \iff L_F > \frac{L_H}{\alpha}. \tag{8}$$

The above expressions show that the puzzle with immigration policy is not solved by the presence of a fiscal cost. A standard form of the production function such as the Cobb-Douglas delivers predictions in terms of optimal immigration policy outcomes that are patently inconsistent with the basic stylized facts on immigration discussed in the Introduction. In particular, condition (8) tells us that the welfare function is *concave* only for levels of immigration that contradict the second stylized fact. Notice that even the most conservative estimates of α, say $\alpha = 0.5$,[6] would suggest that the optimal number of immigrants (if positive) must be *at least* twice the size of the native population for the second order condition to be satisfied (and hence for an interior solution to exist).

If we restrict attention to economies in which $\bar{L}_F < L_H$, we find that $\partial^2 N\Pi_H/\partial L_F^2 > 0$, and hence that any L_F solving the FOC is indeed a minimum. Since the welfare function is everywhere strictly convex, the global maximum must be at one of the two extremes, either $L_F^* = 0$ or $L_F^* = \bar{L}_F$, and the choice between a closed door or an open door policy depends on the fiscal burden which

[6] In growth accounting exercises a $\alpha = 1/3$ is usually taken as a rough measure of the share of physical capital. When considering both human and physical capital, then a α close to $1/2$ is considered a more appropriate measure.

immigrants impose on natives. In particular, there exists a cut-off value, $\hat{\gamma}$, above (below) which it is optimal to set a closed door (open door) policy. This value, as a function of all parameters of the model, is the one that solves the following equation:

$$N\Pi_H(0) = N\Pi_H\left(\bar{L}_F\right),$$

where

$$N\Pi_H(0) = (1-\alpha)\left(\frac{K}{L_H}\right)^{\alpha} L_H + \alpha\left(\frac{K}{L_H}\right)^{\alpha-1} K$$

is the net welfare of the receiving country when immigration is fully banned, and

$$N\Pi_H\left(\bar{L}_F\right) = (1-\alpha)\left(\frac{K}{L_H+\bar{L}_F}\right)^{\alpha} L_H + \alpha\left(\frac{K}{L_H+\bar{L}_F}\right)^{\alpha-1} K - \gamma\bar{L}_F$$

is the net welfare that accrues to natives when all foreign workers are admitted. The value $\hat{\gamma}$ is then

$$\hat{\gamma} = (1-\alpha)\frac{L_H}{\bar{L}_F}\left[\left(\frac{K}{L_H+\bar{L}_F}\right)^{\alpha} - \left(\frac{K}{L_H}\right)^{\alpha}\right] + \alpha\frac{K}{\bar{L}_F}\left[\left(\frac{K}{L_H+\bar{L}_F}\right)^{\alpha-1} - \left(\frac{K}{L_H}\right)^{\alpha-1}\right].$$

This implies that, for high values of the social policy in the receiving country ($\gamma > \hat{\gamma}$), the optimal immigration policy is $L_F^* = 0$, while for any $\gamma < \hat{\gamma}$, the optimal policy is to impose no restriction to the entry of foreign workers (i.e. $L_F^* = \bar{L}_F$). While this finding has the realistic property that economies with larger redistributive systems will want to set more restrictive immigration policies, this configuration for the optimal immigration policy contradicts the first stylized fact on immigration, as it predicts "extreme" policy outcomes.

Before moving to analyze the solutions to the immigration policy puzzle, we discuss the intuition behind the emergence of extreme policy outcomes. Notice once again that this result does not hinge upon the (well known) fact that the immigration surplus is increasing in the number of migrants. That alone would not deliver extreme policy outcomes in presence of linearly increasing costs of immigration (as captured by the social policy in our model). These policy outcomes instead emerge because, for realistic restrictions of the parameter space ($\bar{L}_F < L_H/\alpha$), the immigration surplus increases at an *increasing rate* ($\partial^2 N\Pi_H/\partial L_F^2 > 0$). That is, the positive effect that foreign workers have on pre-tax income of the receiving region increases with their number. This implies that, if the *first* immigrant that enters the receiving economy has a net positive effect on the after-tax income of natives, so will all other foreign workers. In this case, the receiving government optimally sets no limits on immigration. Conversely, if the marginal benefit of the *last* immigrant to the receiving economy's pre-tax income is too low relative to her fiscal cost, then all other foreign workers must as well reduce the aggregate welfare of natives. For this reason, the government of the receiving economy optimally bans immigration.

3 Solutions to the Immigration Policy Puzzle

We have seen above that introducing the fiscal costs of immigration is not sufficient to guarantee a solution to the choice of immigration policy which is consistent with basic stylized facts on immigration in receiving countries. If we are willing to maintain that governments do not choose immigration policy at random but rationally weighing costs and benefits from immigration, we may reasonably suspect that the model outlined above is missing salient aspects of immigration costs and/or benefits, which are instead taken into account by destination countries. In this section we introduce three possible variations of the above model, which can reconcile the theoretical results on immigration policy with the empirical evidence.

3.1 Congestion Effects of an Increasing Immigrant Community

It is reasonable to conjecture that the costs of immigration are not only fiscal, but also include other (possibly non-economic) costs such as those related to the integration of the immigrants' community into the receiving society. In particular, consider the possibility that the entry of foreign workers may produce "congestion effects", in that it may become more and more difficult to integrate an increasing community of foreigners in the destination country. This would suggest that the costs of immigration are *convex* in the number of immigrants, and not linear as implied by the model in Section 2.

Assume that the overall costs of immigration are described by a twice continuously differentiable function $c(L_F)$, with $c'(\cdot), c''(\cdot) > 0$, $c(0) = 0$, $c(\bar{L}_F) = \bar{c}$. The optimal number of immigrants L_F^* - and hence the optimal immigration policy - is the one which maximizes

$$N\Pi_H = w_H(L_F) \cdot L_H + r_H(L_F) \cdot K - c(L_F).$$

Under a Cobb-Douglas technology, the new FOC is

$$\frac{\partial N\Pi_H}{\partial L_F} = \alpha(1-\alpha)\left(\frac{K}{L}\right)^{\alpha} \frac{L_F}{L} - c'(L_F) = 0.$$

A sufficient condition for an $L_F^* \in (0, \bar{L}_F)$ satisfying the FOC to be a global interior maximum is that the welfare function be strictly concave, that is:

$$\frac{\partial^2 N\Pi_H}{\partial L_F^2} = \alpha(1-\alpha)\left(\frac{K}{L}\right)^{\alpha} \frac{1}{L}\left(\frac{L_H}{L} - \alpha\frac{L_F}{L}\right) - c''(L_F) < 0$$

Notice that a "sufficiently strong" convexity of the immigration cost function guarantees that the second derivative is negative. In this case an intermediate level of restrictions to immigration L_F^* (as opposed to an open door or closed door policy) would be an optimal solution to the maximization problem of the receiving country's policy maker.

To show this point, consider as an example the following cost function:[7]

$$c(L_F) = K^\alpha \frac{L_F^\eta}{\eta(\eta-1)}, \text{ with } \eta > 1.$$

The new FOC is

$$\frac{\partial N\Pi_H}{\partial L_F} = \alpha(1-\alpha)\left(\frac{1}{L}\right)^\alpha \frac{L_F}{L} - \frac{L_F^{\eta-1}}{\eta-1} = 0.$$

We now show that, if the cost function is "sufficiently convex" ($\eta > \bar{\eta}$), the welfare function is everywhere strictly concave, which ensures that, if L_F^* exists which solves the FOC, it is a global interior maximum. In fact

$$\frac{\partial^2 N\Pi_H}{\partial L_F^2} = \alpha(1-\alpha)\left(\frac{1}{L}\right)^{\alpha+1}\left(\frac{L_H}{L} - \alpha\frac{L_F}{L}\right) - L_F^{\eta-2} < 0 \iff$$
$$\eta > \frac{\ln\left[\alpha(1-\alpha)\left(\frac{1}{L}\right)^\alpha \frac{1}{L}\left(\frac{L_H}{L} - \alpha\frac{L_F}{L}\right)\right]}{\ln L_F} + 2.$$

Define

$$h(L_F) \equiv \frac{\ln\left[\alpha(1-\alpha)\left(\frac{1}{L}\right)^\alpha \frac{1}{L}\left(\frac{L_H}{L} - \alpha\frac{L_F}{L}\right)\right]}{\ln L_F}.$$

It is immediate to verify that, for any $L_F \in (1, \bar{L}_F]$, $h(L_F)$ is negative. Then, a sufficient condition for the welfare function to be strictly concave in that interval is that $\eta > 2$.[8] Intuitively, the

[7] We have in mind a simple convex function like $c(L_F) = L_F^\eta$, with $\eta > 1$. We introduce K^α, which is exogenous in our framework, as well as the term $\eta(\eta-1)$ at denominator to simplify the calculations and help us determine an explicit condition on η for the concavity of the welfare function.

[8] A slightly different cost function could be used to obtain the same sufficient concavity condition over the whole interval $[0, \bar{L}_F]$:

$$c(L_F) = \frac{K^\alpha}{\eta(\eta-1)}\left[(L_F + a)^\eta - a^\eta\right], \text{ with } \eta > 1,\ a > 1.$$

equilibrium policy is an interior solution if the congestion effects of immigration in the receiving society -as captured by the cost elasticity η - are sufficiently strong.

3.2 The Political Economy of Immigration Policy

In Section 2 we have disregarded the redistributive implications of immigration and focused more narrowly on its aggregate effects on the receiving economy. The second variation that we analyze here is the one of a policy maker with redistributive concerns.

Consider the model of Section 2 with fiscal costs of immigration. However, we now assume that the government weighs the utility of capital owners and workers differently. More specifically, consider the following problem of welfare maximization:[9]

$$\max_{L_F} \left\{ N\Pi_H \equiv a \cdot (r_H K - \gamma L_F) + (1-a) \cdot w_H L_H \right\},$$

where $L_F \in \left[0, \bar{L}_F\right]$, and $a, 1-a$ represent the utility weights given to capitalists and workers respectively, with $a \in [0,1]$. The FOC of this problem is

$$\frac{\partial N\Pi_H}{\partial L_F} = (1-\alpha)\,\alpha \left(\frac{K}{L}\right)^{\alpha} \left[a - (1-a)\,\frac{L_H}{L}\right] - a\gamma = 0.$$

The new $h(L_F)$ corresponding to this cost function would be negative in the whole interval and would not have discontinuity points at $L_F = 0, 1$.

[9] If the "political" weight were equal for the two groups, the objective function of the government would correspond to the aggregate social welfare for the receiving country (as in Section 2). As it is well understood from the theory of collective action (Olson, 1965), however, governments tend to favor better organized special interests. This may explain deviations from pure welfare maximization. Facchini, Mayda and Mishra (2007) employ a lobbying model and provide a micro-analytic foundation to this political economy representation.

We now turn to study the concavity of the welfare function and obtain

$$\frac{\partial^2 N\Pi_H}{\partial L_F^2} = (1-\alpha)\,\alpha\left(\frac{K}{L}\right)^{\alpha}\frac{1}{L}\left[(1-a)\,\frac{L_H}{L} - \alpha\left(a-(1-a)\,\frac{L_H}{L}\right)\right] < 0 \iff$$
$$\iff L_F > \upsilon L_H,$$

where

$$\upsilon \equiv \frac{(1+\alpha)\,(1-a)-\alpha a}{\alpha a} \lesseqgtr 1$$

depending on the parameters a and α.

Notice that this new condition for concavity ($L_F > \upsilon L_H$) is less stringent than the one obtained under the baseline model ($L_F > L_H/\alpha$) whenever the government has a bias towards capitalists' interests. Formally, $\upsilon < 1/\alpha \iff a > 1/2$.[10] In particular, the higher the weight given to capitalists relative to workers, the lower υ (and hence the less stringent the condition on concavity). Intuitively, while it is obviously true that the politically weighted gain from immigration is larger the higher the consideration of capitalists' interests in the policy maker objective function (a), this gain increases at a decreasing rate for a sufficiently high value of a and is, therefore, compatible with interior solutions for the immigration policy problem. For instance, if $\alpha = 0.3$, $a = 0.8$, then $\upsilon \simeq 0.08$, which implies that the welfare function is strictly concave when immigrant population is at least 8% of native population. Although such a high value of a may be unrealistic for some countries, this simple model suggests that the introduction of policy makers' redistributive concerns goes in the direction of bringing theoretical predictions closer to the immigration policies observed across countries.

[10] Interestingly, Facchini, Mayda and Mishra (2007) find evidence that in the US the government weighs capitalists' interests relatively more than workers' interests (that is, $a > 1/2$).

3.3 A Simple Immigration Model with Human Capital

We finally consider a last extension of the basic model, where immigrants create positive external effects on the destination country. Specifically, suppose that the knowledge of foreign workers, particularly skilled ones, has a positive spillover onto the aggregate technology of the receiving economy, as in the following production function:

$$Y = AK^{\alpha}L^{1-\alpha},$$

where A describes the aggregate level of technology in the receiving economy which is assumed to depend on the number of skilled workers (for simplicity, we assume here that all labor is skilled), that is

$$A = L^{\mu} \text{ with } \mu \in (0,1)\,. \tag{9}$$

Firms take A as given and, hence, produce via a constant return to scale technology. Input factors are paid

$$w_H = A\,(1-\alpha)\left(\frac{K}{L}\right)^{\alpha} \text{ and } r_H = A\alpha\left(\frac{K}{L}\right)^{\alpha-1}.$$

When maximizing the welfare of the economy however, the policy maker internalizes the positive externality by substituting for L^{μ} in the expression for A. Assuming that there are linear fiscal costs associated to migrants in the form introduced in the previous section, the welfare to be maximized is

$$N\Pi_H = L^{\mu}\left[(1-\alpha)\left(\frac{K}{L}\right)^{\alpha}L_H + \alpha\left(\frac{K}{L}\right)^{\alpha-1}K\right] - \gamma L_F.$$

We obtain the expression for the FOC as

$$\frac{\partial N\Pi_H}{\partial L_F} = L^{\mu}\left[\alpha\left(1-\alpha\right)\left(\frac{K}{L}\right)^{\alpha}\frac{L_F}{L}\right] + \mu L^{\mu-1}\left[\left(1-\alpha\right)\left(\frac{K}{L}\right)^{\alpha}L_H + \alpha\left(\frac{K}{L}\right)^{\alpha-1}K\right] - \gamma = 0.$$

The second derivative of welfare with respect to L_F is

$$\begin{aligned}\frac{\partial^2 N\Pi_H}{\partial L_F^2} &= 2\mu L^{\mu-1}\left[\alpha\left(1-\alpha\right)\left(\frac{K}{L}\right)^{\alpha}\frac{L_F}{L}\right] + L^{\mu}\left[\alpha\left(1-\alpha\right)\left(\frac{K}{L}\right)^{\alpha}\frac{1}{L}\left(\frac{L_H}{L} - \alpha\frac{L_F}{L}\right)\right] \\ &\quad - \mu\left(1-\mu\right)L^{\mu-2}\left[\left(1-\alpha\right)\left(\frac{K}{L}\right)^{\alpha}L_H + \alpha\left(\frac{K}{L}\right)^{\alpha-1}K\right].\end{aligned}$$

After some algebra we obtain that

$$\frac{\partial^2 N\Pi_H}{\partial L_F^2} < 0 \iff L_F > \phi L_H,$$

where

$$\phi = \frac{\alpha\left(1-\alpha\right) - \mu\left(1-\mu\right) - \mu\left(1-\mu\right)\left(1-\alpha\right)}{\mu\left(1-\mu\right) + \alpha^2\left(1-\alpha\right) - 2\mu\alpha\left(1-\alpha\right)} \gtreqless 0.$$

Numerical calculations show that ϕ is lower than zero for a wide range of reasonably chosen parameter values. For instance, for any $\alpha \in [0.2, 0.5]$ we have that $\phi < 0$ - that is the welfare function is everywhere strictly concave - for any value of μ belonging to the interval $[0.2, 0.65]$. In all these economies a global maximum is always an interior maximum. The intuition is that the existence of positive externalities of (foreign) skilled workers introduces an element of concavity which might more than offset the convexity of total benefits. In particular, each new immigrant has a positive effect on the aggregate technology of the receiving economy. However, as this knowledge spillover is subject to diminishing returns ($\mu < 1$), the increase in the immigration gain decreases as the country admits more foreign workers.

4 Conclusions

The paper shows that, under standard assumptions on the production technology of the receiving economy, the commonly used economic model of immigration policy - in which the costs and the benefits from immigration are respectively captured via a social redistributive policy and the immigration surplus - fails to be consistent with two stylized facts on immigration. We then analyze three extensions of this basic model which reconcile the theory with the evidence. While not exhaustive, these three solutions provide a panoramic of the possible extensions of the basic economic model, as the first corresponds to a change in the cost structure of immigration, the second introduces redistributive considerations within the receiving society, while the latter considers a different technology. These solutions are not mutually exclusive, the relative importance of each of the determinants of immigration policy discussed in this paper being an interesting empirical question.

References

[1] Antras, P. (2004) "Is the U.S. Aggregate Production Function Cobb-Douglas? New Estimates of the Elasticity of Substitution". *Contributions to Macroeconomics*, Berkeley Electronic Press, Vol. 4(1), Article 4.

[2] Benhabib, J. (1996). "On the Political Economy of Immigration". *European Economic Review*, 40, 1737-1744.

[3] Bentolila, S.; G. Saint-Paul (2003) "Explaining Movements in the Labor Share". *Contributions to Macroeconomics*, Berkeley Electronic Press, Vol. 3, Article 9.

[4] Borjas, G. J. (1994). "The economics of immigration". *Journal of Economic Literature*, XXXII, 1667-1717.

[5] Borjas, G. J. (1995). "The economic benefits from immigration". *Journal of Economic Perspectives*, 9(2), 3-22.

[6] Duffy, J.; C. Papageorgiou (2000). "A Cross-Country Empirical Investigation of the Aggregate Production Function Specification", *Journal of Economic Growth*, vol. 5(1), pp. 87-120.

[7] Facchini, G., A. Mayda and P. Mishra (2007). "Do Interest Groups Affect Immigration?". IZA Discussion Paper No. 3183.

[8] Giordani, P. and M. Ruta (2009). "Prejudice and Immigration". WTO, Mimeo.

[9] Hatton, T. J. and J. G. Williamson (2005). *Global Migration and the World Economy: Two Centuries of Policy and Performance*. MIT Press, Cambridge, MA.

[10] Klump, R., P. McAdam and A. Willman (2007). "Factor Substitution and Factor-Augmenting Technical Progress in the United States: A Normalized Supply-Side System Approach". *The Review of Economics and Statistics*, vol. 89(1), pp. 183-192.

[11] Olson, M. (1965). *The Logic of Collective Action.* Harvard University Press, Cambridge, MA.

Appendix: The Optimal Policy under a CES Technology

Assume that the technology of the receiving economy can be represented by a CES production function:

$$Y = \left[bK^{\beta} + (1-b)\,L^{\beta}\right]^{\frac{1}{\beta}},$$

where $b \in (0,1)$ and $\beta \in (-\infty, 1]$. As before, capital is in fixed amount and is only owned by natives, while labor is the sum of native and foreign labor, $L = L_F + L_H$. Also assume that the economy is characterized by a social policy as the one described in the main body of the paper.

Given the expression for welfare as in (5), we can easily obtain the FOC for the welfare maximization problem as

$$\frac{\partial N\Pi_H}{\partial L_F} = (1-\beta)\,(1-b)\,L^{\beta-2}\left[bK^{\beta} + (1-b)\,L^{\beta}\right]^{\frac{1}{\beta}-2} bK^{\beta}L_F - \gamma = 0.$$

Let us now verify the concavity of the welfare function by computing the second derivative. After some algebra we obtain

$$\begin{aligned}\frac{\partial^2 N\Pi_H}{\partial L_F^2} = {} & (1-\beta)\,(1-b)\,L^{\beta-3}\left[bK^{\beta} + (1-b)\,L^{\beta}\right]^{\frac{1}{\beta}-3} bK^{\beta}\cdot \\ & \cdot\left\{(1-b)\,L^{\beta}\,(L_H - \beta L_F) + bK^{\beta}\left[L_H - (1-\beta)\,L_F\right]\right\}.\end{aligned}$$

The expression above can be higher or lower than zero. We will now provide a *sufficient* condition for the welfare function to be strictly *convex*, that is, for our policy puzzle to exist, even in presence of fiscal costs of immigration. The first multiplicative term is always positive. The first term inside the curly brackets is for sure positive whenever $L_F < L_H$ given that $\beta \leq 1$ - in particular, it is always positive when $\beta \in (-\infty, 0]$, while it is positive for any $L_F < L_H/\beta$ when $\beta \in (0,1]$. Finally, notice that the second term is positive for any $L_F < L_H/(1-\beta)$. Recalling that for a CES function the elasticity of substitution between capital and labor is $e \equiv 1/(1-\beta)$, we can then rewrite the latter inequality as $L_F/L_H < e$. In other words, insofar as the ratio of immigrants over native population lies below the value for the elasticity of substitution between capital and labor, the marginal gain from admitting an additional immigrant is increasing.

Estimates of the elasticity of substitution vary quite remarkably depending on, among others, the data set used (time series or cross-section), the countries involved in the estimation, and the econometric technique. These estimates, however, usually range between 0.7 and 1.4 (recent studies include Bentolila-Saint Paul (2003) - $e = 1.06$ -, Antras (2004) - e between 0.8 and 1 -, Duffy-Papageorgiou (2000) - $e = 1.4$). The lowest recent estimate we are aware of is the one in Klump et al. (2007), where e is between 0.5 and 0.7. Even if we place ourselves in this "worst case" scenario (that is, $e = 0.5$), this condition - which, again, is simply sufficient for the welfare function to be everywhere strictly *convex* - tells us that there can never exist an interior solution to the immigration policy problem where the optimal number of immigrants is lower than half of native population. Given the average number of immigrants across destination countries, we can exclude that the baseline model, even under the CES, may help rationalize the immigration policy set up across countries.