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Who Contributes? A Strategic Approach to a European Immigration Policy

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Abstract

According to the Lisbon Treaty the increasing cost of enforcing the European border against immigration shall be shared among the EU members. Nonetheless, the Treaty is rather vague with respect to the "appropriate measures" to adopt in order to distribute the financial burden. Members who do not share their borders with source countries have an incentive to free ride on the other countries. We study a contribution game where a border country and a central country minimize a loss function with respect to their national immigration target. We consider both sequential and simultaneous decisions and we show that joint contribution occurs only if the immigration targets are not too different. Total contribution is higher when decisions are simultaneous, but the sequential framework achieves joint contribution under a wider difference in the national targets.

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1 Introduction

The Amsterdam Treaty in 1997 and the Tampere Meeting in 1999 have laid out the foundations of a common EU immigration and asylum policy. Nevertheless, member states still control the most important aspects of immigration policy, and the Constitutional Treaty reiterates the right of the EU members to determine volumes of admissions into their own economies[1]. Since immigration is in nature a supranational process, and since internal borders in the EU are not enforced, the existence of a coordination issue is not unexpected (Boeri and Bruecker, 2005; Schain, 2010).

According to Schein (2010, p.121), "the key indication of the failure of immigration policy to take off at the European level [...] is that no structure has been established that would provide policy-makers with a framework for cooperation".

Somewhat surprisingly, even the ongoing emigration wave due to the Arab Spring is producing pressures to reintroduce internal border checks rather than promoting a European immigration policy.[2]

The Lisbon Treaty defines external border enforcement as a "shared competence", disciplined by the ordinary legislative procedure. In particular, "the policies of the Union [...] and their implementation shall be governed by the principle of solidarity and fair sharing of responsibility, *including its financial implications,* between the Member States" (article no. 80).

In spite of its importance, article no. 80 does not provide any rule on how to share these costs in practice, though article no. 77 calls for the development of a European border surveillance system (EUROSUR). The final implementation of EUROSUR will represent a major financial effort for the EU budget (European Commission, 2008b; Jeandesboz, 2008), but it seems quite likely that the current fiscal crisis is going to delay its achievement for several years.

Despite the general awareness of the urgent need for some coordination in the management of immigration flows, the literature on this issue is still very thin. It includes Mayr et al. (2011), who study the joint funding of immigration restriction when a border country may legalize illegal immigrants who can then flow legally to an interior country, and Haake et al. (2010), who propose a mechanism-design approach in order to redistribute resources from northern countries to southern countries[3].

Freedom of movement in the Schengen area implies that countries enforcing the external border -i.e. Southern European countries- provide a public good.

[1] See article III-267 (5).

[2] In April 2011 French President Nicolas Sarkozy and Italian Prime Minister Silvio Berlusconi sent a joint letter to the European Commission and the European Council, requesting EU to "review the possibility of temporarily restoring controls at international borders" in the Schengen area.

[3] Haake et al. (2010) propose the adoption of the expected externality mechanism, where a supranational authority asks each country its own marginal willingness to pay for the public good, then countries are taxed and provided with the public good according to the revealed information. Unfortunately, this mechanism does not always satisfy the participation constraints.

Northern members of the EU seem indeed reluctant to contribute to enforce the border in the South (Wolff, 2008).

So far, the main attempt to move immigration control to a supranational level has been the establishment of the FRONTEX agency in 2005. The intent of FRONTEX is coordinating national immigration policies at the European level. For example, in 2006 it has coordinated eight EU members to help Spanish authorities to patrol the waters along the African Coast and Italian authorities to monitor the strait between Sicily and Libya. According to Spain's deputy Prime Minister Maria Teresa Fernandez de la Vega, this has been the first attempt of a common EU policy on border control (Cuschieri, 2007).

It is evident that the development of a European immigration policy and of an integrated border surveillance system will require resources. Besides the above-mentioned articles no. 77 and no. 80 of the Lisbon Treaty, we note that FRONTEX is funded through a subsidy of the EU plus "a contribution from the countries associated with the implementation, application and development of the Schengen acquis" and "any voluntary contribution from the Member States".[4] However, the institutional framework in which these resources have to be gathered is still undetermined.

The tools provided by mechanism design might be useful in this respect, but the lack of a federal authority allowed to tax and redistribute suggests that it is still too early to adopt such an approach[5].

Without further institutional innovations, in the near future voluntary national contributions are going to be crucial. As a consequence, the best modelling framework for understanding to what extent *current* EU institutions make it possible to share the burden of external border control is provided by contribution games.

For our purposes it is essential to stress a distinctive feature of immigration policy, namely that different countries have different optimal quotas[6]. While foreign workers are necessary to the economy, their potential supply largely exceeds the demand of any national labour market. As a consequence, immigration has to be be restricted.

The existence of an optimal inflow implies that any deviation from the target causes disutility. This is captured in our model by introducing loss functions with respect to the national immigration target.

Heterogeneity in national targets is crucial in our analysis, and we show that it could easily prevent contribution although information is complete and symmetric. A conclusion is that imperfect information is *not* the main culprit for the lack of a European immigration policy.

[4](Official Journal of the EU, 25-11-2004, L 349/9)

[5]In addition, mechanisms are especially used to deal with informational asymmetries (see Clarke, 1971; Arrow, 1979; d' Aspremont and Gerard-Varet, 1979) while contribution games show that free riding can occur under perfect information.

[6]For the endogenous determination of immigration quotas, we refer to the seminal paper by Benhabib (1996). Giordani and Ruta (2011) clarify the main issues related to the decisions over immigration quotas. Russo (2011) develops a model of voting over immigration quotas and contains a short survey of the literature.

Our model includes a central country (henceforth C) and a border or local country (henceforth L). L shares its border with an emigration country and must provide some border enforcement, while C does not. C and L have different immigration targets and different fiscal resources.

Since our purpose is to check whether there exists an institutional framework which dominates the others in terms of total contribution or incentive to contribute, we compare simultaneous and sequential decisions. In the sequential case we explore what happens when the leader is C or L.[7]

By confronting the alternative regimes we find that:

1) in order to obtain positive contributions, the immigration targets of C and L must not be "too" different;

2) the admissible difference in the immigration targets is wider in the sequential game;

3) when both contributions are positive, total contribution is unambiguously higher in the simultaneous game (no matter who is the leader in the sequential game);

4) equilibrium contributions are Pareto-inefficient;

5) in each game a simple condition determines whether C or L contributes more.

Results 1) and 2) reverse the conclusions in Varian (1994): they show that the presence of a target incentivates contribution when preferences are similar and that free riding is less likely in the sequential game.

With respect to the perspectives of a European immigration policy, we argue that a simultaneous regime, in which central countries decide jointly with border countries, produces tighter border enforcement but makes it more likely that a country does not contribute. On the other hand, the sequential regime provides an incentive to contribute despite a smaller total contribution.

The paper is organized as follows: the next Section introduces our model, Section 3 presents the results when decisions are sequential or simultaneous, Section 4 studies the effect of the cost asymmetry on the equilibrium contribution, Section 5 is devoted to compare the equilibrium contributions under the different institutional frameworks, Section 6 proves that the equilibrium contributions are Pareto inefficient, and Section 7 concludes.

2 The model

Our model must depict the basic issues related to the European immigration policy we have discussed in the introduction. First of all, external border enforcement is a public good, and there exists a conflict over its funding. At the

[7] A great deal of literature studies joint provision of public goods within a sequential or simultaneous game (see for example Warr, 1982 and 1983; Cornes and Sandler, 1984; Bergstrom et al., 1986; Varian, 1994). With respect to the funding of immigration restriction, Mayr et al. (2011) consider simultaneous decisions, and do not study the properties of a sequential funding process where a country can exploit the advantage of being the first mover.

moment, no supranational authority can enforce a scheme of taxes and subsidies, thus countries interact strategically with nobody being forced to contribute.

Finally, we assume that C and L face different costs in raising the resources needed to curb immigration and that their preferences over the optimal inflows can be different, but both want some restriction.

In what follows, we develop the simple contribution game able to include all of these points into our analysis.

2.1 Immigration control

In principle, a country would like to stop at the border each immigrant exceeding the quota. Immigration control is expensive: it requires resources to enforce the border, screen the immigrants, contrast illegal inflows and so on. A convenient way to summarize these actions is describing immigration restriction as an output produced through the resources C and L are willing to spend in order to achieve their targets.

We define with g_L and g_C the contributions by L and C respectively. Let M be the inflow of immigrants. Then, we can depict immigration inflow as follows:

$$M = \bar{M} - d(g_L + g_C) \qquad 0 < d < 1; \tag{1}$$

Where $\bar{M}$ depicts the inflow into the federation in case of no restriction ($g_L = g_C = 0$). This kind of "production function" fits the idea that the amount of restriction is proportional to the resources used.[8]

2.2 Payoffs

As we have pointed out in the introduction, the peculiarity of immigration policy is the existence of a bliss point coinciding with the national optimal quota. Thus, we assume that each country has a quadratic loss function with respect to its own target ($M_C^* < \bar{M}$ and $M_L^* < \bar{M}$ respectively).

We also assume perfect information on the destination chosen by immigrants: the countries know how many immigrants are willing to settle in C and how may immigrants are willing to settle in L. Though this assumption may look too optimistic, we only need that destination countries are aware of their respective attractiveness for the immigrants, and thus that they know how the population inflow is going to be distributed[9].

[8] Linearity is useful in order to obtain closed-form solutions with no loss in generality. Our results are due to the properties of the loss functions and not to the functional form of (1).

[9] Note that M is the same in both payoffs because for a single country a *national* immigration target implies a *federal* immigration target, thus M_C^* and M_L^* depict the target that C and L would like to impose to the federation. An example clarifies this point: suppose that C wants 100 immigrants. Suppose also that one half immigrants settle in C and one half immigrants settle in L. Then, $M_C^* = 200$. Also note that this depicts quite well the ongoing conflict between Italy, France and Germany over the responsibility for refugees due to the Arab Spring.

Finally, C and L bear a quadratic cost to collect the resources needed to enforce the border.[10] As a consequence, we write the utilities as follows:

$$U_C = -\frac{1}{2}(M - M_C^*)^2 - \frac{1}{2}g_C^2 \tag{2}$$

$$U_L = -\frac{1}{2}(M - M_L^*)^2 - \frac{\pi}{2}g_L^2 \tag{3}$$

where $\pi > 1$ means that for L it is relatively costlier to gather the resources needed to curb immigration. This assumption is used because C and L may bear different costs to gather the same contribution, and it mirrors a situation in which a small border country provides immigration restriction for the whole federation.[11]

Finally, we assume $\bar{M} > M_C^* \geq 0$ and $\bar{M} > M_L^* \geq 0$.

By substituting (1) into (2) and (3) we can rewrite the payoffs:

$$U_C = -\frac{1}{2}(\bar{M} - d(g_L + g_C) - M_C^*)^2 - \frac{1}{2}g_C^2 \tag{4}$$

$$U_L = -\frac{1}{2}(\bar{M} - d(g_L + g_C) - M_L^*)^2 - \frac{\pi}{2}g_L^2 \tag{5}$$

We are now going to solve the model under sequential and simultaneous decisions. In order to avoid redundancies the main properties of the results are discussed at the end of this section.

2.3 Results: sequential decisions

In the case of sequential decisions, both C and L could have the right to move first. We are now going to explore both cases.

2.3.1 C moves first

Assume for the moment that C is the leader and L is the follower. We solve the game by backwards induction. The best response of L to C is

$$\bar{g}_L = \frac{d(\bar{M} - M_L^*) - d^2 g_C}{\pi + d^2}. \tag{6}$$

By substituting (6) into (4) we can write the leader's problem:

$$\max_{g_C} U_C = -\frac{1}{2}\left[\bar{M} - d\left(g_C + \frac{d(\bar{M} - M_L^*) - d^2 g_C}{\pi + d^2}\right) - M_C^*\right]^2 - \frac{1}{2}g_C^2$$

[10] Gathering real resources always generates costs: they can be the political costs of raising taxes, or even the opportunity costs of diverting funds from alternative projects.

[11] Consider for example the following figures: the aggregate GDP of Italy, Spain and Greece in 2010 -possibly the Local government in our model- is 23.4% of the EU GDP. In contrast, the aggregate GDP of France, Germany, Austria, Netherlands and the Nordic countries -possibly the Central government- accounts for 49.5%. Hence, the fiscal base of C is wider than the fiscal base of L.

which yields

$$g_C^* = \frac{\Delta_C(\pi + d^2)\pi d - \pi d^3 \Delta_L}{\pi^2 d^2 + (\pi + d^2)^2} \tag{7}$$

where $\Delta_C \equiv (\bar{M} - M_C^*)$, and $\Delta_L \equiv (\bar{M} - M_L^*)$ measure the desired entry restriction.

By substituting (7) into (6) we get

$$g_L^* = \frac{\Delta_L(\pi + d^2 + \pi d^2)d - \pi d^3 \Delta_C}{\pi^2 d^2 + (\pi + d^2)^2} \tag{8}$$

we therefore have obtained the equilibrium contributions of both players when C moves first.

These contributions are positive under the following conditions:

$$g_C^* > 0 \qquad for \quad \frac{\Delta_C}{\Delta_L} > \frac{d^2}{\pi + d^2} \tag{9}$$

$$g_L^* > 0 \qquad for \quad \frac{\Delta_C}{\Delta_L} < \frac{\pi + d^2 + \pi d^2}{\pi d^2} \tag{10}$$

Since Δ_C and Δ_L measure the restriction desired by C and L respectively, we define the ratio $\frac{\Delta_C}{\Delta_L}$ as the "relative restriction" desired by C.

$\frac{\Delta_C}{\Delta_L} > 1$ means that C likes more restriction relative to L. The opposite occurs when $\frac{\Delta_C}{\Delta_L} < 1$. Conditions (9) and (10) indicate that for a player to contribute positively his desired relative restriction must be sufficiently high. This will be crucial in the rest of the paper.

Now we are going to present the results when L is the leader.

2.3.2 C moves second

When L moves first, the best response function of C is

$$\bar{g}_C = \frac{d(\bar{M} - M_C^*) - d^2 g_L}{1 + d^2}. \tag{11}$$

In order to solve the leader's problem, we now substitute the best response function of C (11) into (5) and we find the equilibrium contribution of L (g_L^{**}). Then, we plug g_L^{**} into (11) and we solve for the follower's contribution (g_C^{**}).

The equilibrium contributions are

$$g_C^{**} = \frac{\Delta_C(d^2 + \pi + \pi d^2)d - d^3 \Delta_L}{d^2 + \pi(1 + d^2)^2} \tag{12}$$

$$g_L^{**} = \frac{\Delta_L(1 + d^2)d - d^3 \Delta_C}{d^2 + \pi(1 + d^2)^2}. \tag{13}$$

The conditions for having positive contributions are summarized below:

$$g_C^{**} > 0 \qquad for \quad \frac{\Delta_C}{\Delta_L} > \frac{d^2}{d^2 + \pi + \pi d^2} \tag{14}$$

$$g_L^{**} > 0 \qquad for \quad \frac{\Delta_C}{\Delta_L} < \frac{1 + d^2}{d^2}. \tag{15}$$

Finally, we are going to solve the simultaneous game.

2.4 Results: simultaneous decisions

In a simultaneous game, the best response functions for C and L are, respectively, (11) and (6), and the solutions are

$$\tilde{g}_C = \frac{\Delta_C(\pi + d^2)d - d^3\Delta_L}{d^2 + \pi + \pi d^2} \tag{16}$$

$$\tilde{g}_L = \frac{\Delta_L(1 + d^2)d - d^3\Delta_C}{d^2 + \pi + \pi d^2}. \tag{17}$$

These contributions are positive under the following conditions:

$$\tilde{g}_C > 0 \qquad for \quad \frac{\Delta_C}{\Delta_L} > \frac{d^2}{d^2 + \pi} \tag{18}$$

$$\tilde{g}_L > 0 \qquad for \quad \frac{\Delta_C}{\Delta_L} < \frac{1 + d^2}{d^2} \tag{19}$$

By observing (7), (8), (12), (13), (16) and (17) it is evident that the equilibrium contribution of each player is decreasing with respect to the desired immigration restriction of the other player. In other words, in all cases the contribution of C is decreasing with Δ_L, and the contribution of L is decreasing with Δ_C.

To understand intuitively this result, suppose then that L prefers strict border enforcement and C is relatively open. As a consequence the ratio $\frac{\Delta_C}{\Delta_L}$ is low, and C has an incentive to free ride, because L will provide enough immigration control for both countries. This conveys the essential insight that, in order for both countries to contribute, the national targets M_C^* and M_L^* must not be too different. This result has crucial consequences that we are going to discuss in the rest of the paper.

Before proceeding to compare the outcomes under the sequential and the simultaneous regimes, it is indispensable to understand when contributions are positive and when there exists joint contribution.

3 Conditions for joint contribution

We define "joint contribution" a situation in which *both* contributions are positive in equilibrium. We know that individual equilibrium contributions are positive when conditions (9), (10), (14), (15), (18) and (19) hold. The cut values of $\frac{\Delta_C}{\Delta_L}$ are ordered in Figure 1, and the intervals of $\frac{\Delta_C}{\Delta_L}$ under which both contributions are positive in the different games are denoted by lines in red and bold.

By simple inspection of these conditions we can write the following proposition:

Proposition 1 *(Conditions for joint contribution): joint contribution occurs if and only if the individual immigration targets are not too different. The admissible difference is broader in the sequential game.*

Proof. See the appendix. ■

The proposition is crucial because it points out that in a sequential framework the range of $\frac{\Delta_C}{\Delta_L}$ under which there exists joint contribution is wider compared to the simultaneous framework (see Figure 1). In this respect, our results depart from Varian (1994), who argues that sequentiality can exacerbate free riding problems: in Varian a leader with higher marginal utility from the public good might be better off by not contributing and free riding on the follower.

In our model this result is reversed because a player does not contribute only when the other player's contribution is sufficient to saturate his utility. This occurs only when the players have very different targets.

In a sequential game with close targets the follower's contribution is not sufficient to put the leader on his bliss point, so the leader has no incentive to free ride.

As a consequence, the only way to exploit the leadership is trying to set the contribution at a level that does not satisfy the follower and pushes him to add his own contribution.

4 The role of the cost asymmetry

In this section we report some comparative statics results with respect to the effect of the cost asymmetry π.

In the Appendix we show that, quite intuitively, L reduces his equilibrium contribution as π increases. On the other hand, the equilibrium contribution of C increases with π in all cases, *provided that joint contribution occurs.* Results are summarized in the following table:

sequential

C leader	L leader
$\frac{\partial g_C^*}{\partial \pi} > 0;$	$\frac{\partial g_C^{**}}{\partial \pi} > 0 \quad \text{for} \quad \frac{\Delta_C}{\Delta_L} < \frac{1+d^2}{d^2}$
$\frac{\partial g_L^*}{\partial \pi} < 0$	$\frac{\partial g_L^{**}}{\partial \pi} < 0$

simultaneous

$$\frac{\partial \tilde{g}_C}{\partial \pi} > 0 \quad \text{for} \quad \frac{\Delta_C}{\Delta_L} < \frac{1+d^2}{d^2} \qquad \frac{\partial \tilde{g}_L}{\partial \pi} < 0 \quad \text{for} \quad \frac{\Delta_C}{\Delta_L} < \frac{1+d^2}{d^2}$$

The most important outcome of this comparative statics analysis is that when there is joint contribution the timing of the game does *not* determine the effect of π on the equilibrium contributions.

What matters is the *decision to contribute*: once C decides to put resources in immigration control, he is going to increase his equilibrium contribution as L faces higher costs in gathering his own contribution. To understand the reason of this behavior it is important to remember that this holds when both contributions are positive, i.e. when the targets of C and L are sufficiently close. In such a case, C finds it convenient to increase his equilibrium contribution in order to compensate the disadvantage of L.

5 Sequential vs. simultaneous decisions

5.1 Total contribution

In this section we restrict our attention to the case of joint contribution. By comparing the equilibrium solution in the three cases, it is straightforward to conclude that total contribution is higher in the simultaneous regime. This is summarized in the following proposition:

Proposition 2 *(Total contribution with simultaneous decisions): when joint contribution occurs, total contribution is higher in the simultaneous game.*

Proof. See the appendix. ■

The proposition simply states that the simultaneous game dominates the sequential game in terms of total contribution -no matter who is the leader-. Unlike proposition 1, this result is in line with Varian (1994), who shows that in a game with complete information total contribution is never larger in the sequential framework.[12]

[12] We also have $(g_C^* + g_L^*) \geq (g_C^{**} + g_L^{**})$ when $\frac{\Delta_C}{\Delta_L} \leq \frac{\pi(1+d^2)+d^2(2+d^2)}{\pi(1+2d^2)+d^2(1+d^2)}$. There are no particular reasons why this condition should hold, thus we conclude that it is not possible to know a priori whether total contribution is higher when C or L is the leader. Note however that the right-hand side is smaller than unity.

Proposition 1 and proposition 2 convey our most important result, namely that the simultaneous game increases total contribution, but it requires more stringent conditions in order to get positive contributions from both players.

In other words, the simultaneous framework is successful in increasing total contribution *given that countries are willing to contribute*, while the sequential framework is successful in *inducing contribution.* It follows that the sequential game should be recommended when the immigration targets of C and L are very different and the main issue is to provide an incentive to contribute. This seems to be the case of the EU, therefore an effort to frame a federal immigration policy at the current stage of the European integration should favor sequential funding decisions.

In addition, we must stress that the simplest attempt to obtain some contribution from a reluctant country is to make it act as a follower in the sequential game. In fact, from Proposition 1 we know that the leader tries to set his own contribution at a level that encourages the follower to contribute as well. This widens the range of $\frac{\Delta_C}{\Delta_L}$ allowing a positive contribution (see Figure 1).

5.2 Individual contribution

We now compare the individual contributions within the different regimes in the case of joint contribution.

Our first conclusion is summarized in the following proposition:

Proposition 3 *(Equilibrium contributions in the sequential game): in the sequential game the leader contributes more than the follower when* $\frac{\Delta_C}{\Delta_L} > \frac{\pi+d^2+2\pi d^2}{\pi+2\pi d^2}$ *(C leader) and when* $\frac{\Delta_C}{\Delta_L} < \frac{1+2d^2}{\pi_L+\pi_L d^2+2d^2}$ *(L leader).*

Proof. See the appendix. ■

To understand the meaning of this proposition, consider the case of C leader, and notice that the cut value of $\frac{\Delta_C}{\Delta_L}$ is $\frac{\pi+d^2+2\pi d^2}{\pi+2\pi d^2} > 1$. This means that for the leader to contribute more than the folllower his desired relative restriction must be sufficiently high[13].

This happens because he exploits the information on the follower's target. Thus in our game the first mover advantage has two aspects: 1) the leader can push the follower to contribute (proposition 1); 2) the leader can reduce his own contribution as the follower has a stronger taste for relative restriction.

The comparison of the individual contributions in the simultaneous game is reported in the next proposition:

Proposition 4 *(Equilibrium contributions in the simultaneous game): in the simultaneous game C contributes more than L if* $\frac{\Delta_C}{\Delta_L} > \frac{1+2d^2}{\pi+2d^2}$.

Proof. See the Appendix. ■

[13] Obviously the same occurs in the case of L leader, when $\frac{1+2d^2}{\pi_L+\pi_L d^2+2d^2} < 1$ implies that the relative restriction desired by L is sufficiently high.

To understand intuitively the meaning of this proposition, notice that when costs are symmetric (i.e. $\pi = 1$) the condition $\frac{\Delta_C}{\Delta_L} > \frac{1+2d^2}{\pi+2d^2}$ boils down to $\Delta_C > \Delta_L$. Hence, when the cost of gathering the resources for immigration control is the same, the country who desires more restriction contributes more. When π is larger than unity this condition is relaxed: we have $\tilde{g}_C > \tilde{g}_L$ if $\Delta_C > \left(\frac{1+2d^2}{\pi+2d^2}\right)\Delta_L$, with $\left(\frac{1+2d^2}{\pi+2d^2}\right) < 1$.

In other words, C observes that L bears a higher cost, and, if π is sufficiently high, C is going to contribute more than L even though $\Delta_C < \Delta_L$.[14].

6 Efficiency

We now consider the solutions (7), (8), (12), (13), (16) and (17), with respect to Pareto efficiency. We define the social welfare W as the sum of the utilities (2) and (3):

$$W = -\frac{1}{2}(M - M_C^*)^2 - \frac{1}{2}g_C^2 - \frac{1}{2}(M - M_L^*)^2 - \frac{\pi}{2}g_L^2 \tag{20}$$

Since the outcome is clearly inefficient when a player free-rides, we focus our attention on the intervals of $\frac{\Delta_C}{\Delta_L}$ that allow joint contribution. Then, it is straightforward to prove the following proposition:

Proposition 5 *(Pareto inefficiency): the equilibrium contributions are inefficient for all values of* Δ_C/Δ_L *but one.*

Proof. See the appendix. ■

Inefficiency arises when, for a given total contribution, the marginal costs of C and L are different and a planner could increase the social welfare by reallocating some contribution towards the player with lower marginal cost.

In the appendix we show that both in the sequential and in the simultaneous games this is always the case, but for one value of $\frac{\Delta_C}{\Delta_L}$[15]. Thus, the decentralized equilibrium is generally not Pareto efficient.

7 Conclusions

The simple model we have developed has several implications for framing a European immigration policy.

[14] This outcome is consistent with the comparative statics results presented in the previous section, where we have showed that when both contributions are positive $\frac{\partial \tilde{g}_C}{\partial \pi} > 0$ and $\frac{\partial \tilde{g}_L}{\partial \pi} < 0$.

[15] This happens because Δ_C and Δ_L vary arbitrarily. Consider for example country L, and suppose that $\Delta_L = 0$, i.e. that $M_L^* = \bar{M}$. In such a case L has no need to enforce the border and its marginal cost is 0. Suppose for example that Δ_L grows arbitrarily. Then, the marginal cost that L bears in equilibrium grows as well. As a consequence the marginal cost of L in equilibrium might span from 0 to a value arbitrarily high, thus there always exist a value of Δ_L such that the marginal cost of L equals the marginal cost of C.

The main insight of this paper is that central countries and border countries contribute jointly to fund immigration control only if their objectives are not too different. Therefore, the real root of the coordination problem lies in the heterogeneity of national immigration targets rather than in imperfect information. This is even more worrying because it means that improving information will *not* make coordination easier.

On the other hand we notice that, once joint contribution is achieved, the central country compensates to some extent the possible lack of resources of the border country. This holds for both a simultaneous and a sequential framework.

Another important result is that total contribution is higher when decisions are simultaneous but, unlike Varian (1994), achieving joint contribution is easier in the sequential game.

It follows that, if the federation members are heterogeneous and the most urgent issue is to avoid free riding, sequential decisions should be preferred at the cost of a smaller total contribution. The latter case seems closer to the current situation of the EU, thus a sequential framework should make more likely that EU members contribute to fund a common immigration policy.

In the wait for a full-fledged federal immigration authority able to tax the single countries, the adoption of a sequential contribution process seems therefore a promising option to implement in some measure article no. 80 of the Lisbon Treaty.

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8 Appendix

Proof of Proposition 1

In the simultaneous game there is joint contribution when

$$\frac{d^2}{\pi + d^2} < \frac{\Delta_C}{\Delta_L} < \frac{1 + d^2}{d^2}. \tag{21}$$

In the sequential game when C is the leader there is joint contribution when

$$\frac{d^2}{\pi + d^2} < \frac{\Delta_C}{\Delta_L} < \frac{d^2 + \pi + \pi d^2}{d^2} \tag{22}$$

since $\frac{1+d^2}{d^2} < \frac{d^2+\pi+\pi d^2}{d^2}$, it follows that the interval of $\frac{\Delta_C}{\Delta_L}$ under which joint contribution occurs is wider in the sequential game.

In the sequential game when L is the leader there is joint contribution when

$$\frac{d^2}{d^2 + \pi + \pi d^2} < \frac{\Delta_C}{\Delta_L} < \frac{1 + d^2}{d^2} \tag{23}$$

since $\frac{d^2}{d^2+\pi+\pi d^2} < \frac{d^2}{\pi+d^2}$, it follows that the interval of $\frac{\Delta_C}{\Delta_L}$ under which joint contribution occurs is wider in the sequential game.

Proof of Proposition 2

We want to prove that total contribution in the simultaneous framework ($\tilde{g}_C + \tilde{g}_L$) dominates total contribution in the sequential framework ($g_C^* + g_L^*$ and $g_C^{**} + g_L^{**}$). Thus, we have to verify that

$$\underbrace{\frac{d(\pi\Delta_C + \Delta_L)}{\pi + d^2 + \pi d^2}}_{\text{simultaneous}} > \underbrace{\frac{d(\pi^2\Delta_C + \Delta_L(\pi + d^2))}{\pi^2 d^2 + (\pi + d^2)^2}}_{\text{sequential, } C \text{ leader}} \tag{24}$$

Condition (24) boils down to

$$\frac{\Delta_C}{\Delta_L} > \frac{d^2}{\pi + d^2}.$$

When L is the leader we have.

$$\underbrace{\frac{d(\pi\Delta_C + \Delta_L)}{\pi + d^2 + \pi d^2}}_{\text{simultaneous}} > \underbrace{\frac{d\Delta_C(\pi + \pi d^2) + d\Delta_L}{d^2 + \pi(1 + d^2)^2}}_{\text{sequential, } L \text{ leader}} \tag{25}$$

which boils down to

$$\frac{\Delta_C}{\Delta_L} < \frac{1 + d^2}{d^2}.$$

we conclude that total contribution in the simultaneous framework dominates total contribution in the sequential framework when $\frac{\Delta_C}{\Delta_L} > \frac{d^2}{\pi+d^2}$ (C leader) and $\frac{\Delta_C}{\Delta_L} < \frac{1+d^2}{d^2}$ (L leader). However, these conditions coincide with the values of $\frac{\Delta_C}{\Delta_L}$ assuring joint contribution in the simultaneous framework. Thus we conclude that when both contributions are positive, total contribution in the simultaneous game dominates total contribution in the sequential game.

Proof of Proposition 3

We want to prove when the leader contributes more than the follower. When C is the leader, the condition $g_C^* \geq g_L^*$ is

$$\frac{\Delta_C(\pi+d^2)\pi d - \pi d^3 \Delta_L}{\pi^2 d^2 + (\pi+d^2)^2} \geq \frac{\Delta_L(\pi+d^2+\pi d^2)d - \pi d^3 \Delta_C}{\pi^2 d^2 + (\pi+d^2)^2} \tag{26}$$

by rearranging condition (26) we obtain

$$\frac{\Delta_C}{\Delta_L} \geq \frac{\pi + d^2 + 2\pi d^2}{\pi + 2\pi d^2}.$$

With L leader, we set $g_L^{**} \geq g_C^{**}$:

$$\frac{\Delta_L(1+d^2)d - d^3\Delta_C}{d^2 + \pi(1+d^2)^2} \geq \frac{\Delta_C(d^2+\pi+\pi d^2)d - d^3\Delta_L}{d^2 + \pi(1+d^2)^2}. \tag{27}$$

By rearranging condition (27) we obtain

$$\frac{\Delta_C}{\Delta_L} \leq \frac{1+2d^2}{\pi + \pi d^2 + 2d^2}.$$

Since

$$\frac{d^2}{\pi+d^2} < \frac{\pi+d^2+2\pi d^2}{\pi+2\pi d^2} < \frac{\pi d^2 + d^2 + \pi}{\pi d^2}$$

and

$$\frac{d^2}{d^2+\pi+\pi d^2} < \frac{1+2d^2}{\pi+\pi d^2+2d^2} < \frac{1+d^2}{d^2}$$

we conclude that proposition 3 holds when there is joint contribution.

Proof of Proposition 4

To compare the individual contributions in the simultaneous game, we set $\tilde{g}_C \geq \tilde{g}_L$, i.e.

$$\frac{\Delta_C(\pi+d^2)d - d^3\Delta_L}{d^2+\pi+\pi d^2} \geq \frac{\Delta_L(1+d^2)d - d^3\Delta_C}{d^2+\pi+\pi d^2}. \tag{28}$$

By rearranging condition (28) we obtain

$$\frac{\Delta_C}{\Delta_L} \geq \frac{\pi+2d^2}{1+2d^2}.$$

The effect of π

$$\frac{\partial \tilde{g}_C}{\partial \pi} = \frac{d\Delta_C(d^2+\pi+\pi d^2)-(1+d^2)(\Delta_C(\pi+d^2)d-d^3\Delta_L)}{(d^2+\pi+\pi d^2)^2}$$

$$\frac{\partial \tilde{g}_L}{\partial \pi} = \frac{d^5\Delta_C(d^2+2\pi)+2d^3\pi\Delta_L(\pi d^2+\pi+d^2)}{(d^2+\pi+\pi d^2)^2}$$

proof that $\frac{\partial g_C^*}{\partial \pi} < 0$:

$$\frac{\partial g_L^*}{\partial \pi} < 0 \qquad \text{for} \qquad \frac{\Delta_C}{\Delta_L} \leq \frac{(\pi+d^2+\pi d^2)^2-d^6}{\pi^2 d^2(1+d^2)-d^6}$$

but for both contributions to be positive we need $\frac{\Delta_C}{\Delta_L} \leq \frac{(\pi+d^2+\pi d^2)}{\pi d^2}$. Since

$$\frac{(\pi+d^2+\pi d^2)}{\pi d^2} < \frac{(\pi+d^2+\pi d^2)^2-d^6}{\pi^2 d^2(1+d^2)-d^6}$$

we conclude that $\frac{\partial g_C^*}{\partial \pi} < 0$ when both contributions are positive.

Proof of Proposition 5

Consider the social welfare function (20):

$$W = -\frac{1}{2}(M-M_C^*)^2 - \frac{1}{2}g_C^2 - \frac{1}{2}(M-M_L^*)^2 - \frac{\pi}{2}g_L^2.$$

The total differential of (20) with respect to g_C and g_L is

$$\begin{aligned} dW = {} & [d(\Delta_C - d(g_C+g_L)) + d(\Delta_L - d(g_C+g_L))]\, dg_C + \\ & + [d(\Delta_C - d(g_C+g_L)) + d(\Delta_L - d(g_C+g_L))]\, dg_L - g_C dg_C - \pi g_L dg_L \end{aligned}$$

Suppose now that total contribution $(g_C + g_L)$ is kept constant, while some contribution is reallocated between C and L. In such a case we have

$$dg_C + dg_L = 0$$

by substituting $dg_L = -dg_C$ the differential dW boils down to

$$dW = dg_C(\pi g_L - g_C).$$

A reallocation $dg_C > 0$ increases the social welfare when $(\pi g_L - g_C) > 0$. Since $(\pi g_L - g_C)$ is the difference in the marginal costs of C and L, we conclude that when the marginal costs are different in equilibrium the decentralized allocation is Pareto inefficient. Thus, to prove inefficiency we only have to compare the marginal costs in equilibrium. In the sequential game with C leader we have to set $(\pi g_L^* - g_C^*) > 0$, i. e.

$$\pi\left(\frac{\Delta_L(\pi + d^2 + \pi d^2)d - \pi d^3 \Delta_C}{\pi^2 d^2 + (\pi + d^2)^2}\right) > \frac{\Delta_C(\pi + d^2)\pi d - \pi d^3 \Delta_L}{\pi^2 d^2 + (\pi + d^2)^2}$$

which reduces to

$$\frac{\Delta_C}{\Delta_L} < \frac{\pi + \pi d^2 + 2d^2}{\pi + d^2 + \pi d^2}$$

since joint contribution occurs in the interval

$$\frac{d^2}{d^2 + \pi} < \frac{\Delta_C}{\Delta_L} < \frac{d^2 + \pi + \pi d^2}{\pi d^2}$$

and since

$$\frac{d^2}{d^2 + \pi + \pi d^2} < \frac{\pi + \pi d^2 + 2d^2}{\pi + d^2 + \pi d^2} < \frac{d^2 + \pi + \pi d^2}{d^2}$$

we conclude that

$$(\pi g_L^* - g_C^*) < 0 \quad \text{for} \quad \frac{\Delta_C}{\Delta_L} > \frac{\pi + \pi d^2 + 2d^2}{\pi + d^2 + \pi d^2}$$
$$(\pi g_L^* - g_C^*) \geq 0 \quad \text{for} \quad \frac{\Delta_C}{\Delta_L} \leq \frac{\pi + \pi d^2 + 2d^2}{\pi + d^2 + \pi d^2}.$$

By applying the same reasoning when L is the leader, the value of $\frac{\Delta_C}{\Delta_L}$ that equals the marginal costs is

$$\frac{\Delta_C}{\Delta_L} = \frac{\pi + d^2 + \pi d^2}{\pi + d^2 + 2\pi d^2}$$

In this case too, it is easy to check that the critical value of $\frac{\Delta_C}{\Delta_L}$ lies in the interval of joint contribution:

$$\frac{d^2}{d^2 + \pi + \pi d^2} < \frac{\pi + d^2 + \pi d^2}{\pi + d^2 + 2\pi d^2} < \frac{1 + d^2}{d^2}.$$

Finally, in the simultaneous game the marginal costs are equalized when

$$\frac{\Delta_C}{\Delta_L} = 1$$

and it is immediate to verify that 1 lies in the interval of joint contribution:

$$\frac{d^2}{d^2 + \pi} < 1 < \frac{1 + d^2}{d^2}.$$

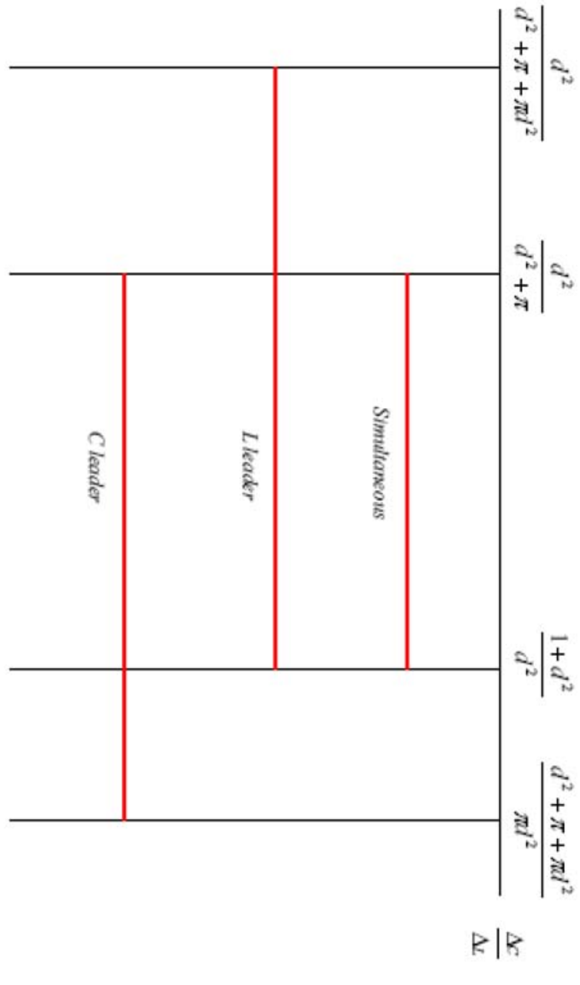

***Figure 1**: positivity conditions for the equilibrium contributions*