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# Asylum seekers in Europe: the warm glow of a hot potato

Received: 20 October 2004 / Accepted: 31 October 2005 / Published online: 31 March 2006  
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**Abstract** The Common European Asylum System calls for increased coordination of the European Union (EU) countries' policies towards asylum seekers and refugees. In this paper, we provide a formal analysis of the effects of coordination, explicitly modelling the democratic process through which policy is determined. In a symmetric, two-country citizen-candidate setup, in which accepting asylum seekers in one country generates a cross-border externality in the other, we show that coordination is desirable. Internalizing the externality leads to a welfare improvement over the non-cooperative outcome. However, contrary to suggestions by many observers, we show that allowing for cross-country transfers in the cooperative outcome leads to a welfare inferior outcome because the possibility of compensation exacerbates strategic delegation effects.

**Keywords** Political economy · Asylum policy · Migration

**JEL Classification** J61 · H77 · F22

## 1 Introduction

Since the 1970s the European Union (EU) has removed formal barriers to the internal mobility of production factors. At the same time, member countries have

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*Responsible editor:* Gil S. Epstein

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continued to follow autonomous policies towards immigration from the rest of the world. The ‘Single European Act’, which established the Single Market, went as far as explicitly specifying that “nothing in these provisions shall affect the right of member states to take measures as they consider necessary for the purpose of controlling immigration from third countries.”<sup>1</sup>

Retaining control over immigration policy is of utmost political concern to most countries. Indeed, as recent Eurobarometer surveys show, a majority of EU citizens consistently opposes the idea of delegating authority over the issue to Brussels,<sup>2</sup> and the successful anti-immigration campaigns of Pim Fortuyn or Jörg Haider only confirm the importance of this policy dimension. At the same time, the efforts towards the creation of a pan-European labor market and the removal of border controls between EU countries have made it difficult to enforce limits on the mobility of third country nationals within the EU. Furthermore, there is a serious risk of under-provision of border controls by those EU member countries that are not likely to be the final destination of immigration flows.<sup>3</sup> For these reasons, many observers have suggested that coordinating migration policies might actually be desirable.<sup>4</sup> While the EU is far from having a common immigration policy, the debate has led to the adoption of a series of initiatives aimed at increasing the coordination of the actions of the member countries (Schengen agreements), but with only limited impact on the integration of labor markets. A more substantial step is the proposed establishment of a Common European Asylum System. This initiative has so far led to two directives, spelling out a precise definition of refugees, and some minimum standards concerning the status of refugees and asylum procedures and reception conditions for asylum seekers. Many observers suggest that these first steps are not sufficient and recommend a more substantial effort towards further coordination. For instance, Boeri et al. (2002) propose to “... coordinate the implementation of the rules, and *share the costs of humanitarian migration equally, for example by a fund for asylum seekers, refugees and other humanitarian migrants*.”<sup>5</sup> This will internalize costs and prevent countries with more generous policies from being penalized.”

While standard welfare economics seems to support this idea, the purpose of our paper is to address the desirability of coordination, when the democratic process through which migration policies are decided, is explicitly taken into account. To this end, we develop a symmetric, two-country model in which an inflow of foreigners in one country gives rise to a positive externality on the residents of the other. Policy is determined through a two-stage process: in the first stage, citizens elect a representative, while in the second stage the representatives determine immigration policy.<sup>6</sup> We compare the outcome without coordination to two

<sup>1</sup> General Declaration on Articles 13 to 19.

<sup>2</sup> See Luedtke (2005).

<sup>3</sup> “Switzerland and Austria have accused Italy of turning a blind eye to would-be refugees heading north.” *The Economist*, September 6, 2001.

<sup>4</sup> See for instance Boeri et al. 2002, and Hatton (2004).

<sup>5</sup> Emphasis added by the authors.

<sup>6</sup> The citizen-candidate framework we are using has been introduced by Besley and Coate (1997) and Osborne and Slivinski (1996). The concept of strategic delegation has been applied in different contexts: Besley and Coate (2003) use it to analyze the provision of local public goods, Willmann (2004) employs it to endogenize trade policy, Lorz and Willmann (2005) explain the degree of regionalism in this way, etc.

possible scenarios in which countries cooperate: in the first, no transfer payments between countries are possible, whereas, in the second, transfer payments are possible, as has been suggested in the recent debate.

We find for both scenarios that taking into account the democratic process does not alter the main conclusion that there are gains from policy coordination. However, because of strategic delegation, the utilitarian optimum is not achieved. Interestingly, allowing for transfers between countries leads to an outcome which is inferior to the situation without transfers. The intuition for this result is that the possibility of direct cost sharing will exacerbate the strategic delegation emerging in the political game, implying an inefficiently low level of immigration. From a normative perspective, our analysis suggests that while some coordination might be desirable, very pervasive approaches can lead to less attractive outcomes. With asymmetric preferences for immigration, we show the additional presence of the usual beneficial role of side payments as they allow a more efficient allocation of asylum seekers.

The existing literature on policy towards asylum seekers has emphasized the risk of a ‘race to the bottom’, i.e., a tendency for those countries with more generous provisions towards refugees to adopt more restrictive policies in order to avoid becoming asylum magnets. Noll (2000) has even talked of a ‘common market of deflection’ within the European Union. While the issue has spurred a lively debate in the media, it has attracted relatively little formal analysis. In two recent papers, Hatton (2004) and Hatton and Williamson (2004) have developed a formal framework that highlights how policy coordination might be desirable from the point of view of welfare maximization. The key driving force behind their results is the existence of positive spill-overs between countries, rather than the internalization of deflection effects. Our analysis also emphasizes the public good nature of public policy towards asylum seekers; however, we move beyond simple welfare maximization and model explicitly the role of the democratic process in shaping policy.

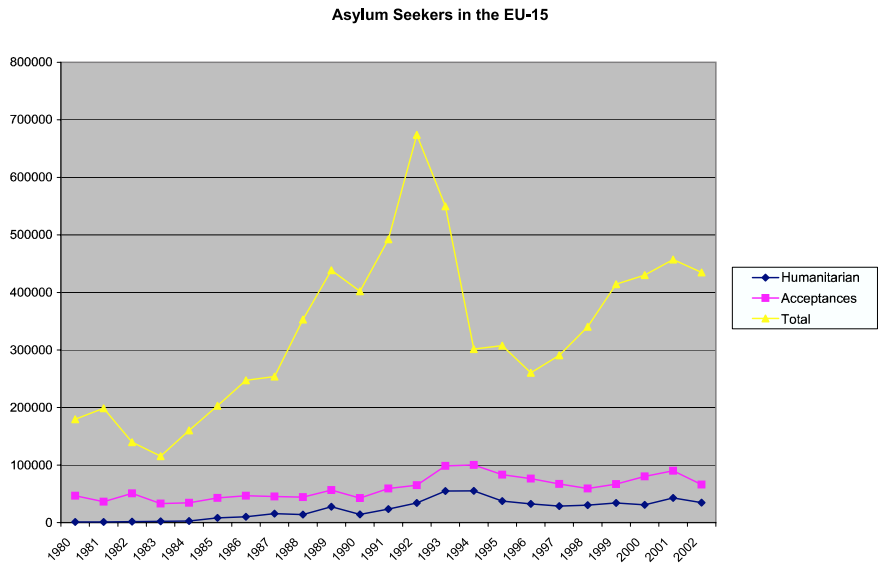
The remainder of the paper is organized as follows. Section 2 reviews the recent developments in the inflows of asylum seekers in the EU and the policy stances adopted by the member countries. We then introduce the model used for our analysis and discuss the social planner solution as a benchmark case against which to evaluate the endogenous policy outcomes. In Section 4, we determine the endogenous migration policy adopted when countries do not cooperate. The outcome with coordination is discussed in Section 5, where we consider first the situation without transfers between countries and subsequently allow for explicit cost sharing. Section 6 explores the case of asymmetric preferences for asylum seekers before we offer concluding remarks in Section 7.

## 2 Asylum seekers and policies

In 2002, about two thirds of all asylum applications in the western world were directed at the EU-15 member countries (UNHCR (2003)). The number of asylum seekers trying to enter the EU-15 has increased dramatically over the past 20 years, peaking in the aftermath of the fall of the iron curtain at around 700,000 in 1992. By 2002, a little over 400,000 applications were filed, a figure that is still more than twice as high as the level of the 1980s (see Fig. 1). Notwithstanding these fluctuations in the flow of asylum seekers, the number of applications that were actually accepted based

on the Geneva convention has remained relatively stable at around 38,000 a year, while the number of refugees admitted on humanitarian grounds has increased substantially over the period, accounting for about half of the total admissions in 2002. The main message that emerges from Fig. 1 is that while the number of applications has experienced a substantial upward trend, the number of positive decisions has not increased proportionally, implying that policy towards asylum seekers has become more restrictive over time. What lies behind this development?

We can distinguish two components of a EU country’s policy towards asylum seekers: a supra-national component and a national one. The supranational dimension is due to the Geneva Convention Relating to the Status of Refugees. The document, agreed upon in 1951, defines a refugee as someone who is outside his country of origin and is unable or unwilling to return to it (Art. 1). It also establishes the principle of *non-refoulement*, which means that the refugee cannot be forcibly returned to the frontier of a territory where her life or freedom would be threatened (Art. 33). By 1978, all EU-15 members had ratified the Geneva convention and this agreement represents the basic legal foundation of the EU’s policy towards asylum seekers. The growing number of refugees during the eighties led to an effort to harmonize the rules and the policies followed by member states. Particular emphasis was put on the harmonization of visa policies and the establishment of sanctions against carriers that illegally transport refugees. In 1990, the Dublin Convention sought to put an end to the so-called ‘asylum shopping’ phenomenon, decreeing that the application for asylum should be dealt with by one state only, usually the state of first entry. The subsequent London resolution established a series of important, though non-binding principles: first, the concept of a ‘safe third country’, allowing refusal of admission if the refugee had gone through a safe third country; second, ‘manifestly unfounded’ claims could be rejected without the right to appeal; third, a list of ‘safe countries of origin’ was



**Fig. 1** Asylum applications approval (Source: Eurostat)

**Table 1** Changes in asylum policies 1990–1999. (Source: Hatton (2004))

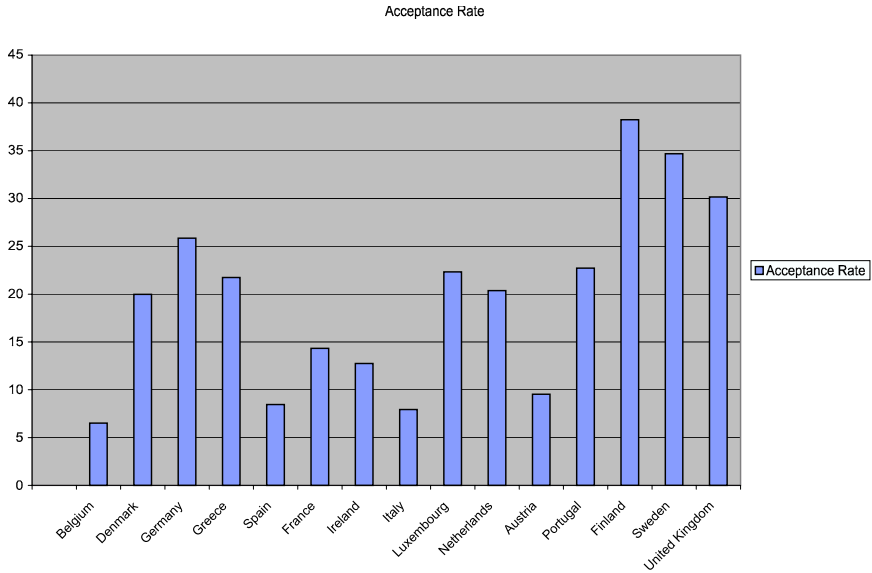
	Access index	Procedure index	Outcomes index	Conditions index
Austria	1.43	1.46	1.9	1.57
Belgium	0.47	2.4	1.86	1.6
Denmark	1	2.5	1.9	2
Finland	1	2.3	1.68	1.16
France	1.48	1.33	1.8	1.48
Germany	1.65	1.95	1.8	2.1
Greece	0	1.25	1.9	2.8
Ireland	0.2	0.53	0.7	0.96
Italy	1.92	1.92	0.5	1.72
Netherlands	1.02	1.57	1.53	1.7
Portugal	1	1.13	1.62	2
Spain	1.58	1.08	1.69	2
Sweden	1	1.74	2.48	1.1
UK	1	1.8	1.02	2.09

drawn up, with the presumption that no serious risk would be incurred by the claimant were she to be expelled and repatriated to a country on that list.

The most recent developments stem from the Amsterdam Treaty and the Tampere 1999 European Council. Consequently, as of 2002, the EU Commission has the sole right to propose legislation and two further directives were adopted: the first one, introduced in March 2003, specifies ‘minimum standards for the qualifications and the status of asylum seekers in the EU’ and the second, adopted in April 2004, deals with ‘minimum standards for the qualifications and status of third country nationals and stateless persons as refugees or as persons who otherwise need international protection’. The intention has been to increase the coordination of the policies pursued by the various EU-15 countries. Along the same lines, a European Refugee Fund was established in 2000. Endowed with 216 million Euros for the period 2000–2004, the fund aims at providing financial support to help the member states receive asylum seekers, refugees and displaced persons.

Table 1, taken from Hatton (2004), gives us an idea of the evolution of the policy towards asylum seekers followed by each of the EU-15 countries. The indices we report are intended to capture changes of the respective policies. A value of 1 indicates the introduction of a more restrictive policy, whereas, a value of 0 means that no major change was introduced that year. Each ‘policy’ stance involves multiple possible dimensions. For instance, in the construction of the procedure index, Hatton (2004) considered the introduction of ‘safe third country’ provisions, rules concerning ‘manifestly unfounded claims’ and ‘fast-track procedures’.<sup>7</sup> The reported indices are averages over the 1990–1999 period. While the construction of these indicators necessarily involves some arbitrariness, the main message is clear: all countries have moved towards more restrictive policies, with the possible exception of Ireland, where the government’s attitude seems not to have changed much.

<sup>7</sup> For more details on the construction of the figures, we refer the reader to the Appendix of Hatton (2004).



**Fig. 2** Asylum applications approval (Source: Eurostat)

Even though the policy stance adopted by the various countries has moved in the same direction and a substantial effort has been profused towards coordinating policies, when it comes to the actual acceptance of asylum seekers, we see from Fig. 2 that there are still considerable differences across countries. The data are taken from Eurostat and represent the share of all asylum-seeking applications that are accepted. As we can see, the Northern countries (Sweden and Finland, in particular, and to a lesser extent Denmark) seem to be much more receptive than Belgium, Italy, or Austria. While there may be many reasons behind these differences, it is fair to say that the efforts at coordinating asylum policy undertaken so far have produced only very limited results. In the remainder of this paper, we will discuss to what extent policy coordination is desirable, once due attention is paid to the democratic process that determines such policies.

### 3 The model

We consider two symmetric countries, indexed by  $i \in \{1, 2\}$ . Each country is populated by a continuum of citizens, and we normalize the mass of each population to one. Refugees coming from the rest of the world can be admitted into either country. We denote by  $m_i$  the number of asylum seekers allowed into country  $i$ . Note that, due to the above normalization,  $m_i \in (0, 1)$  indicates the number of asylum seekers as a fraction of the domestic population. Country  $i$  controls the access to its territory and can therefore choose  $m_i$ ; similarly the other country determines  $m_{-i}$ . Let the vector  $m = (m_1, m_2)$  summarize the policies followed by the two countries. The residents of country  $i$  derive an altruistic benefit from admitting refugees into either country. We denote this benefit by  $B_i(\sum_j m_j)$  and note that it depends on the total number admitted into both

countries. The same effect has been modelled out by Hatton and Williamson (2004). It captures the warm glow of helping refugees to avoid their plight elsewhere and enjoy safe haven in either country. Clearly, there are also costs from admitting asylum seekers, which we denote by  $C_i(m_i, m_{-i})$ . In the interest of tractability, we assume that the benefit to country  $i$  takes the form  $B_i = (1 + \alpha) \sum_j m_j$  and that the cost amounts to  $C_i = -\ln(1 - \lambda m_i - [1 - \lambda]m_{-i})$ , where  $1/2 < \lambda < 1$ .<sup>8</sup> While the cost to country  $i$  is primarily determined by the number of refugees it accepts ( $m_i$ ), we do allow for cost spill-overs from the inflow ( $m_{-i}$ ) into the other country.<sup>9</sup> These spill-overs can, for example, be due to a permeable, imperfectly controlled interior border between the two countries. In this case,  $\lambda$  should be thought of as the fraction of immigrants admitted by country  $i$ , who choose country  $i$  as their final destination, whereas  $1 - \lambda$  is the fraction of the immigrants admitted by country  $i$  who end up moving to the other country.<sup>10</sup> In addition to this interpretation, our formulation also allows us to capture pecuniary spill-overs, for example, from wage effects in one country's labor market onto the other's, due to the free mobility of native workers between the two countries that are member of the EU.

Following these assumptions, the utility of individual  $\alpha_i$  in country  $i$  takes the form:

$$U_i(\alpha_i, m) = [1 + \alpha_i][m_i + m_{-i}] + \ln(1 - \lambda m_i - [1 - \lambda]m_{-i}), \quad (1)$$

where  $\alpha_i$  represents the strength of the individual's altruistic preference for admitting refugees. We assume that citizens within both countries differ with respect to this preference term, i.e., in either country,  $\alpha_i$  follows the same well-behaved density function with mean and median  $\bar{\alpha}$ .

As a normative benchmark for our analysis, we start by deriving the values for  $m_i$  and  $m_{-i}$  that maximize the combined welfare of both countries. This is the policy vector a social planner who weighs the utility of all individuals in both countries equally would set.<sup>11</sup> Thus, we are seeking the solution to the following problem:

$$\max_{m_1, m_2} W = U_1(\bar{\alpha}, m) + U_2(\bar{\alpha}, m). \quad (2)$$

The corresponding first order conditions are:

$$2 + 2\bar{\alpha} - \frac{\lambda}{1 - \lambda m_i - [1 - \lambda]m_{-i}} - \frac{1 - \lambda}{1 - \lambda m_{-i} - [1 - \lambda]m_i} = 0. \quad (3)$$

<sup>8</sup> It is worth emphasizing that the specific functional forms are chosen solely to guarantee a closed-form solution. The crucial features of this setup are the convex cost that gives rise to a concave objective function and the positive *net* spill-over from admitting asylum seekers. A similar functional form is used by Segendorff (1998).

<sup>9</sup> Conceptually, we can distinguish up-front processing costs and the ongoing cost burden. While our model allows for both, the inclusion of spill-overs is relevant mainly for the latter.

<sup>10</sup> Notice that in our model, we do not explicitly consider the dynamic adjustments involved in the 'relocation' of migrants across countries. This is realistic as long as the relocation takes place quickly. Alternatively, as suggested by one referee, we could think of  $m_i$  as representing the stock of refugees, and the costs and utilities should then be interpreted as present values.

<sup>11</sup> Note that the welfare of immigrants enters aggregate welfare in each country only indirectly through the warm glow effect.

Taken together, the first-order conditions of both countries imply that the number of refugees admitted into each country is the same, i.e.,  $m_i = m_{-i}$ . This common number amounts to:

$$m_i^U(\bar{\alpha}) = \frac{1 + 2\bar{\alpha}}{2 + 2\bar{\alpha}}, \quad (4)$$

the level of immigration that maximizes utilitarian social welfare. This is the level that we will use as a reference point to determine the welfare properties of the political equilibria we will examine next.

#### 4 Immigration levels without coordination

In this section, we consider the scenario where each country determines the number of refugees to admit non-cooperatively. Within each country, the decision is taken following a two-stage political process. In the first stage, citizens elect a representative. In the second stage, each country's representative decides on the level of refugees to admit,  $m_i$ , taking the level in the other region,  $m_{-i}$ , as given. Both representatives are assumed to be citizen-candidates in the sense of having the personal preferences of an ordinary citizen. That is, the representative of region  $i$  has a preference  $\hat{\alpha}_i$  for immigration, and the vector  $\hat{\alpha}$  represents the preference profile of the representatives in the two countries. In the remainder of the paper we will use 'hats' to indicate the preferences of representatives. To look for the noncooperative outcome, we solve the game backwards. That is, we start by analyzing first the second stage, where the representative chooses the number of refugees. Taking the identity of representative  $i$  as given (for the time being), the first order condition of her maximization problem takes the following form:

$$1 + \hat{\alpha}_i - \frac{\lambda}{1 - \lambda m_i - [1 - \lambda]m_{-i}} = 0. \quad (5)$$

Solving this equation for  $m_i$ , we obtain the reaction function of each representative:

$$m_i = \frac{1 + \hat{\alpha}_i - \lambda}{\lambda[1 + \hat{\alpha}_i]} - \frac{1 - \lambda}{\lambda} m_{-i}. \quad (6)$$

As can be seen from the coefficient in front of  $m_{-i}$ , the immigration levels are strategic substitutes. In other words, the higher the number of asylum seekers admitted by the other country, the lower is the number of refugees country  $i$  decides to accept, because country  $i$ 's representative already benefits from the refugees the other country lets in. Solving for the Nash equilibrium, we find that the equilibrium immigration levels  $m_i^N(\hat{\alpha})$  are given by:

$$m_i^N(\hat{\alpha}) = \frac{\lambda[1 + \hat{\alpha}_i - \lambda]}{[2\lambda - 1][1 + \hat{\alpha}_i]} - \frac{[1 - \lambda][1 + \hat{\alpha}_{-i} - \lambda]}{[2\lambda - 1][1 + \hat{\alpha}_{-i}]}. \quad (7)$$



Note that these noncooperative levels depend on the identity of both representatives. Straightforward comparative statics reveals that an increase in  $\hat{\alpha}_i$  raises the immigration level in country  $i$  but lowers the immigration level in the other country. More formally:<sup>12</sup>

$$\frac{dm_i^N}{d\hat{\alpha}_i} = \frac{\lambda^2}{[1 + \hat{\alpha}_i]^2 [2\lambda - 1]} > 0, \quad (8)$$

$$\frac{dm_{-i}^N}{d\hat{\alpha}_i} = -\frac{\lambda[1 - \lambda]}{[1 + \hat{\alpha}_i]^2 [2\lambda - 1]} < 0. \quad (9)$$

The effect of the own representative is intuitively clear: the more inclined the representative towards immigration is, the more refugees she admits. The negative effect of the other country's representative stems from the own effect and the strategic substitutability that we established above. In a symmetric equilibrium with both representatives having the same preference, Eq. 7 simplifies to

$$m_i^N(\hat{\alpha}) = \frac{1 + \hat{\alpha}_i - \lambda}{1 + \hat{\alpha}_i} \quad \text{for} \quad \hat{\alpha}_i = \hat{\alpha}_{-i}. \quad (10)$$

We are now ready to analyze the first stage of the game, taking into account what we already know about the second stage. The citizens in each country elect their representative so as to maximize their utility imputation  $U_i(\alpha_i, m^N(\hat{\alpha}))$ , where  $m^N(\hat{\alpha}_i)$  is given by Eq. 7 above. The corresponding first order condition takes the form:

$$[1 + \alpha_i] \left[ \frac{dm_i^N}{d\hat{\alpha}_i} + \frac{dm_{-i}^N}{d\hat{\alpha}_i} \right] - \frac{\lambda dm_i^N / d\hat{\alpha}_i + [1 - \lambda] dm_{-i}^N / d\hat{\alpha}_i}{1 - \lambda m_i(\hat{\alpha}) - [1 - \lambda] m_{-i}(\hat{\alpha})} = 0. \quad (11)$$

Inserting for  $dm_i^N / d\hat{\alpha}_i$ ,  $dm_{-i}^N / d\hat{\alpha}_i$ ,  $m_i(\hat{\alpha})$ , and  $m_{-i}(\hat{\alpha})$  from above, and focusing on a symmetric solution (i.e.,  $\hat{\alpha}_i = \hat{\alpha}_{-i}$ ), we can rewrite Eq. 11 as follows:

$$\frac{\alpha_i - \hat{\alpha}_i}{1 + \hat{\alpha}_i} = \frac{1 - \lambda}{\lambda}. \quad (12)$$

As the right hand side is positive, because  $\lambda < 1$ , we see that each voter prefers a representative with a lower preference for immigration than she has herself, i.e.,  $\hat{\alpha}_i < \alpha_i$ . This holds a fortiori for the median voter who determines the election outcome. The median voter with  $\alpha_i = \bar{\alpha}$  strategically delegates to a representative with  $\hat{\alpha}_i < \bar{\alpha}$ . In other words, the elected representatives in equilibrium have a lower preference for immigration  $\hat{\alpha}_i^N$  than the respective median. We have, therefore, established the following result:

<sup>12</sup> Recall that we assume  $1/2 < \lambda < 1$ .

**Proposition 1** Strategic delegation worsens the problem of noncooperative decision-making:

$$m_i^N(\hat{\alpha}^N) < m_i^N(\bar{\alpha}) < m_i^U(\bar{\alpha}). \quad (13)$$

As it turns out, the number of refugees accepted in the noncooperative equilibrium is suboptimally low for two reasons: first, because the net positive spill-overs are not internalized; second, because the median voter strategically delegates to someone with a lower preference for immigration.<sup>13</sup>

## 5 Policy coordination

We now turn our attention to the case where the two countries cooperate. Again, we envisage a two-stage political process, similar to the one in the previous section, only that now the two representatives cooperatively choose the migration vector into either country in the second stage. This approach is intended to provide a stylized model of the Common European Asylum System. We distinguish further between the case in which transfers between countries are not permitted and the case in which cost sharing is instead allowed. We begin by discussing the former case, while the analysis of the latter is conducted in the second subsection.

### 5.1 Without cost sharing

Consider the case in which the two representatives cooperatively decide on the migration levels and the cost of the policy is borne by each country without the possibility of side payments. We model coordination by assuming that in the second stage the two representatives engage in a Nash-bargaining game. They seek to maximize the Nash product  $N = s_1 \cdot s_2$ , where the surplus from bargaining  $s_i$  is given by  $s_i = [1 + \hat{\alpha}_i][m_i + m_{-i}] + \ln(1 - \lambda m_i - [1 - \lambda]m_{-i}) - U_i(\hat{\alpha}_i, m^N(\hat{\alpha}^N))$  and where  $U_i(\hat{\alpha}_i, m^N(\hat{\alpha}^N))$ , in turn, denotes the outside utility of representative  $i$  if no agreement is reached. In other words, if this happens, we assume that the noncooperative migration levels of the previous section are implemented.<sup>14</sup>

<sup>13</sup> Note that in the absence of cost spill-overs ( $\lambda = 1$ ) strategic delegation would disappear in the noncooperative game. This is not true in the coordination case because their strategic delegation is undertaken for different reasons, as will become clear in the next section.

<sup>14</sup> The outside utility, thus, takes the form  $U_i(\hat{\alpha}_i, m^N) = 2[1 + \hat{\alpha}_i]m_i^N(\hat{\alpha}^N) + \ln(1 - m_i^N(\hat{\alpha}^N))$ , where  $m_i^N(\hat{\alpha}^N)$  is determined by the equilibrium without coordination derived in the previous section. Note that this implies that the representatives who bargain are not necessarily the same as those who set the immigration level noncooperatively. We make this assumption to keep the model tractable.

The maximization of the Nash product yields the following first-order conditions:

$$\left\{ 1 + \hat{\alpha}_i - \frac{\lambda}{1 - \lambda m_i - [1 - \lambda]m_{-i}} \right\} s_{-i} + \left\{ 1 + \hat{\alpha}_{-i} - \frac{1 - \lambda}{1 - \lambda m_{-i} - [1 - \lambda]m_i} \right\} s_i = 0. \quad (14)$$

These first-order conditions implicitly determine the immigration levels in the bargaining equilibrium without side payments,  $m_i^B(\hat{\alpha})$  and  $m_{-i}^B(\hat{\alpha})$ , as functions of the identity of the two representatives. Focusing again on a symmetric equilibrium where both representatives have the same preference for immigration, we obtain from Eq. 14 that  $m_1^B = m_2^B$  and in particular:

$$m_i^B(\hat{\alpha}) = \frac{1 + 2\hat{\alpha}_i}{2 + 2\hat{\alpha}_i} \quad \text{for} \quad \hat{\alpha}_i = \hat{\alpha}_{-i}. \quad (15)$$

Note that this solution resembles the utilitarian optimum of Section 3. However,  $\hat{\alpha}_i$  may well differ from the preference parameter  $\bar{\alpha}$  of the average citizen. To derive the equilibrium  $\hat{\alpha}_i$ , we now turn to the election stage of the model. As in the previous section, each voter in country  $i$  chooses  $\hat{\alpha}_i$  to maximize  $U_i(\alpha_i, m^B(\hat{\alpha}))$ , with  $m_i^B(\hat{\alpha})$  and  $m_{-i}^B(\hat{\alpha})$  determined implicitly by Eq. 14 above. The first-order condition of the voter's maximization problem takes the form:

$$[1 + \alpha_i] \left[ \frac{dm_i^B}{d\hat{\alpha}_i} + \frac{dm_{-i}^B}{d\hat{\alpha}_i} \right] - \frac{\lambda dm_i^B/d\hat{\alpha}_i + [1 - \lambda] dm_{-i}^B/d\hat{\alpha}_i}{1 - \lambda m_i^B(\hat{\alpha}) - [1 - \lambda] m_{-i}^B(\hat{\alpha})} = 0. \quad (16)$$

With symmetry ( $\hat{\alpha}_i = \hat{\alpha}_{-i}$ ), the marginal influence of  $\hat{\alpha}_i$  on  $m_i^B$  and  $m_{-i}^B$  can be written as (see the [Appendix](#) for a derivation):

$$\frac{dm_i^B}{d\hat{\alpha}_i} = \frac{[1 + s_i][2\lambda - 1] + 2[1 + \hat{\alpha}_i][m_i^B(\hat{\alpha}) - m_i^N(\hat{\alpha}^N)]}{4[2\lambda - 1][1 + \hat{\alpha}_i]^2[1 + s_i]}, \quad (17)$$

$$\frac{dm_{-i}^B}{d\hat{\alpha}_i} = \frac{[1 + s_i][2\lambda - 1] - 2[1 + \hat{\alpha}_i][m_i^B(\hat{\alpha}) - m_i^N(\hat{\alpha}^N)]}{4[2\lambda - 1][1 + \hat{\alpha}_i]^2[1 + s_i]}. \quad (18)$$

In equilibrium, the median voter determines the election outcome. Setting  $\hat{\alpha}_i = \bar{\alpha}$  and inserting the above expressions for  $dm_i^B/d\hat{\alpha}_i$  and  $dm_{-i}^B/d\hat{\alpha}_i$  and Eq. 15 for  $m_i^B(\hat{\alpha})$  and  $m_{-i}^B(\hat{\alpha})$  into Eq. 16, we obtain:

$$\frac{\bar{\alpha} - \hat{\alpha}_i^B}{(1 + \hat{\alpha}_i^B)^2} = \frac{2[m_i^B(\hat{\alpha}^B) - m_i^N(\hat{\alpha}^N)]}{1 + s_i}. \quad (19)$$

As  $m_i^N(\bar{\alpha})$  is less than  $m_i^U(\bar{\alpha})$  due to the presence of the externality which is not internalized in the noncooperative outcome and because  $m_i^B(\bar{\alpha}) = m_i^U(\bar{\alpha})$ , we know that  $m_i^B(\bar{\alpha}) > m_i^N(\bar{\alpha})$ .<sup>15</sup> Equation 19 then can only be satisfied if  $\hat{\alpha}_i^B < \bar{\alpha}$  and  $m_i^B(\hat{\alpha}^B) > m_i^N(\hat{\alpha}^N)$ . The political outcome under cooperation, thus, entails strategic delegation as before since the median voter chooses a representative with  $\hat{\alpha}_i^B < \bar{\alpha}$ . We can, therefore, conclude that:

**Proposition 2** The number of refugees admitted under cooperation without transfer payments is higher than without cooperation at all, but is still inefficiently low, i.e.,

$$m_i^N(\hat{\alpha}^N) < m_i^B(\hat{\alpha}^B) < m_i^U(\bar{\alpha}). \quad (20)$$

The last result tells us that the strategic delegation effect alone is not sufficient to reduce the equilibrium immigration levels to a level which is as inefficiently low as the one prevailing in the noncooperative outcome. The reason is that while in both cases we do have strategic delegation, the positive net spill-overs are ignored under the noncooperative regime, but are internalized if cooperation is possible. From a policy perspective, the implication is that the push towards increased coordination in the determination of asylum policy is desirable, even if we take into account the democratic process through which the policy itself is determined.

In the following subsection, we analyze the extent to which coordination is desirable, i.e., whether a further deepening of policy coordination is going to lead to further welfare gains.

## 5.2 With cost sharing

We now extend the analysis by allowing countries to share the cost of the migration policies. That is, we no longer assume that each country pays the costs of its own refugees. Instead, the representatives bargain not only over immigration levels but also over how to share the cost. In particular, we allow for a side-payment  $Z$  that country 2 pays to country 1, or vice versa if  $Z$  is negative. As in the previous subsection, we assume that the two representatives engage in Nash bargaining. The Nash product now takes the form  $N = (s_1 + Z)(s_2 - Z)$ . To maximize this Nash product with side payments, we proceed in two steps: first, we derive the immigration levels  $m_i^S$  and  $m_{-i}^S$  that maximize the aggregate bargaining surplus  $s_1 + s_2$ ; second, we determine the transfer  $Z^S = [s_2 - s_1]/2$ , which divides the bargaining surplus equally between the two countries.

The first order conditions for  $m_i^S$  and  $m_{-i}^S$  take the following form:

$$2 + \hat{\alpha}_i + \hat{\alpha}_{-i} - \frac{\lambda}{1 - \lambda m_i - [1 - \lambda]m_{-i}} - \frac{1 - \lambda}{1 - \lambda m_{-i} - [1 - \lambda]m_i} = 0. \quad (21)$$

<sup>15</sup>Note that this argument would hold even if  $\lambda = 1$ , and therefore, there were no strategic delegation in the non-cooperative game the of previous section.

These equations are similar to the ones we derived for the utilitarian social optimum, only that here, we still have to determine the identity of the respective representatives.

As in the utilitarian optimum, both equations in Eq. 21 taken together imply that  $m_i^S = m_{-i}^S$ . In particular, the immigration levels amount to:

$$m_i^S(\hat{\alpha}) = m_{-i}^S(\hat{\alpha}) = \frac{1 + \hat{\alpha}_i + \hat{\alpha}_{-i}}{2 + \hat{\alpha}_i + \hat{\alpha}_{-i}}. \quad (22)$$

The equilibrium side payment that distributes the surplus equally then takes the form:

$$Z^S(\hat{\alpha}, m^S(\hat{\alpha})) = [\hat{\alpha}_2 - \hat{\alpha}_1][m_i^S(\hat{\alpha}) - m_i^N(\hat{\alpha}^N)]. \quad (23)$$

We can now analyze the first stage of the game, in which elections take place. Voters seek to maximize their utility imputation

$$U_i(\alpha_i, m^S, Z^S) = 2[1 + \alpha_i]m_i^S + \ln(1 - m_i^S) \pm Z^S \quad (24)$$

where  $m_i^S = m_i^S(\hat{\alpha})$  is given by Eq. 22 and  $Z^S = Z^S(\hat{\alpha}, m^S(\hat{\alpha}))$  is given by Eq. 23. Solving for the symmetric equilibrium, the first order condition of the median voter's problem can be written as follows:

$$\frac{\bar{\alpha} - \hat{\alpha}_i^S}{(1 + \hat{\alpha}_i^S)^2} = 2[m_i^S(\hat{\alpha}^S) - m_i^N(\hat{\alpha}^N)]. \quad (25)$$

As in the previous subsection, this result implies strategic delegation. Again, we can see that the number of asylum seekers admitted by each country continues to be inefficiently low, but higher than in the noncooperative case. This implies that some form of cooperation, whether with or without transfers between countries, is desirable from the point of welfare maximization, even if the political process leading to the decision on the number of refugees to be admitted, is taken into account explicitly.

The question left to answer is how the outcome with side payments compares to the case in which countries are not allowed to carry out side payments. Inserting  $m_i = [1 + 2\hat{\alpha}_i]/[2 + 2\hat{\alpha}_i]$  into Eqs. 19 and 25 and rearranging yields:

$$\frac{\bar{\alpha} - \hat{\alpha}_i^B}{[1 + \hat{\alpha}_i^B]\{1 + 2\hat{\alpha}_i^B - 2[1 + \hat{\alpha}_i^B]m^N(\hat{\alpha}^N)\}} = \frac{1}{1 + s_i}, \quad (26)$$

$$\frac{\bar{\alpha} - \hat{\alpha}_i^S}{[1 + \hat{\alpha}_i^S]\{1 + 2\hat{\alpha}_i^S - 2[1 + \hat{\alpha}_i^S]m^N(\hat{\alpha}^N)\}} = 1. \quad (27)$$

It is easy to show that the left-hand side of both equations decreases in  $\hat{\alpha}_i$ . As  $s_i$  is positive, this implies that  $\hat{\alpha}_i^B > \hat{\alpha}_i^S$ . In other words, strategic delegation with side payments is more pronounced than in the case without side payments. The reason is that strategic delegation is now aimed at a more efficient transfer mechanism—side

payments—instead of misusing the migration decision as a transfer mechanism and thereby, incurring efficiency losses as in the previous subsection.<sup>16</sup> We can summarize our results as follows:

**Proposition 3** Coordination in the determination of policy towards refugees is desirable, but coordination with side payments between countries turns out to be less efficient than coordination without side payments, i.e.,

$$m_i^N(\hat{\alpha}^N) < m_i^S(\hat{\alpha}^S) < m_i^B(\hat{\alpha}^B) < m_i^U(\bar{\alpha}). \quad (28)$$

In other words, either form of coordination is better than the noncooperative outcome because coordination leads to the internalization of the cross-country spill-overs. Comparing different degrees of coordination, we see that less is more: the outcome without side payments is more efficient than the result with cost sharing because the strategic delegation effect is not as severe.<sup>17</sup> It is still present, however, so that even coordination without side payments does not achieve the first best outcome.

## 6 Asymmetric countries

So far, we have considered the case of two symmetric countries. In reality, countries are heterogenous and it is natural to ask to what extent the main results of our analysis carry over even if we allow for differences between countries. Out of the many possible forms of heterogeneity, we focus on different average attitudes towards asylum seekers. Without loss of generality, we assume that  $\bar{\alpha}_2 > \bar{\alpha}_1$ . To simplify matters and maintain tractability, we limit the analysis to the case where only the positive spill-overs of the warm glow apply ( $\lambda = 1$ ). Individual utility then takes the following form:

$$U_i(\alpha_i, m) = [1 + \alpha_i][m_i + m_{-i}] + \ln(1 - m_i). \quad (29)$$

The utilitarian optimum now involves the following immigration levels:

$$m_1^U(\bar{\alpha}) = m_2^U(\bar{\alpha}) = \frac{1 + \bar{\alpha}_1 + \bar{\alpha}_2}{2 + \bar{\alpha}_1 + \bar{\alpha}_2}. \quad (30)$$

Note that the optimum implies the same number of asylum seekers in both countries, even though preferences differ, because this allocation equalizes marginal costs.

<sup>16</sup> This result is reminiscent of Wilson (1990) who shows that the availability of a more efficient policy instrument can lead to a less efficient equilibrium because the efficient instrument is used more extensively.

<sup>17</sup> One may wonder why the two countries would consider side payments at all, as these turn out to lead to a welfare inferior outcome. We are implicitly assuming that politicians cannot commit to not use such payments. This assumption is supported by the fact that the use of side payments is a prominent feature of the current political debate.

Consider next the noncooperative case without policy coordination. Proceeding by backward induction, as before, we can derive the following immigration levels that are chosen by the respective elected representative:

$$m_i^N(\hat{\alpha}_i) = \frac{\hat{\alpha}_i}{1 + \hat{\alpha}_i}. \quad (31)$$

In the election stage, the median voter chooses to represent the country herself ( $\hat{\alpha}_i = \bar{\alpha}_i$ ) implying that in this context, we do not see any strategic delegation.<sup>18</sup> We have, therefore, established the following series of inequalities:

$$m_1^N(\bar{\alpha}_1) < m_2^N(\bar{\alpha}_2) < m_i^U(\bar{\alpha}). \quad (32)$$

In other words, the migration level in the less welcoming country is lower than in the more supportive country. Furthermore, both levels fall short of the utilitarian optimum. This implies an additional source of inefficiency, as the marginal costs are no longer equalized.

### 6.1 Policy coordination without cost sharing

We now turn to the case of policy coordination, but exclude for the time being the possibility of cross-country transfers. As in Section 5.1, the two parties—by way of Nash bargaining—seek to maximize  $N = s_1 \cdot s_2$ , where the surplus from coordination now takes the form:

$$s_i = [1 + \hat{\alpha}_i][m_1 + m_2] + \ln(1 - m_i) - U_i(\hat{\alpha}_i, m^N(\hat{\alpha}^N)). \quad (33)$$

The corresponding first order conditions are:

$$\left[1 + \hat{\alpha}_i - \frac{1}{1 - m_i}\right]s_{-i} + [1 + \hat{\alpha}_{-i}]s_i = 0. \quad (34)$$

From these first order conditions, we can derive (see the [Appendix](#) for the calculations) the effect of a marginal change in the identity of the representative ( $\hat{\alpha}_i$ ) on the policies ( $m_i^B$ ) decided in the second stage:

$$\frac{dm_i^B}{d\hat{\alpha}_i} = \frac{s_{-i}^2(2 + s_{-i} - 2s_i[1 - m_i^B][1 + \hat{\alpha}_{-i}]/s_{-i} + [1 + \hat{\alpha}_{-i}]\Delta m^B)}{s_i[1 - m_i^B]^2 |H|}, \quad (35)$$

$$\frac{dm_{-i}^B}{d\hat{\alpha}_i} = \frac{s_{-i}^2(2 + s_i - 2[1 - m_i^B][1 + \hat{\alpha}_i] - [1 + \hat{\alpha}_i]\Delta m^B)}{s_i[1 - m_i^B]^2 |H|}. \quad (36)$$

<sup>18</sup> This is due to our simplifying assumption of  $\lambda = 1$ , not to the asymmetry.

where  $\Delta m^B = (m_1^B - m_1^N) + (m_2^B - m_2^N)$  and the determinant  $|H| > 0$ . Turning to the election stage, the first-order condition of the median voter in country  $i$  takes the following form:

$$[1 + \bar{\alpha}_i] \left[ \frac{dm_i^B}{d\hat{\alpha}_i} + \frac{dm_{-i}^B}{d\hat{\alpha}_i} \right] = \frac{dm_i^B/d\hat{\alpha}_i}{1 - m_i^B}. \quad (37)$$

Inserting from Eqs. 35 and 36 yields

$$\begin{aligned} & [\bar{\alpha}_i - \hat{\alpha}_i^B][2 + s_i + s_{-i}] \\ &= [\hat{\alpha}_{-i}^B - \hat{\alpha}_i^B](s_i - [1 + \bar{\alpha}_i]\Delta m^B) + \frac{[1 + \hat{\alpha}_{-i}^B]\Delta m^B}{1 - m_i^B}. \end{aligned} \quad (38)$$

It follows from the above equations, that  $\hat{\alpha}_1^B \neq \hat{\alpha}_2^B$ . To see this, suppose they were the same. Then the right-hand side of the two equations would be identical, but not the left-hand side, which is a contradiction. Under standard stability assumptions, it can further be shown that  $\hat{\alpha}_2 > \hat{\alpha}_1$ , which is intuitively plausible. It follows that  $m_1^B(\hat{\alpha}^B) \neq m_2^B(\hat{\alpha}^B)$ . Note the significance of this result, as it implies that analogously to the noncooperative case, the allocation of asylum seekers is asymmetric and hence, inefficient because marginal costs differ.

In addition, it follows from Eq. 38 that if  $\hat{\alpha}_i^B$  and  $\hat{\alpha}_{-i}^B$  are sufficiently close together (i.e.,  $|\hat{\alpha}_i - \hat{\alpha}_{-i}|$  is sufficiently small), we again have strategic delegation, that is, a representative with a lower preference for immigration than the median. This result of our symmetric model, thus, carries over to the asymmetric case—as long as the countries are not too different.

## 6.2 Policy coordination with cost sharing

Finally, we consider the situation where side payments are possible. Solving backwards, the solution of the second stage has to maximize  $\sum_j s_j$ . This leads to the following policies:

$$m_i^S(\hat{\alpha}) = \frac{1 + \hat{\alpha}_1 + \hat{\alpha}_2}{2 + \hat{\alpha}_1 + \hat{\alpha}_2}. \quad (39)$$

From this, it follows that  $m_1^S(\hat{\alpha}) = m_2^S(\hat{\alpha})$ , i.e., marginal costs are equalized which means that transfers are effective in eliminating the inefficiency pointed out above. We thus, see that in the asymmetric case, the possibility of side payments also has a beneficial, efficiency-enhancing role that mitigates its adverse effect on strategic delegation. The actual monetary transfer paid by country 2 to country 1 amounts to:

$$Z^S(\hat{\alpha}, m^S(\hat{\alpha})) = \frac{[\hat{\alpha}_2 - \hat{\alpha}_1]\Delta m^S + \ln(1 - m_1^N) - \ln(1 - m_2^N)}{2}, \quad (40)$$

where  $\Delta m^S = (m_1^S - m_1^N) + (m_2^S - m_2^N)$ . Note that the transfer increases in the difference between the two representatives' preferences for immigration.



Following the same procedure as before, we can derive the following equilibrium condition for the election stage of the model:

$$\frac{2[\bar{\alpha}_i - \hat{\alpha}_i^S]}{[2 + \hat{\alpha}_1^S + \hat{\alpha}_2^S]^2} = \frac{\Delta m^S}{2}. \quad (41)$$

This condition is equivalent to the corresponding condition in the symmetric case. We see from Eq. 41 that, measured by the difference between  $\bar{\alpha}_i$  and  $\hat{\alpha}_i$ , the degree of strategic delegation is the same for both countries. Clearly then, the representative of country 2 has a higher preference for immigration than his counterpart in country 1. Furthermore, we see from Eq. 40 that the side payment is positive, i.e., country 2 pays country 1 to accept more asylum seekers.

## 7 Conclusion

While opinion polls show that EU citizens prefer their countries to retain national immigration policies, many political observers have argued in favor of policy coordination, especially where asylum seekers are concerned. On the one hand, the ever increasing restrictiveness of national EU policies has prompted authors like Noll (2000) to demand that a ‘race to the bottom’ be avoided. On the other, Hatton (2004) and Hatton and Williamson (2004) advance the argument that EU citizens share an altruistic attitude towards ‘real’ refugees. As a consequence, coordination is needed to internalize interjurisdictional spill-overs. Others have gone a step further and suggested even deeper coordination in the form of monetary cost sharing to compensate those member countries that are particularly popular destinations for refugees.

In this paper, we model policy towards asylum seekers and refugees along public good lines. However, whereas previous work has focused on welfare maximizing arguments, we move beyond the perspective of a benevolent social planner and focus on the democratic process that determines policy. Comparing the noncooperative, decentralized outcome to cases of differing degrees of coordination, interesting results emerge. On the one hand, coordination is desirable, even when we take into account the political process, as it leads to an internalization of the interjurisdictional spill-overs. On the other, when comparing different degrees of coordination, we show that cost sharing in the form of monetary transfers across countries can make matters worse. In fact, while coordination with transfers is still better than the noncooperative outcome, it is dominated in the symmetric setup by the lesser form of coordination without such side payments. The availability of side payments exacerbates the strategic delegation effect and leads countries to accept an inefficiently low number of refugees. This result suggests that caution is in order when considering the coordination of policies towards asylum seekers and refugees. While some degree of cooperation is desirable, excessive coordination that involves cost sharing can be less efficient. Even though our model is tailored to fit the case of involuntarily displaced individuals, the argument is clearly applicable to more general settings. As long as workplace regulations are imperfectly enforced and immigrants in the EU common market give rise to cross-

country spill-overs, a similar argument can be made against ‘excessive’ coordination of migration policy.

To the best of our knowledge, the current paper is the first to rigorously model the political determination of asylum policies. As such, it employs a number of simplifying assumptions that could be relaxed. By introducing asymmetric preferences towards asylum seekers, we take a first step in this direction. Allowing for additional asymmetries could be important in assessing the more general effects of policy coordination. Similarly, explicitly modelling more than two countries would allow us to achieve a better understanding of the dynamics aspects of the formation of coalitions in the bargaining game. While these are clearly very interesting questions, we leave them for further research.

**Acknowledgements** We are grateful to Gil Epstein who provided the impetus for this research, to two anonymous referees for insightful comments and to conference participants at the Midwest International Economics Spring 2005 meeting for helpful discussions. The usual caveat applies: all errors are ours.

## Appendix

### 1.1 Symmetric case

This appendix derives  $dm_i^B/d\hat{\alpha}_i$  and  $dm_{-i}^B/d\hat{\alpha}_i$  for the bargaining equilibrium without side payments. The first-order condition for  $m_i^B$  as given by Eq. 14 is  $N_{m_i} = 0$ . The first-order condition for  $m_{-i}^B$  is  $N_{m_{-i}} = 0$ . By totally differentiating these equations, we obtain

$$\frac{dm_i^B}{d\hat{\alpha}_i} = \frac{-N_{m_i\hat{\alpha}_i}N_{m_{-i}m_{-i}} + N_{m_{-i}\hat{\alpha}_i}N_{m_im_{-i}}}{N_{m_im_i}N_{m_{-i}m_{-i}} - N_{m_im_{-i}}N_{m_{-i}m_i}}, \quad (42)$$

$$\frac{dm_{-i}^B}{d\hat{\alpha}_i} = \frac{-N_{m_{-i}\hat{\alpha}_i}N_{m_im_i} + N_{m_i\hat{\alpha}_i}N_{m_{-i}m_i}}{N_{m_im_i}N_{m_{-i}m_{-i}} - N_{m_im_{-i}}N_{m_{-i}m_i}}. \quad (43)$$

Departing from the symmetric equilibrium ( $\hat{\alpha}_i = \hat{\alpha}_{-i}$  and  $s_i = s_{-i}$ ), the respective terms in Eqs. 42 and 43 can be derived as

$$N_{m_im_i} = -2[1 + \hat{\alpha}_i]^2 \left\{ 2s_i[1 - 2\lambda + 2\lambda^2] + [1 - 2\lambda]^2 \right\} = N_{m_{-i}m_{-i}}, \quad (44)$$

$$N_{m_im_{-i}} = -2[1 + \hat{\alpha}_i]^2 \left\{ 4s_i\lambda[1 - \lambda] - [1 - 2\lambda]^2 \right\} = N_{m_{-i}m_i}, \quad (45)$$

$$N_{m_i\hat{\alpha}_i} = s_i + 2[1 + \hat{\alpha}_i][2\lambda - 1][m_i^B(\hat{\alpha}) - m_i^N(\hat{\alpha}^N)], \quad (46)$$

$$N_{m_{-i}\hat{\alpha}_i} = s_i - 2[1 + \hat{\alpha}_i][2\lambda - 1][m_i^B(\hat{\alpha}) - m_i^N(\hat{\alpha}^N)]. \quad (47)$$

Inserting these equations into Eqs. 42 and 43 and rearranging yields

$$\frac{dm_i^B}{d\hat{\alpha}_i} = \frac{[1 + s_i][2\lambda - 1] + 2[1 + \hat{\alpha}_i][m_i^B(\hat{\alpha}) - m_i^N(\hat{\alpha}^N)]}{4[2\lambda - 1][1 + \hat{\alpha}_i]^2[1 + s_i]}, \quad (48)$$

$$\frac{dm_{-i}^B}{d\hat{\alpha}_i} = \frac{[1 + s_i][2\lambda - 1] - 2[1 + \hat{\alpha}_i][m_i^B(\hat{\alpha}) - m_i^N(\hat{\alpha}^N)]}{4[2\lambda - 1][1 + \hat{\alpha}_i]^2[1 + s_i]}. \quad (49)$$

## 1.2 Asymmetric case

As in the symmetric case, the equations determining the marginal influence of  $\hat{\alpha}_i$  on the immigration levels can be derived from the first-order conditions and are identical to Eqs. 42 and 43 above, with  $N_{m_i} = 0$  given by Eq. 34. From Eq. 34 the following equations can be derived:

$$N_{m_i m_i} = -\frac{s_{-i}}{[1 - m_i]^2} - 2[1 + \hat{\alpha}_{-i}]^2 s_i / s_{-i}, \quad (50)$$

$$N_{m_i m_{-i}} = 2[1 + \hat{\alpha}_i][1 + \hat{\alpha}_{-i}], \quad (51)$$

$$N_{m_{-i} m_{-i}} = -\frac{s_i}{[1 - m_{-i}]^2} - 2[1 + \hat{\alpha}_i]^2 s_{-i} / s_i, \quad (52)$$

$$N_{m_i \hat{\alpha}_i} = s_{-i} + [1 + \hat{\alpha}_{-i}]\Delta m^B, \quad (53)$$

$$N_{m_{-i} \hat{\alpha}_i} = s_{-i} - [1 + \hat{\alpha}_i]\Delta m^B s_{-i} / s_i. \quad (54)$$

Inserting these equations, employing Eq. 34, and rearranging yields Eqs. 35 and 36, with  $|H| \equiv N_{m_i m_i} N_{m_{-i} m_{-i}} - N_{m_i m_{-i}} N_{m_{-i} m_i} > 0$ .

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