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On the institutional design of burden sharing when financing external border enforcement in the EU

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Abstract

Illegal immigration affects not only EU member states at the Mediterranean Sea but also more Northern states due to open internal borders and onward migration. Northern member states may free-ride on border countries' enforcement efforts, leading to a sub-optimal level of border control. While neither a centralized nor a coordinated policy appears to be feasible, we show that employing an *expected externality mechanism* leads to voluntary preference revelation with respect to immigration policy under several (but not all) scenarios. This policy measure requires, however, the EU Commission to take on a very active role as moderator between member states, which at the same time must accept the Commission to play this role.

Key Words: illegal migration, immigration policy, border enforcement, interregional transfers, European Union, expected externality mechanism

JEL Codes: F22, J61, J68.

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The European Council asks the Council and the Commission to work out arrangements for cooperation between services responsible for external border control and to examine the conditions in which a ***mechanism*** *or common services to control external borders could be created.*

(From: Presidency conclusions of the European Council meeting in Laeken, 2001 (bold added).)

1 Introduction

Illegal immigration is a matter of major concern in the political and public debate in many EU member states. In particular, countries along the Mediterranean border like Italy, Spain and Malta have experienced numerous attempts of migrants and refugees to illegally enter these countries. Despite substantial efforts to keep borders closed, large inflows can be observed. The illegal immigration flows towards the Mediterranean countries may also affect other EU member states, due to the openness of internal borders in the Schengen area which enables illegal immigrants to move on to more Northern states. In fact, recent evidence from Italy shows that a reasonable share of illegal immigrants coming to this country is actually planning to head for Germany or France as their final destination (Chiuri et al., 2007).

Under these circumstances, public spending on the enforcement of external borders in Southern EU member states may be characterized as a public good. This is because each Euro spent on enforcing the borders in these countries reduces inflows to more Northern member states, even if they do not contribute to enforcement spending, i.e. EU member states at the Mediterranean Sea impose a strong positive externality on the rest of the EU. In fact, Wolff (2008) observes that countries without (relevant) external borders, such as Germany, Austria or Sweden, seem to be rather reluctant to contribute to financing border controls in the South, possibly because they cannot be excluded from the benefits from enforcement efforts in Spain, Italy or other places. Hence, they 'free-ride' on these efforts or on any contributions made by some other non-Mediterranean member state which (for whatever reason) truthfully states its willingness to pay.

From an economic perspective positive externalities or public goods typically lead to a sub-optimally low level of border enforcement because countries at the external border do not take into account the positive effects on other EU member states when deciding about enforcement spending. In the most extreme case, the equilibrium outcome of this game between member states is such that border countries may be left completely alone with the burden of enforcement. More likely, however, is a scenario in which the Northern member states contribute at a level well below the level that corresponds to their true preferences with respect to immigration policy. This problem was one of the main reasons for the European Commission to propose the concept of

integrated border management in 2002 which aims at establishing (among other things) a financial burden-sharing mechanism between all member states based on the idea of 'solidarity' (Jorry, 2007). However, few advances in this field can be observed so far. Still in 2006, for instance, the Maltese president Adami claimed in an address to the European Parliament that "Europe urgently needs an immigration policy that can deliver a response that offers Europe's trademark solidarity with [...] the countries of first arrival in Europe that are unable to deal with this problem on their own."

In order to solve the underlying public good problem, traditional economic theory suggests either to delegate political decision-making on this issue to the next higher government level or to harmonize policy. An efficient provision of a public good requires a supranational governing body to be fully informed about the benefits and costs of the individual countries (or the entire Union) and to be able to enforce the welfare-optimal policy, e.g. by levying taxes. Otherwise, as Samuelson (1954) puts it, "it is in the selfish interest of each person to give false signals, to pretend to have less interest in a given collective activity than he really has," i.e. countries have a strong incentive to free-ride (at least to some degree which does not violate the idea of solidarity too obviously) on other countries' actions. Harmonizing policy, on the other hand, appears in fact to be even more difficult as it requires unanimous decisions of all member states.

From an institutional perspective, the EU was never given the possibility to act as a powerful supranational governing body with respect to border management policy in the past as this issue was never among the exclusive competences of the EU, but had to be agreed upon (unanimously) in the EU Council. Hence, the supranational EU body did neither have full information nor coercive power.[1] At the same time, policy coordination between member states or within the EU Council is a difficult task. Even under the French EU Presidency, which pushed on the topic quite strongly, no substantial advances could be achieved. So far, joint initiatives are rare. For instance, the common EU agency Frontex was founded in 2005 to coordinate EU-wide efforts in the enforcement of the external borders but suffers from low enthusiasm of its participating members, especially in operations involving maritime patrols (European Commission, 2008). The important Nautilus initiative, for instance, which targeted illegal migration across the central Mediterranean Sea to Malta and Lampedusa faced a substantial lack of contributions from member countries (Lutterbeck, 2008). Not only the problem of under-supply of public goods shows up quite clearly in this case, but also the strategic interests of some member state to underreport their interest in the joint measure (and thus their willingness to pay). While a Northern member state may in fact be

[1]This relates to issues covered under Articles 62–64 TEC (now Articles 77–79 TFEU), i.e. 'border controls, asylum and immigration'. The border agancy Frontex is formally an exception to this rule, as it is legally designed as an "EC first pillar institution". However, the tasks undertaken are not legally defined and member states are not under legal obligation to collaborate (Carrera 2007).

harmed substantially by illegal immigration if borders were open, in order to *free-ride* on other countries' enforcement efforts it may decide to indicate a low interest in border enforcement. Since other member states can hardly estimate the negative effect of illegal immigration on a country without external border, an information problem arises.

Things will change slightly under the Lisbon Treaty (TEU, TFEU) which treats border enforcement policies as 'shared competencies' to which the 'ordinary legislative procedure' applies. Decisions will be taken by the qualified majority in the Council (55% of the EU member states representing 65% of EU's population) in 'codecision' with the European Parliament. While this rule should enhance efficiency of the decision making process, it is doubtful that this will solve the problems generated by the public good character of border enforcement. This is because the information problem is not solved through simply changing the legislative procedure. Despite the newly introduced possibility for the EU to develop its own actions and policies, the 'double majority' requirement is an important restriction. In order to achieve the necessary majority, the EU (as well as the potential beneficiaries among the member states) has to bid for support by the larger Northern member states, which allows the latter to behave strategically (e.g. by underreporting their interests). However, the right of initiative for the EU has the advantage that the EU may play a more active role in this field, thereby possibly acting as a *moderator* in designing an *enforcement mechanism*. More specifically, the EU could become active within the *'open method of coordination in immigration'* (OMC Immigration), which is a soft law framework trying to improve voluntary coordination under the moderation of the EU institutions (Caviedes, 2004).

If neither a social-planner solution at a supranational level nor a policy coordination or harmonization in the Council appears to be feasible, one has to consider alternative institutional settings that may help introducing a welfare-maximizing solution on a voluntary basis. In this framework, the EU may in fact act as a moderator (rather than active player), introducing a mechanism in which all member states truthfully state their preferences for external border enforcement. In an economist's terminology, a *mechanism* is "an institution with rules governing the procedure for making a collective choice" (Mas-Colell et al., 1995, p. 866). More specifically, although countries' preferences are not public information and thereby unobservable for any other country and the central EU authority, a mechanism sets incentives for all countries to act in a way that the burdens from external border enforcement are shared in accordance with national preferences, while implementing the socially optimal enforcement level. The aim of this article is to investigate whether a specific mechanism is able to fulfill this goal.

The economic literature on *mechanism design* has suggested a number of mechanisms for implementing the optimal level of a public good. One of the best known is the *Vickrey-Clarke-Groves mechanism* (Vickrey, 1961; Clarke, 1971; Groves, 1973), which imposes compensating (side) payments and transfers on each single actor depending on actors' announced preferences. These pay-

ments induce the actors to reveal their true preferences, irrespective of what all other agents announce. A similar, yet extended, proposal is the scheme going back to the works of Arrow (1979) and d'Aspremont and Gerard-Varet (1979) which is also known as the *expected externality mechanism*. It allows to consider asymmetrically informed actors, who form expectations about their counterparts' characteristics. Contrary to the *Vickrey-Clarke-Groves mechanism* the *expected externality mechanism* rests on a more demanding assumption that the actors have to take the others' actions into account. The concept of a Bayesian-Nash equilibrium is used, meaning that stating the true preference is optimal, whenever all opponents do so. Hence, telling the truth may not be a dominant strategy, but at least it forms a (Bayes-)Nash equilibrium.

Not only does the *expected externality mechanism* allow for easier implementation of a welfare-optimal mechanism, it also resembles the situation in the EU more closely. This is because the decision about border enforcement in the EU is likely to be one of incomplete information and of interdependent decision-making. We therefore base our following analysis on this mechanism and choose the following setting: We consider an economic union in which illegal migrants enter a member country situated at the external border. Fellow member countries, located distant from the external border, are only affected by *onward migration*, i.e. illegal immigrants moving on from the Southern border country to a more Northern interior country. The problem of incomplete information relates to the assumption that countries have different preferences on illegal immigration and governments can only form an expectation about the true preferences in the fellow member states. Member states' preferences on illegal migration are shaped by its negative impacts on economy and society, but also possible gains from employing illegal immigrants in a shadow sector of the economy or from extracting some sales tax revenues etc.

Our results are somewhat encouraging with respect to possbile outcomes of introducing a mechanism, but nevertheless suffer from a substantial drawback. Acknowledging that our model is a strong simplification of the real-world situation, we can show that the *expected externality mechanism* leads to an efficient level of enforcement at the EU's external borders, solves the information problem of the central authority, i.e. the EU Commission, and also balances the budget by use of side payments. In this sense, we are able to explain and justify the EU's role as a moderator (rather than being an active legislator) in a policy field of truely European dimension, given that the EU accepts and adopts this role (whether it does, is certainly an open debate from today's perspective). On the other hand, the mechanism does not guarantee voluntary participation of all involved countries. In fact, by applying a simple numerical example we show that the participation constraint is fulfilled only in some cases, mainly when the border country is relatively small and rates of onward migration are relatively high. Interestingly, it is the border country – which at the outset suffered most from uncoordinated behaviour – which may prefer to stay outside the voluntary agreement described by the mechanism in the remaining cases. The reason for this finding

is that – for a given burden sharing rule – the effect of illegal immigration must be sufficiently negative to interior states to induce sufficiently large transfer payments to the border countries.[2]

The main lesson from our exercise may be summarized as follows: Voluntary policy coordination between EU member states on issues involving a public-good problem is difficult to achieve. The EU acting as a moderator imposing an efficiency-enhancing preference revelation mechanism may appear as a promising alternative to attempts of policy coordination under unanimity rule or the ordinary legislative procedure. However, our proposed solution fails to guarantee voluntary participation of all member states under some specifications. The problem of voluntary participation in the mechanism also highlights the impossibility of introducing a social-planner solution, which in theory leads to an optimal outcome. Shifting the entire responsibility for European border enforcement to the EU level will not be supported by all EU member states, but requires unanimous agreement between all members. In sum, even from a theoretical perspective (and more so, from a practical point of view) there does not appear to be a simple solution for improving policy outcomes in this field. Mechanism design may nevertheless be a promising way of approaching this topic.

The rest of the paper is organized as follows. In Section 2 we introduce a simple model of a federation, which is prone to illegal immigration. We derive the welfare maximizing level of enforcement efforts in Section 3, and demonstrate that a decentrally chosen level diverges from the social optimum in Section 4. In Section 5, we introduce the expected externality mechanism and describe how it can be applied in the field of border management. Additionally, we give a numerical example of the mechanism to clarify its incentive structure in Section 6. Here we consider two different scenarios, which differ in the characteristic of the border country. The last section discusses the results and gives some policy implications. Note that we abstain from presenting technical details in the main parts of the paper; the appendix contains a full technical specification of the model.

2 A simple model of a federation with illegal immigration

In this section, we introduce a basic model of a federation – such as the European Union – which is prone to illegal immigration. In order to keep the formal apparatus manageable, we restrict the model to include three member countries only. One of these countries, called the *border country*, is located at the fringe of the federation. In terms of today's situation in the EU, we may think of Mediterranean countries such as Spain, Italy, Malta or Greece, which are well-known to be targets of substantial illegal immigration. The two other countries, called *interior countries*, have no (relevant) external border with the rest of the world; consider, e.g., Germany or Austria. Border

[2]Note that the term 'transfer' refers to net payments through some fund which is the typical procedure to redistribute resources between member states of the EU.

country and interior countries are located next to each other and separated only by a legal border which is not enforced, reflecting the situation in the Schengen area. Passing this borderline presents no relevant obstacle to the movement of people including illegal immigrants.[3] Because the federation as a whole has a relatively high wage level and living standard compared to the rest of the world, we expect a steady inflow of illegal immigrants into the federation.

Furthermore, we assume that – as in today's EU – there is no common and comprehensive immigration policy in the federation at the outset. Each member state chooses restricting immigration according to national cost-benefit considerations and preferences for immigration, thereby ignoring the effects of national immigration policy on other member states. As we assume that there are always attempts to illegally enter the country, there is a high migration pressure which exceeds the maximum legal limit set by any national legislation. In order to keep our analysis as simple as possible, we further assume that illegal immigrants have first to arrive in the border country before they can eventually move on to an interior country. We call the latter behaviour *onward migration*. Any effort to curb illegal immigration must therefore be conducted by the border country, possibly supported by other member states through monetary transfers.

The number of illegal immigrants, M, in the federation depends positively on the exogenously given migration pressure on the federation ($\overline{M}$) and negatively on the total effort in border enforcement along the external border (E), such that enforcement reduces the illegal inflow. Those illegal immigrants slipping through the border controls may move onward to the interior countries. This behavior results in illegal immigrants spreading over all countries. Obviously, the number of illegal immigrants in the border country (M_1) is the difference between all illegal immigrants that arrived in the federation (M) and those that moved on to the interior countries ($M_2 = \alpha M$, $M_3 = \beta M$)) for given rates of onward migration (α, β).

The well-being of the citizens in a single country i is represented by a quasi-linear utility function.[4] This type of utility function has some nice properties simplifying our analysis; in particular, it increases the number of implementable mechanisms (Maskin and Sjöström, 2001) and thus offers a broader range of welfare-optimal allocations which may be applied to our federal framework. The aggregate utility in country i, U_i, is described by the following function:

$$U_i = y_i - H_i - c_i + m_i + x_i,$$

where y_i is output, H_i is a valuation function reflecting the costs of illegal immigration, c_i is the

[3] In an alternative setting, Krieger and Minter (2007) and Mayr et al. (2009) investigate a scenario in which illegal immigrants, after entering the country and because of fear of detection, wait until they are legalized before they move to another member state.

[4] This type of utility function implies that a country's willingness to pay for the public good is unaffected by its social product or total tax revenues net of the contribution to financing the public good. This appears to be a reasonable assumption in this context as necessary enforcement spending is probably negligible relative to GDP.

cost share of financing border enforcement, m_i is the initial endowment of money and x_i is a side payment paid to (or received from) some other country.

Positive utility is derived from private consumption which is paid out of social product y_i. Here, we assume a simple production process generating y_i which is the same in each country and uses legal (L) and illegal labor (M) as factors of production ($y_i = F(L_i, M_i)$). Illegal immigrants concentrate in the underground economy, which is nevertheless complementary to the regular labor market. Countries differ in their endowment of legal labor.

Illegal immigration results in a (net) disutility, denoted by a (negative) valuation function H_i. This function summarizes all benefits and costs of illegal immigration to society which go beyond the mere production process. Negative effects may arise, for instance, from the impact of illegal immigration on the social stability in the country. Illegal immigrants are often perceived as having a higher probability of getting involved in crimes as victims or as fellons compared to natives and legal migrants (Epstein and Weiss, 2001). There may also be a problematic influence on the moral standards in a country. A high number of illegal immigrants tends to increase the shadow economy and may thus lower moral barriers for other people to get involved in clandestine activity.[5] On the other hand, positive effects of illegal immigration are documented as well, for example, when it comes to social cohesion. In many countries, home care can only be sustained with support of illegal immigrants who are clandestinely employed to look for elderly and sick people (Welt, 2009). This positive effect goes beyond the mere influence on the production of the consumption good via releasing natives from their caring duties. Furthermore, at least in countries granting citizenship based on *ius soli* the immigrants' children become legal citizens and will eventually contribute to the social systems.[6] This names just a few of several – positive as well as negative – effects from illegal immigration which may be relevant.

When modelling the *expected externality mechanism* the valuation function plays an important role because countries may have different preferences over illegal immigration. For instance, the negative effect through the valuation function may be especially pronounced if the positive effect through home care is low or the shadow economy is considered as particularly problematic. While a country's government can – by and large – assess its citizens' preferences, these preferences are hardly observable for the fellow member countries. It is therefore a reasonable assumption to account for the possibility of incomplete information among member states. In addition, we make the simplifying assumption that incomplete information matters mainly for interior countries, but not the border country. This is justified by the fact that border countries often have a long tradition

[5] Particularly relevant for the european countries appears to be the influence on the welfare state. Algan and Cahuc (2006) named the public spiritedness of citizens as an important feature of the efficiency of welfare instruments. This public spiritedness might be negatively influenced by illegal immigration.

[6] Sinn (2001) shows that a child generates a positive externality of €90.000 to the German society.

of dealing with illegal immigration, such that information can be deduced from the country's past behavior. In order to keep our approach technically tractable, we also assume that there are only two 'preference' levels that the two interior countries may take on, namely that countries have a high or low valuation of the negative (net) effect of illegal immigration. Both interior countries have the possibility to misreport their true preferences, which is not an option for the border country.

Finally, the direct costs of enforcement, c_i, depend on the total effort devoted to controlling the border. These costs include wages for border guards and expenditures on building and maintaining the infrastructure. The endowment m_i is needed to provide necessary resources in the economy. Side payments x_i will be discussed only later in Section 5 when the *expected externality mechanism* is introduced; until then side payments do not play a role.

3 Socially optimal border enforcement

In the previous sections, we identified positive externalities (on which the public good problem rest) between member states of the federation to be the reason for the inefficient level of external border enforcement. Obviously, these spillover effects are fully internalized when assuming a perfectly informed and benevolent central government, e.g. a powerful EU governing body, taking decisions for (and gathering information from) the entire federation. All cost and benefit considerations are taken into account in the central government's decision; strategic misreporting by single member states is excluded under these circumstances. Hence, we are able to characterize the optimal policy on border enforcement by treating the federation as one large country (with three sub-central units and a well-informed central government). Defining the welfare of the federation as the sum of the utilities of the three single countries, i.e. $U = U_1 + U_2 + U_3$, we can derive the welfare maximizing level of enforcement. In the course of our analysis, this optimal level will serve as a benchmark scenario to which all other outcomes have to be compared.

In the appendix, we present the full optimization problem of a central government. In the following proposition, we restrict ourselves to a non-technical characterization of the optimality conditions.

Proposition 1 *A fully informed benevolent central government achieves a welfare optimal level of enforcement by balancing the marginal costs and marginal benefits of enforcement in its entire territory, consisting of all three member states of the federation.*

Border enforcement tends to reduce the number of illegal immigrants which generates both positive and negative effects to the federation. The positive effect is the reduction of the negative impact of immigrants indicated by the valuation function.[7] The marginal costs of border enforcement are

[7]Here, we implicitly assume an interior solution of the optimization problem.

twofold. On the hand, enforcement reduces the supply of the production factor 'illegal labor' and has therefore a negative impact on the production side. On the other hand, there is an increase of the direct costs of enforcement through additional border guards and facilities etc. Note also that the marginal benefit of enforcement is decreasing with the total effort on enforcement. A benevolent central government chooses the level of enforcement up to that point where marginal benefits equal the marginal costs, i.e. when an additional Euro spent on enforcement generates a benefit (in monetary terms) of equal size.

4 The outcomes of decentralized decision-making

In this section we analyze the decision over enforcement when there does not exist a central government and all decision-making takes place at the national level. A priori no coordination between member states of the federation is assumed. This scenario resembles the situation within the EU before either negotiating a possible policy coordination or introducing some preference revelation mechanism. We expect an under-supply problem to arise because when deciding on the level of external border enforcement, the border country (which in our framework is the only country to directly decide on enforcement spending) does not take into account the negative effects of onward migration of illegal immigrants for the interior countries. Since spending on border enforcement reduces illegal immigration and thus onward migration, it generates a positive externality. We summarize and evaluate this idea in the following proposition. Again, we provide a non-technical specification and relegate the formal derivation to the appendix.

Proposition 2 *Assuming that all countries in the federation decide alone and uncoordinately on immigration policy, the border country then chooses a level of external border enforcement such that its own marginal benefits and marginal costs balance in equilibrium, thereby ignoring any effcts on fellow member states. Compared to the social optimum, the level of enforcement diverges, depending on the preferences in the interior countries and the cost sharing rule.*

The proposition shows that decentrally chosen enforcement spending fails to provide the optimal level of enforcement. The total direct costs of enforcement are borne by the border country only. While some benefits accrue to the border country, other countries may benefit as well. However, benefits accruing to other countries do not enter the border country's decision because no compensation is taking place. Therefore, it is optimal from a national perspective to equate national marginal benefits and costs only. From a national perspective costs appear relatively high compared to benefits such that a too low level of enforcement is chosen, given that additional benefits are

enjoyed by other countries (but ignored by the border country) due to reduced onward migration.[8]

Any payments related to onward migration and enforcement by the interior countries will change the optimization problem of the border country. If low levels of onward migration result in transfer payments from an interior to the border country, the border country will consider the effect of onward migration in its decision on enforcement spending. Now tightening costly border controls will increase national benefits due to the money received and, ceteris paribus, a higher level of border enforcement will be chosen, thereby possibly approaching the welfare optimal level from the federation's perspective. Transfer payments of this type, in the following denoted as *side payments*, will play an important role in the discussion of the *expected externality mechanism* in the next section.

5 Mechanism design

In section 4 we demonstrated that the decentrally chosen level of enforcement diverges from the welfare maximizing level. This result leads us to search for a policy option which ensures the welfare maximizing level derived in section 3, even when preferences are private information of the individual countries. Hence, the crucial question is whether we can design an institution, or *mechanism*, in which the individual countries have an incentive to truthfully report their valuation of the public good 'border enforcement'. Before answering this question by applying the expected externality mechanism numerically in section 6, we provide some background information on this technique here.[9]

Broadly speaking, a (direct) revelation mechanism provides incentives for the actors – in this case the governments of the member countries – to truthfully report their preferences. Based on this information a central authority may be able to implement a welfare maximizing policy. There are several conceivable mechanisms that have been dealt with in the literature, for an overview see Jha (1998). The underlying idea is that the supranational governing body asks all national governments about their (marginal) willingness to pay for providing a public good. This information is used to determine (i) the level of public good provision and (ii) each countries' payments to the supranational government (or an EU fund, respectively). The mechanism is then set up such that a single member state has to pay a tax whenever its announced contribution imposes an externality

[8]Note that our numerical example in section 6 reveals that under some circumstances the argument may turn upside down, i.e. the decentralized solution may involve higher spending than the outcome under a central government.

[9]For more details on the expected externality mechanism and a general overview on mechansim design see Maskin and Sjöström (2001) or Jackson (2001). An intuitive application of mechanism design to the provision of environmental protection offers Emons (1994).

on the other countries. Ideally the tax covers precisely the external effect, thereby resembling a *Pigouvian tax*. A country's misreporting of preferences usually causes an externality and is punished by introducing compensating contributions through the mechanism. Therefore, truthtelling is the optimal strategy for each country.

For the analysis in this paper we use the expected externality mechanism going back to the work of Arrow (1979) and d'Aspremont and Gerard-Varet (1979) which implements truthtelling in Bayesian-Nash equilibrium. This mechanism has some features that make it especially attractive for an application to immigration policy in the EU. These features are the following:

- The mechanism ensures an efficient provision of the public good, i.e. the level of the public good maximizes welfare in the federation. More specifically, the resulting level of border enforcement maximizes the sum of valuations of all EU member states.
- Contrary to the well-known Vickrey-Clarke-Groves mechanism the expected externality mechanism succeeds in balancing the budget of all side payments, i.e. no outside source of financing is needed nor does the mechanism leave a surplus of money whose redistribution may bias incentives. Practically, this implies that an EU fund collecting financial means for financing border enforcement neither runs a deficit nor a surplus.
- The mechanism ensures Bayesian incentive compatibility. In equilibrium, every country always reports its true type – even without knowing the other countries' preferences. No EU member country chooses to free-ride on other countries' enforcement spending.

When it comes to applying the expected externality mechanism to European border enforcement policy, we may describe the mechanism as follows. If the central EU government body (e.g. the EU commission) wants to implement a regime of coordinated border enforcement, which is financed by equal cost shares of all member countries, the EU government asks the member states for their willingness (i.e. their preferences) to contribute to border enforcement in a first step.[10] Since the preferences are private information each country has an incentive to strategically misreport. A country with a low valuation of enforcement has an incentive to underreport, a country with a high valuation tends to overstate its preferences. The mechanism therefore specifies payments and transfers depending on all countries' reports to the authority. The central authority then carefully chooses the structure of payments to the 'enforcement fund' based on each country's report and the estimated externality (relative to the welfare optimum). Since the rules of the mechanism are common knowledge and since misreporting ultimately leads to compensating payments, the central

[10]We implicitly apply a direct mechanism, where actors directly report their preferences to the authority. Other, more complex institutional arrangements are also conceivable but according to the revelation principle of Dasgupta, Hammond and Maskin (1979) each of them can be mimicked by a direct mechanism.

government sets incentives which guarantee that each country truthfully reports its preferences from the outset. In a second step the authority implements the optimal level of enforcement based on the countries' reports (which are truthful, given the first step's incentive structure).

Within the set-up, each country has incomplete information about preferences in the fellow member countries. For simplicity we assume that each country may prefer only a high or low level of enforcement. While the preferred level of illegal immigration (or enforcement, respectively) of a single country is randomly drawn, the probability distribution is common knowledge to all countries and the central authority. When asked for its preferences each country's government strives to maximize the expected utility of its citizens. The payments of the mechanism are specified as to internalize the expected externality that this country inflicts on all other countries by reporting its type, or as Emons (1994) puts it: "each agent is essentially paid the expected value of the other agents' net surpluses conditional on her own report". Therefore the mechanism induces each country to help maximizing joint welfare through its decision what to report, thereby having no incentive to misreport its preferences. A formal presentation of the mechanism is included in the appendix.

To demonstrate the expected externality mechanism in the context of EU immigration policy more clearly we turn to a simple numerical example in the next section.

6 Numerical example

This section contains a numerical example to demonstrate how border policy in the EU can be coordinated with the expected externality mechanism. The example is based on the 3-country model introduced in section 2. We assume that one country is situated at the external border facing migratory pressure from the rest of the world; the other two countries are labeled interior countries with no external borders. We provide two distinct scenarios which are inspired by recent real-world observations and which lead to (partly) different results.

Our scenarios are derived from the most recent flows of illegal migrants towards the EU via the 'Central Mediterranean route'.[11] According to Fasani (2008) this route, on which immigrants take off from North Africa (mostly Libya) and arrive in Italy (mostly on the islands of Lampedusa and Sicily) or Malta, has recently gained in relative importance.[12] For our analysis, it suffices to take account of the stylized fact that destination (i.e. border) countries may differ substantially in

[11] For a classification of the different routes see https://www.imap-migration.org/

[12] Gonzalez-Enriquez (2009) shows that migration streams from Morocco to the mainland of Spain and the Canary Island have become weaker since the SIVE surveillance system was introduced and a readmission agreement with Morocco was signed in 2004.

size. While Malta is a very small country, Italy is among the most populous countries in Europe. Hence, relative migratory pressure is much stronger in Malta compared to Italy because a small country can hardly accomodate large numbers of immigrants. Estimates on migration pressure are naturally imprecise and have to be treated with caution. For example, in 2004 Italy's Interior Minister estimated two million potential illegal immigrants waiting for passage in Libya alone.[13] Other sources mention up to 18 million potential immigrants.[14]

Given the relative size of potential destination countries, it is unlikely that illegal migrants consider a small country such as Malta to be their final destination. Hence, a small country may serve only as a port-of-entry to the EU or as an intermediate stop on the migrants' way to some other place in the EU. This will have consequences for the rates of onward migration considered in our model. Unfortunately the data situation on illegal immigration is dense. Therefore, we have to make some assumptions here. Note that in the following we label the border country as country 1 and the interior countries as countries 2 and 3.

First, we make an assumption regarding the size of the intended final destination countries (assuming that some onward migration will take place). We assume that the two interior countries are relatively populous but nevertheless differ to some degree. More specifically, country 2 is about 50% larger than country 3 (this resembles the difference in active labor force between France and Germany). Second, we make an assumption about the size of the border country relative to the interior countries. In scenario 1 (the Malta case), the border country 1 makes up merely 0,2% of the total working population[15] in the federation while interior country 2 accounts for 60% and interior country 3 for 39,8%. In scenario 2 (the Italian case), all countries are relatively large, i.e. the border country 1 accounts for 26%, interior country 2 for 45% and interior country 3 for 29% of the labor force. Third, we assume that the rate of onward migration in scenario 1 is such that 50% of the illegal immigrants move to interior country 2, 40% to interior country 3 and 10% remain in border country 1. This reflects the fact that illegal immigrants will not stay in a small border country but prefer to move on. In scenario 2 we assume that only 11% move onward to interior country 2, 6% move to interior country 3 and 83% stay in border country 1.[16]

In order to deal with the problem of incomplete information with respect to member states preferences for border enforcement, we introduce a probability distribution over these preferences which we assume to be commonly known to all governments at national and supranational level. We

[13]Source: http://www.csmonitor.com/2004/0909/p04s01-woeu.html.

[14]Source: http://www.zdk.de/salzkoerner/salzkorn.php?id=361&page=1.

[15]In 2007, Malta had an active working population of only 166.000 persons compared to 41.8 million in Germany.

[16]These numbers are taken from a survey conducted in 2003 by Chiuri et al. (2007) who asked 920 illegal immigrants in Italy for their intended final destination (75% named Italy, 10% Germany and 5% France). For Malta no such information is available.

keep the distribution as simple as possible by assuming that each 'type combination' (high vs. low preference) occurs with probability $\frac{1}{4}$ for interior country 2 and interior country 3. Table 1 visualizes this distribution. Remember that there is complete information about preferences in border country 1.

	$t_2 = h$	$t_2 = l$
$t_3 = h$	$\frac{1}{4}$	$\frac{1}{4}$
$t_3 = l$	$\frac{1}{4}$	$\frac{1}{4}$

Table 1: Probability of type combinations in country 2 and 3

For our analysis we ran several specifications of our model with differing country sizes and rates of onward migration. While results differ to some degree, our chosen scenarios with a small and a large border country are by and large representative for our findings. We will therefore present only these scenarios to give a flavor of what we can expect in general from our exercise.

6.1 Scenario 1: Small border country

Our first scenario demonstrates the mechanism when the border country is small. Next to the previously stated parameter specification, we assume a migration pressure of 5% of the federation's labor force which amounts to 3.5 million potential illegal immigrants waiting to enter the EU. In the appendix we present alternative specifications with a migratory pressure of 1% and 10%, respectively. In a first step, we now analyze the optimal and decentral choice of enforcement in this setting and take a look at the payment structure of the mechanism.

Welfare Optimum As demonstrated in section 3 the optimal amount of enforcement spending from a federal perspective maximizes the sum of utilities in the single countries. Here, the (benevolent) central government maximizes the sum of national utilities, i.e. the utility functions of the small border country 1 and the large interior countries 2 and 3. The optimal level of enforcement depends on the preferences in each country. Table 2 gives the optimal enforcement levels for the respective combination of types in interior country 2 and interior country 3.

	$t_2 = h$	$t_2 = l$
$t_3 = h$	10.42	5.17
$t_3 = l$	5.97	3.05

Table 2: Welfare maximizing enforcement level for $\bar{M} = 5$

The table may be interpreted as follows. Each cell contains the optimal level of enforcement given the true preferences for enforcement in each country. For instance, the combination of types

$t_2 = t_3 = h$ with a numerical value of 10.42 shows the relatively highest optimal level of enforcement because in both interior countries preferences for enforcement are high, which will be taken into account in the central government's optimization problem for the entire federation.[17] If the cost function $c(E)$ is known, from the optimal level of enforcement the monetary cost of optimal enforcement can be calculated.

Decentral choice of enforcement Next we compare the previously derived welfare optimal levels of enforcement with the decentralized solution, assuming that there is no central authority which coordinates the level of enforcement. In this case the border country chooses to enforce the border according to its national preferences without considering possible effects through onward migration on other member states. The optimal decentralized choice of the small border country 1 then amounts to

$$E_1 = E = 0.$$

Here, the public good character of enforcement shows up very clearly. The small border country is mainly a country of transit for illegal immigrants heading North and therefore chooses not to enforce the border at all. This is because under a completely decentralized policy regime the country does not receive any support from their fellow member countries. Hardly surprising the decentrally choosen level of enforcement diverges substantially from the welfare maximizing level because now the full (negative) impact of illegal migrants moving onward rests on the interior countries. This drives down the sum of national utility levels.

Structure of payments Applying the expected externality mechanism under Scenario 1 generates the (side) payments x_i ($i = 1, 2, 3$ is a country index for the three countries under consideration) presented in the upper part of Table 3. While a negative sign indicates a payment or tax which country i has to make to the federation's enforcement fund, a positive sign represents a transfer from the fund. Again, we have to distinguish the different types of preferences (high vs. low) for the interior countries. Note that – by construction of the mechanism – all payments and transfers stated here are based on truthtelling interior countries, i.e. the reported type (high vs. low preference) is always the true type (please refer to the appendix for technical details).

The numbers indicate that the small border country is in every constellation a receiver of payments, while the interior countries always have to pay to the enforcement fund. Since payments depend

[17] Note that in the asymmetric case (with one country having a high and the other country a low preference) the enforcement level is not the same for the different combinations (5.17 vs. 5.97). This is due to the fact that the countries differ in labor force and in the rates of receiving onward migrants. Therefore the optimal enforcement level is higher when interior country 2 has a high preference and interior country 2 has a low preference (recall that country 2 receives more illegal migrants than country 3).

Payments according to mechanism						
	$t_2 = h$			$t_2 = l$		
$t_3 = h$	$x_1 = 224,9$	$x_2 = -186,5$	$x_3 = -38,3$	$x_1 = 199,5$	$x_2 = -135,8$	$x_3 = -63,7$
$t_3 = l$	$x_1 = 220,2$	$x_2 = -191,2$	$x_3 = -28,9$	$x_1 = 194,8$	$x_2 = -140,5$	$x_3 = -54,3$
Utility change through participation						
	$t_2 = h$			$t_2 = l$		
	Country 1	Country 2	Country 3	Country 1	Country 2	Country 3
$t_3 = h$	$-18,4$	$6220,0$	$4048,6$	$6,4$	$4029,4$	$3967,0$
$t_3 = l$	$16,5$	$6150,3$	$2269,5$	$42,5$	$4028,0$	$2300,2$

Table 3: Payments and Utility differentials

on the externality caused by each country it follows that border country 1 is compensated for taking part in enforcement. Without compensation the border country would have abstained from enforcing its borders. Since in this constellation interior country 2 benefits most from enforcement it also has to pay most (relative to interior country 3). Note also the difference in country 2 and 3's payments when having different types. For both countries payments are higher when reporting a high preference. Thereby the mechanism internalizes the externality of higher enforcement inflicted on the border country which results from reporting type h.

Although the mechanism internalizes the externalities caused by each country, it does not guarantee voluntary participation of all countries. Therefore we have to check participation separately. Voluntary participation is guaranteed if a country's utility level under the mechanism exceeds the (reservation) utility in the status quo which is characterized by the decentral enforcement decision of the border country. The lower part of Table 3 gives these utility differentials for each combination of types and every country. The first column gives the numbers for border country 1, the second and third column the numbers for interior countries 2 and 3, respectively. For the large interior countries, voluntary participation is always fulfilled irrespective of the realized type combination (i.e. 'ex-post participation' is fulfilled). For the small border country we find that voluntary participation is fulfilled except under the combination $t_2 = t_3 = h$. This, however, is not a major problem as the border country can only maximize the *expected benefit* due to incomplete information anyway. Since the expected change in utility under the mechanism is positive for the border country, voluntary participation is guaranteed (i.e. in jargon 'ex-interim participation' is fulfilled).[18]

[18]Note that according to tables 7 and 9 (included in the appendix) voluntary participation of the small border country decreases with migratory pressure. While for the case of $\bar{M} = 1$ even the ex-post participation constraint is fulfilled, neither ex-post participation nor interim participation is fulfilled in case of $\bar{M} = 10$.

6.2 Scenario 2: Large border country

After having demonstrated the expected externality mechanism for a scenario with a small border country, we now assume the border country to be relatively large. The border country may now resemble Italy instead of Malta. The relevant parameter specification was stated before at the beginning of this section.

Welfare Optimum The welfare maximizing levels of enforcement are presented in Table 4. Compared to Scenario 1 the difference in the optimal values narrows. This is due to the fact that a significantly larger share of immigrants stays in the border country where enforcement preferences are given.

	$t_2 = h$	$t_2 = l$
$t_3 = h$	6.45	5.80
$t_3 = l$	6.08	5.48

Table 4: Welfare maximizing enforcement level for $\bar{M} = 5$

Decentralized choice of enforcement The decentralized choice of enforcement in the large border country is characterized by the large share of immigrants staying in this country. In contrast to the previous scenario with a small border country, it is beneficial for the large border country to enforce the border even without receiving any support from other countries. The nationally optimal level of enforcement chosen by large border country 1 amounts to

$$E_1 = E = 6.33$$

Comparing this number with the welfare maximizing levels in Table 4 we find that the level of enforcement is too low when both interior countries have a high preference for enforcement. In all other scenarios the decentralized solution is sufficient or even higher than in the cooperative case. At first glance this result seems paradoxical, since we expect undersupply of the public good. But we have to consider that in the cooperative solution each country bears the same share of enforcement costs irrespective of how many immigrants it really receives. Since the interior countries receive only few immigrants, the cost sharing procedure is unattractive to them, thereby pulling down the optimal level from a federal perspective.

Structure of payments The payments under the expected externality mechanism for this scenario are given in the upper part of Table 5. Compared to Scenario 1 the payments differ substantially. While in Scenario 1 the small border country receives all payments, here it is the (large)

border country which has to pay. The two interior countries are recipients of payments. Intuitively, large border country 1 which is the main beneficiary from enforcement due to the large share of immigrants has to compensate interior countries 2 and 3 for accepting the establishment of the EU enforcement fund. Without compensation interior countries would turn out to be net payers due to high contributions to joint enforcement efforts but little effect on national welfare due to a low number of illegal immigrants. Therefore the payments internalize the negative externalities inflicted on the interior countries. Note, furthermore, that the transfers benefitting interior countries 2 and 3 are higher when they have a high rather than a low preference for enforcement. Here the incentive to understate their preferences and thereby free-ride on the efforts of fellow member countries is countered through the mechanism.

Payments according to mechanism						
	$t_2 = h$			$t_2 = l$		
$t_3 = h$	$x_1 = -172,2$	$x_2 = 30,5$	$x_3 = 141,7$	$x_1 = -169,9$	$x_2 = 25,8$	$x_3 = 144,1$
$t_3 = l$	$x_1 = -171,2$	$x_2 = 31,5$	$x_3 = 139,7$	$x_1 = -168,8$	$x_2 = 26,8$	$x_3 = 142,0$
Utility change through participation						
	$t_2 = h$			$t_2 = l$		
	Country 1	Country 2	Country 3	Country 1	Country 2	Country 3
$t_3 = h$	$-129,3$	$9,1$	$120,3$	$-133,6$	$11,5$	$124,5$
$t_3 = l$	$-131,1$	$10,8$	$120,7$	$-139,0$	$17,0$	$128,7$

Table 5: Payments and Utility differentials

To analyze the incentive to voluntarily participate we again compute the effect on utility through participation in the mechanism which is presented in the lower part of Table 5. Here we find, that the large border country has no incentive to participate in the mechanism regardless of the type combination of the interior countries. This does not come as a surprise as the construction of the joint enforcement scheme (without the compensating mechanism) is overly generous to the border country at the expense of the interior countries, while the mechanism avoids this asymmetry. A national solution is therefore preferred over participating in the mechanism as long as the rate of onward migration is low[19] and the cost-sharing rule is biased in favor of the border country. Under these circumstances the expected externality mechanism fails to offer sufficient incentives for the border country to voluntarily participate. The deeper reason for this result is the fact that under the expected externality mechanism each country has to compensate the externalities inflicted on all other countries. In this case, the large border country has to compensate for the high level of enforcement it desires.

[19] And countries are relatively equal in size.

The results differ when the border country is relatively small in size and only few immigrants stay in this country. Here, the border country receives a transfers according to the mechanism because it has a relatively low preference for enforcement. The compensation for the high level of enforcement suffices to guarantee the voluntary participation for reasonable levels of migratory pressure. In general, we may conclude that a weak own-interest of a border country in enforcement because of a high rate of onward migration increases the likelyhood of voluntary participation of all member states in joint enforcement measures leading to positive compensating payments to the border country.

7 Conclusion

Despite years of discussion and rare initiatives the difficulties of introducing a comprehensive and integrated immigration policy in the European Union persist. The results in this paper underline the complexities of finding agreements and creating institutions which are supported by all member countries.

In this paper, we demonstrate that the *expected externality mechanism* has the capability to contribute to approaching an integrated border management as envisaged by the European Commission. In an environment of incomplete information about preferences for border enforcement the mechanism serves to elicit the true preferences of each member state, based on which a welfare optimal level of enforcement for the entire Union may be determined. This feature makes the mechanism especially attractive in light of the reluctancy of non-Mediterranean EU member states to contribute to enforcing the Mediterranean border. Based on this idea of the mechanism a balanced EU enforcement fund may be introduced with payments and transfers that internalize possible externalities. Here, the EU will play the role of a moderator – for instance, within the OMC Immigration framework – setting up the mechanism and helping to determine the optimal payment structure to and from the fund.

Our analysis rests on some assumptions regarding the required information and preference structure which may be non-trivial to solve. However, any solution in this difficult field in European policy will ultimately suffer from restrictions of this kind. In addition, our numerical analysis revealed the more practical problem that – while maximizing the well-being in the whole federation – the mechanism fails to guarantee utility gains for each single country under some parameter constellations. In particular in a scenario with a large border country and low rates of onward migration the incentive for the border country to participate diminishes.

Concluding from our results, the expected externality mechanism may – not only in theory – be a suitable institutional setting to alleviate the problem of burden sharing when European soli-

darity towards a small country at the external border such as Malta is to be achieved. Here, a well-constructed EU enforcement fund based on the expected externality mechanism may work successfully if the EU is capable (and granted the necessary powers) to run the fund in a way underlined before. While the prospects for such an institution may look dense in the light of past experience, the Lisbon Treaty allows for at least some optimism as applying the ordinary legislative procedure in the fiedd of border control is less restrictive than the previous unanimity rule. Hence, it may be possible to find a sufficient (double) majority to set up the necessary institutional framework for introducing a mechanism-based EU enforcement fund.

In general the field of mechanism design occurs to be a promising approach to continue the search for institutional settings rendering the need for coercion in EU border management redundant. Therefore future research in this area should be devoted to finding mechanisms, which guarantee voluntary participation of all member countries in all conceivable settings, at the cost of sacrificing the condition of budget balance or providing a second-best level of enforcement. Additional insights may be derived from investigating EU immigration policy in its entirety, including the existence of several differently populous border countries and the inclusion of third countries like Morocco, Libya or Mali, thereby accounting for recent developments in shifting border controls to extraterritorial places.

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8 Appendix

8.1 Proof of proposition 1

The number of illegal immigrants in the federation, M, depends on an exogenously given migration pressure to the federation, $\bar{M}$, and the total effort in border enforcement, E, along the external border

$$M = M(\bar{M}, E) \tag{1}$$

with $\frac{\partial M}{\partial E} < 0$. Recognizing the possibility of onward migration we specify the number of illegal immigrants in each country by

$$M_1 = (1 - \alpha - \beta)M \tag{2}$$

$$M_2 = \alpha M \tag{3}$$

$$M_3 = \beta M \tag{4}$$

such that a share α of all illegal migrants moves on to country 2 and a share β moves to country 3. The remaining share $(1 - \alpha - \beta)$ of immigrants stays in country 1. Preferences in each country are parametrized by a type parameter t_i, specifying a high or a low impact of immigration on national utility (see below). For simplicity this type parameter can only take on the values 0 and 1. The utility function is given by

$$U_i = y_i - H_i(M_i, t_i) - c_i(E) + m_i + x_i(t_i). \tag{5}$$

where the utility level U_i in each of the countries is determined by the output $y_i = F_i(L_i, M_i)$ of a production process which utilizes legal (L_i) and illegal labor, the valuation function $H_i(M_i, t)$ which depends on the number of illegal migrants and the type parameter, the cost share of border enforcement $c_i(E)$, the exogenously given endowment with money m_i, and side payments x_i which are specified by the mechanism and also depend on the type parameter. Further, the form of the valuation function is specified as follows:

$$H_i(M_i, t) = M_i^2 - t_i M_i \tag{6}$$

Note the effect of t_i on the valuation function. Obviously, a parameter value of $t_i = h = 0$ means that the country has no positive effect of immigration on H_i and therefore the negative impact of illegal immigration on total utility is more pronounced than in the case of $t_i = l = 1$. When choosing the optimal enforcement level, a fully informed benevolent planner maximizes the sum of utilities in all countries, that is

$$\max_E U = U_1 + U_2 + U_3 \tag{7}$$

Differentiating with respect to E yiels the first order condition which implicitly specifies the optimal level of border enforcement E^*:

$$\left[(1-\alpha-\beta)^2+\alpha^2+\beta^2\right] 2M\frac{\partial M}{\partial E} = \left[(1-\alpha-\beta)\left(\frac{\partial F_1}{\partial M}+1\right)+\alpha\left(\frac{\partial F_2}{\partial M}+t_2\right)+\beta\left(\frac{\partial F_3}{\partial M}+t_3\right)\right]\frac{\partial M}{\partial E}-\frac{\partial c}{\partial E} \quad (8)$$

The left hand side denotes the marginal benefit and the right hand side the marginal cost of border enforcement for the whole federation. Note the dependence of the marginal benefit on the type parameter t_i. If $t_i = 0$ the marginal costs of enforcement are lower and consequently a higher level of enforcement is optimal.

8.2 Proof of proposition 2

The decentralized solution is characterized by the border country (country 1) uncoordinately choosing the level of enforcement. Thereby it does not take into account possible spillover effects of onward migration on the interior countries. The government of border country 1 maximizes utility

$$U_1 = y_1(L_1, M_1) - H_1(M_1) - c(E) \quad (9)$$

with respect to the enforcement effort E. The first order condition for E is given by

$$(1-\alpha-\beta)^2 2M\frac{\partial M}{\partial E} = (1-\alpha-\beta)\left(\frac{\partial F_1}{\partial M_1}+1\right)\frac{\partial M}{\partial E}-\frac{\partial c}{\partial E} \quad (10)$$

When comparing the condition for the decentrally chosen level in (10) with the condition for the federation's welfare optimum in (8) we find that the difference between both decision rules is ambiguous and depends on the preference parameters, the production function and the cost sharing rule.

8.3 The expected externality mechanism

The payments x_i for each player in the mechansim[20] depend on the valuation of all other players according to the following rule where $\widetilde{t}_{-i}$ denotes the truthful type report (in vector notation) of all countries excluding i and $EE_{\widetilde{t}_{-i}}$ gives the expected value over all realizations of the random variable $\widetilde{t}_{-i}$:

$$x_i = EE_{\widetilde{t}_{-i}}\left[\sum_{j\neq i}\left[y_j(E^*(t_i,\widetilde{t}_{-i})) - H_j(E^*(t_i,\widetilde{t}_{-i}),\widetilde{t}_j) - c_j(E^*(t_i,\widetilde{t}_{-i}))\right]\right] + z_i(t_{-i}) \quad (11)$$

The first term on the right hand side represents the expected utility of all other countries $j \neq i$ when country i announces its type to be t_i and all other countries report truthfully. Therefore the

[20] See section 23.D in Mas-Colell et. al (1995).

payment of country i hinges crucially on the so called 'expected externality' that it causes on all other countries by reporting its own type t_i. The second term $z_i(t_{-i})$ serves to balance the budget and needs further specification:

$$z_i(t_{-i}) = -\left(\frac{1}{n-1}\right)\sum_{l\neq i}\eta^l(t_l) \tag{12}$$

with

$$\eta^i(t_i) = EE_{\widetilde{t}_{-i}}\left[\sum_{j\neq i}\left[y_j(E^*(t_i,\widetilde{t}_{-i})) - H_j(E^*(t_i,\widetilde{t}_{-i}),\widetilde{t}_j) - c_j(E^*(t_i,\widetilde{t}_{-i}))\right]\right] \tag{13}$$

The logic behind the budget balancing term is that if each country contributes an equal share of all other countries payments (in addition to the expectation term in (11)), then all payments will sum up to zero.

8.4 Numerical example

The specification of parameter values and the specified form of the different functions used in our numerical example are given below. The production and cost functions for each country are identical. We choose the production function to be of a common CES style:

$$y_i = A\left(\delta L_i^{-\rho} + (1-\delta)M_i^{-\rho}\right)^{\frac{-1}{\rho}} \tag{14}$$

where A is an efficiency parameter, δ gives the relative factor shares in the product and ρ determines the elasticity of substitution between both production factors. For our example we choose $A = 5$, $\delta = 0,9$ and $\rho = -0,5$, such that legal labor makes up the main share in the production process and the elasticity of substitution is relatively high.[21] The cost function for each country is linear in enforcement efforts, i.e.

$$c_i(E) = \frac{kE}{n} \tag{15}$$

where we arbitrarily set $k = 10$ as well as $n = 3$ since we want the direct costs of enforcement to be shared equally among all countries.

[21] The elasticity of substiution is defined as $\sigma = \frac{1}{1+\rho}$.

8.4.1 Scenario 1: Small border country

Case 1: Migration pressure amounts to $\bar{M} = 1$

	$t_2 = 0$	$t_2 = 1$
$t_3 = 0$	$2, 6$	$0, 3$
$t_3 = 1$	$0, 6$	0

Table 6: Welfare maximizing enforcement level for $\bar{M} = 1$

Dececntally chosen enforcement level in the status quo: $E = 0$

Payments according to mechanism:						
	$t_2 = h$			$t_2 = l$		
$t_3 = h$	$x_1 = 239, 9$	$x_2 = -200, 0$	$x_3 = -39, 9$	$x_1 = 215, 9$	$x_2 = -152, 1$	$x_3 = -63, 8$
$t_3 = l$	$x_1 = 236, 2$	$x_2 = -203, 6$	$x_3 = -32, 6$	$x_1 = 212, 3$	$x_2 = -155, 8$	$x_3 = -56, 5$
Utility change through participation:						
	$t_2 = h$			$t_2 = l$		
	Country 1	Country 2	Country 3	Country 1	Country 2	Country 3
$t_3 = h$	$0, 3$	$6067, 1$	$3967, 2$	$25, 3$	$3866, 3$	$3876, 4$
$t_3 = l$	$35, 2$	$5991, 3$	$2174, 9$	$60, 6$	$3871, 8$	$2215, 4$

Table 7: Payments and Utility differentials

Case 2: Migration pressure amounts to $\bar{M} = 10$

	$t_2 = 0$	$t_2 = 1$
$t_3 = 0$	$17, 6$	$10, 4$
$t_3 = 1$	$11, 6$	$6, 9$

Table 8: Welfare maximizing enforcement level for $\bar{M} = 10$

Decentrally chosen enforcement level in the status quo: $E = 0, 9$

Payments according to mechanism:						
	$t_2 = h$			$t_2 = l$		
$t_3 = h$	$x_1 = 210,7$	$x_2 = -174,4$	$x_3 = -36,3$	$x_1 = 184,3$	$x_2 = -121,7$	$x_3 = -62,7$
$t_3 = l$	$x_1 = 205,8$	$x_2 = -179,3$	$x_3 = -26,5$	$x_1 = 179,4$	$x_2 = -126,6$	$x_3 = -52,9$
Utility change through participation:						
	$t_2 = h$			$t_2 = l$		
	Country 1	Country 2	Country 3	Country 1	Country 2	Country 3
$t_3 = h$	$-37,7$	$6414,4$	$4158,7$	$-11,1$	$4216,7$	$4080,7$
$t_3 = l$	$-0,7$	$6345,9$	$2376,5$	$26,7$	$4210,3$	$2400,5$

Table 9: Payments and Utility differentials

8.4.2 Scenario 2: Large border country

Case 1: Migration pressure amounts to $\bar{M} = 1$

	$t_2 = 0$	$t_2 = 1$
$t_3 = 0$	$0,64$	$0,46$
$t_3 = 1$	$0,53$	$0,38$

Table 10: Welfare maximizing enforcement level for $\bar{M} = 1$

Dececntally chosen enforcement level in the status quo: $E = 0,61$

Payments according to mechanism:						
	$t_2 = h$			$t_2 = l$		
$t_3 = h$	$x_1 = -182,0$	$x_2 = 38,0$	$x_3 = 143,9$	$x_1 = -180,2$	$x_2 = 34,5$	$x_3 = 145,7$
$t_3 = l$	$x_1 = -181,3$	$x_2 = 38,7$	$x_3 = 142,5$	$x_1 = -179,5$	$x_2 = 35,2$	$x_3 = 144,3$
Utility change through participation:						
	$t_2 = h$			$t_2 = l$		
	Country 1	Country 2	Country 3	Country 1	Country 2	Country 3
$t_3 = h$	$-177,8$	$36,1$	$141,8$	$-179,9$	$38,9$	$143,9$
$t_3 = l$	$-178,3$	$36,5$	$142,4$	$-184,7$	$43,7$	$148,8$

Table 11: Payments and Utility differentials

Case 2: Migration pressure amounts to $\bar{M} = 10$

	$t_2 = 0$	$t_2 = 1$
$t_3 = 0$	$12,8$	$11,7$
$t_3 = 1$	$12,2$	$11,2$

Table 12: Welfare maximizing enforcement level for $\bar{M} = 10$

Dececntally chosen enforcement level in the status quo: $E = 12,6$

Payments according to mechanism:						
	$t_2 = h$			$t_2 = l$		
$t_3 = h$	$x_1 = -163,6$	$x_2 = 28,4$	$x_3 = 135,3$	$x_1 = -160,8$	$x_2 = 22,8$	$x_3 = 138,1$
$t_3 = l$	$x_1 = -162,3$	$x_2 = 29,7$	$x_3 = 132,6$	$x_1 = -159,5$	$x_2 = 24,1$	$x_3 = 135,4$
Utility change through participation:						
	$t_2 = h$			$t_2 = l$		
	Country 1	Country 2	Country 3	Country 1	Country 2	Country 3
$t_3 = h$	$-78,6$	$-14,0$	$92,8$	$-84,7$	$-12,0$	$98,7$
$t_3 = l$	$-81,4$	$-11,3$	$93,1$	$-90,7$	$-5,9$	$102,5$

Table 13: Payments and Utility differentials