Spillovers and Strategic Interaction in Immigration Policies

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Abstract

Asylum policies are interdependent across countries: Policy choices in one country can affect refugee flows into neighbouring countries and may provoke policy changes there, in an a priori unknown direction. We formulate a dynamic model of refugees' location choices and of the strategic interaction among destinations that we fit to Syrian refugee migration to Europe. We find that south and southeastern European countries view recognition rates as strategic substitutes, whereas the same policies can be strategic complements in northern Europe. Our findings imply that regression frameworks which use cross-country variation to estimate effects of recognition rates on immigration underestimate (overestimate) the effect if this policy is a strategic substitute (complement).

Keywords: Policy Spillovers, Policy Equilibrium, Migration, Asylum Policy.
JEL Classification: D78, F22, J15, K37.

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1 Introduction

Throughout the ongoing negotiations over a common asylum policy, European Union countries have varied considerably in their openness towards asylum seekers. These differences were highlighted at the peak of the refugee crisis in 2015, when some member states accused others of exacerbating refugee flows into the EU through generous asylum policies. A central measure of openness in this context is the recognition rate of a country, that is, the share of applicants who are granted asylum. The recognition rate set by one country will affect not only the number of arrivals there, but also how many refugees apply for asylum in other destinations. Such an externality arises, for example, if refugees base their location choice on a comparison of the probability of being granted asylum in different countries. A policy change in one country can then trigger responses in other countries, leading to a strategic interdependence in recognition rates. The exact nature of this interdependence is not clear, however, as a change in recognition rates may not only affect the distribution of refugees across countries, but also the overall number of arrivals in Europe. As a consequence, a more generous policy in one country can lead to fewer or more asylum applications elsewhere.

In this paper, we investigate the strategic interaction between the recognition rates of different countries. To this end, we formulate a dynamic model of refugee migration, in which individuals can move to different locations within Europe. Countries set their policies anticipating the number of asylum applications they receive given their own and other countries' policies. This gives rise to a game between destinations. We calibrate this model to match observed numbers of Syrian refugees. Based on the results, we can calculate the direction and the extent of the externalities in recognition rates among European countries. Furthermore, we can quantify the strategic responses triggered by a change in policy in a particular destination. Our approach is new to the political economy literature on migration and makes this paper the first to document the nature of the strategic interactions among asylum policies across a broad number of countries.

To gain a clearer understanding of the strategic interdependence in asylum policies, consider the neighbouring countries of Sweden and Denmark as a specific example. An increase in the recognition rate of Sweden affects the number of refugees in Denmark through two possible channels: On the one hand, refugee flows are potentially diverted from Denmark to Sweden. On the other hand, the overall number of refugees attracted to Europe may be higher, with a positive effect also on the number of refugees settling in or passing through Denmark. We will refer to these two possibilities as "diversion effect" and "attraction effect", respectively. In either case, an interdependence across countries arises if Denmark adjusts its own asylum recognition rate to counteract the effect of the Swedish policy change. In the spirit of Bulow et al. (1985), we label recognition rates as strategic substitutes if an increase in the rate of one country causes a tightening of policy elsewhere. This may be the case if a large number of additional refugees are attracted into Europe. On the other hand, we speak of strategic complements if a policy change in one country provokes policy changes in the same direction in other countries, as would be the case if the diversion effect dominates.[1] The sign of the cross-elasticities in countries' policies hence becomes an empirical question. Our model incorporates both types of externalities, allowing for a strategic interaction in either direction. More generally, we do not impose any shape restriction on best responses, which can even be non-monotonic, depending on the model's parameter values.

To determine the strategic nature of recognition rates, we calibrate the parameters of the model to match data on the important case of Syrian refugee migration to Europe.[2] Since the outbreak of the Syrian civil war, Syrians constitute the largest group of refugees, both globally and within the European Union. While focusing on the Syrian case does not allow us to investigate potentially interesting heterogeneity in policies towards refugees of different origins, the Syrian case lends itself particularly well to a clean analysis.[3] We consider the early phase of Syrian refugee migration to Europe, 2011-2014, before the introduction of internal border controls and the construction of physical barriers in response to the large number

[1]Complementarity would also arise if some countries could coerce others into following their immigration policies. Given the difficulty of enforcing even supranational EU legislation on asylum policies, we deem this to be an empirically less relevant case. EU legislation on reallocation was initiated after the time period to which we calibrate the model.

[2]Like in many other contexts of forced displacement, most Syrian refugees are either internally displaced or reside in a number of neighbouring countries, while some have moved on to other destinations, primarily to member countries of the European Union. As this paper is concerned with strategic interaction among European countries, we focus on movements of Syrians into and within Europe.

[3]A particularly attractive feature of the Syrian case is that it has a clear starting point in 2011. Despite the political turmoil of the early 1980s, the average number of Syrian refugees registered by UNHCR during 1980-2010 was less than 0.4% of the numbers seen since 2011. For origin countries with a longer history of large refugee flows, such as Afghanistan, the role of pre-existing migrant networks for refugees location choice would need to be accounted for more thoroughly than what is tractable in an equilibrium framework like ours.

of refugees arriving in 2015. A drawback of this choice is that a number of Syrians may have arrived in Europe by plane during this period instead of following one of the Mediterranean routes as we assume in the model.

We estimate the structural parameters of the model using application numbers and policies in different destinations during that time period. Given the estimated parameters, we can then simulate unilateral changes in recognition rates and evaluate the equilibrium responses in the policies of other countries. The results suggest considerable heterogeneity in the strategic interdependence among asylum policies, both in the magnitude and the direction of the effects. At the equilibrium, an increase in the recognition rate of a country in northwestern Europe entails an attraction effect and leads to a marked decrease in the recognition rates of countries further south. The same is true within the group of countries in the southeast, even though the magnitude of the effects is smaller. In contrast, recognition rates are strategic complements within the group of northwestern countries, where the diversion effect is stronger. The strategic interdependence among northern countries is, however, weak. Finally, policy changes in the southeast have essentially no impact on the north.

The calibrated parameters, which drive these results, tell a plausible story about the choices faced by Syrian refugees: In the absence of any shocks to their personal circumstances such as violence or other forms of insecurity in their area of residence, refugees would not migrate. While life as a recognized refugee in Europe provides a higher flow utility than life outside Europe, recognition is uncertain and the cost of migrating to Europe is high. As documented in a recent paper by Aksoy and Poutvaara (2019), many refugees on the route to Europe have a particular destination country in mind, which is often not the first European country they set foot on. Our results confirm this in that we estimate a higher utility refugees derive from being granted asylum in northern Europe. These estimates imply that changes in northern asylum recognition rates have a stronger effect on refugee's location choices. Accordingly, increases in recognition rates in northern Europe also provoke more pronounced policy responses in southeastern Europe than in the reverse case.

Our results have important implications for estimations of policy effects based on cross-country variation. Bertoli and Fernndez-Huertas Moraga (2015) highlight the problems that interdependencies across countries pose for identification. We add to their concern by formally showing and signing the bias arising in a regression framework. In particular, we show that if an increase in one country's recognition rate raises the number of refugees arriving elsewhere, a negative bias arises. If, on the other hand, the diversion effect dominates, spillovers will generate an upward bias in regression estimates.

The policy diffusion literature describes competition effects that lead to a policy change being replicated across countries (Simmons and Elkins, 2004). In the case of immigration and asylum policies the possibility of an opposite effect exists, if increased openness in one country triggers a more restrictive policy decision by other countries. Besides theoretically formulating this hypothesis of policies as strategic substitutes—for which we indeed find empirical evidence—this paper specifically contributes to the political economy literature on refugee migrations. A number of studies have highlighted the interrelatedness between different host countries' migration and asylum policies. For non-refugee migration, the interdependency of destination countries' immigration policies has been pointed out by Boeri et al. (2005), who argue that spillovers of immigration policies can help explain an increased tightening of immigration restrictions in Europe. In terms of our terminology, their paper focuses on the diversion effect of migration policies. Very detailed evidence on spillovers in a migration context is provided by Bratu et al. (2018), who use administrative data to reveal spillovers from a policy restricting family migration to Denmark on migration to and from Sweden. While their paper does not distinguish what we call attraction and diversion effects, it is a neat example of one country's immigration policy affecting migrant flows elsewhere. Most directly related to the current paper are Brekke et al. (2016), who investigate whether both an attraction and a diversion effect can be detected in the data on asylum applications. Regressing the number of asylum applications on a destination country's asylum policies as well as on policies in place in nearby countries, they find that more restrictive policies are associated not only with a lower number of arrivals in that country, but also with more arrivals in other destinations, akin to our diversion effect. To isolate an attraction effect, they further estimate the effect of asylum policies on the total number of arrivals in all OECD countries. We build on these studies by quantifying spillovers at the country-pair level. In an additional step, we analyse the strategic interaction among European countries that arises as a consequence.

Our work is also related to the literature concerned with the *consequences* of externalities across countries in the context of asylum policies. A paper that has received attention beyond academic circles is the analysis by Fernández-Huertas Moraga and Rapoport (2014), who treat the acceptance of refugees as a public good and propose a system of tradable immigration quotas that matches international migrants to host countries while accounting for both migrants' and countries' preferences. In related papers, Delacrétaz et al. (2016), and Jones and Teytelboym (2017, 2018) propose allocation mechanisms of refugees *within* a country that account for constraints in the provision of local services. Facchini et al. (2006), and Fernández-Huertas Moraga and Rapoport (2015) more closely investigate the benefits of policy coordination for the particular case of refugee reallocation within the European Union.

We also contribute to the growing literature that uses dynamic behavioural models to examine internal and international migration (see e.g. Kirdar (2012), Llull (2017), Lessem (2018) and Iftikhar and Zaharieva (2019) for other applications, and Dustmann and Görlach (2016) for a broader overview of this literature).[4] We extend this approach to model refugee movements across several countries in a policy equilibrium framework. For overviews of various economic aspects of refugee migrations, see for instance Ruiz and Vargas-Silva (2013), Chin and Cortes (2015), Dustmann et al. (2017), Fasani et al. (2018) and Hatton (2020).

Before presenting our structural model in Section 3, we put our analysis into the broader context of international refugee migration in Section 2. Section 4 explains how we identify and calibrate the model's parameters, while Section 5 presents the results. Section 6 summarizes our findings and concludes.

2 Context and Descriptive Evidence

This section provides descriptive evidence of correlations in recognition rates set by different destinations. This motivates the model presented in Section 3, which incorporates both refugees' location choice as a function of recognition rates in different destinations and these destinations' optimal policy choice.

[4] Different from ours, the models in these papers consider the choice between one origin and one destination only. Other exceptions include the models on internal migration, such as the ones by Kennan and Walker (2011); Oswald (2019); Piyapromdee (2019), who consider internal migration between multiple locations within the United States; Hwang (2019), who estimates a sorting model for immigrants in England and Wales; and Girsberger (2015), who models both internal rural-urban and emigration from Burkina Faso.

Data. The descriptive evidence in this section is based on Eurostat data, which provide bilateral information on the number of asylum applications and the number of positive decisions on a quarterly basis for the time period 2008-2018, covering refugees from a total of 155 countries of origin. Even though adherence to the Geneva Refugee convention of 1951 limits the degree to which the outcome of an asylum application is a policy parameter, decisions such as the compilation of safe origin country lists or a relaxation of the EU's Dublin agreement are political choices. Burmann et al. (2017), for instance, document how asylum recognition rates vary with the political orientation of government cabinets. Figure 1 shows that for the main refugee sending countries during the period 2008-2018, recognition rates vary strongly across EU countries.[5] Although refugees from some origin countries like Iraq or Syria are generally more likely to be granted asylum during those years than applicants from Kosovo or Nigeria, there is considerable variation across destination countries. For instance, whereas less than one third of the asylum decisions for Afghan refugees in Bulgaria, Croatia, Cyprus, Denmark, Estonia, Hungary, Romania and Slovenia are positive, more than two thirds are granted asylum in France, Lithuania, Luxembourg and Spain. For Iraqis, recognition rates range from just above 20 percent in Denmark and the United Kingdom to more than 90 percent for the 715 applications processed in Estonia, Poland, Portugal and Slovakia.

Correlations in recognition rates. To shed light on how recognition rates set in different destination countries are related, we perform a pairwise comparison across all combinations of European Union destination countries. That is, we construct a dataset containing for any country pair the recognition rates in the two destinations by quarter and country of origin of the applicants. We then compute the correlation in recognition rates across origin-quarter cells, after taking out push factors by regressing recognition rates in each destination on full sets of origin-year and quarter effects and using only the residual variation.[6] For N destinations, this yields an $N \times N$ correlation matrix, which we visualize in Figure 2. Panel (a) isolates country pairs with a positive correlation in recognition rates, with darker shades indicating stronger correlations. Panel (b) shows the negative correlations. The thickness of

[5]The graph singles out the seven major countries of origin. From each of these, least 200,000 asylum applications have been filed during 2008-2018.

[6]See Appendix A for details.

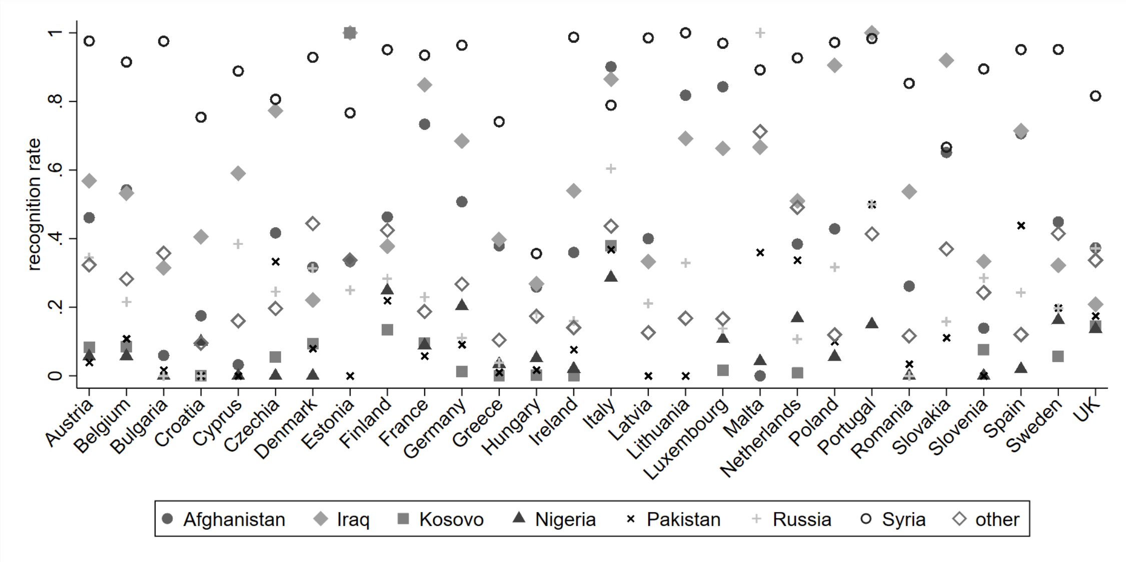


Figure 1: Fractions of asylum applications decided positively for refugees from major origin countries, by European Union destination country. Source: Eurostat data for 2008-2018.

the lines is proportional to the mean of the number of asylum decisions recorded in the data for each pair of destination countries. With the exception of the UK, the pattern that emerges suggests predominantly positive correlations for countries in northwestern Europe. That is, we observe a co-movement in the recognition rates applied across destination countries to a given group of refugees. In contrast, recognition rates in south and southeastern European countries tend to correlate negatively with rates in northwestern Europe, and partly among each other.

One plausible rationale for such a pattern is that European destinations use recognition rates as a tool for influencing the number of asylum applications they receive: A higher recognition rate in one country then triggers a rise in another country's recognition rate if the latter sees its application numbers decrease as refugee flows are diverted. This plausibly is the case for similarly attractive countries in northwestern Europe, none of which are a major port of entry for refugees to the European Union. On the other hand, a higher recognition rate in some country may attract more refugees from outside the European Union, who first enter and potentially apply for asylum in a southern European country. The result would be a tightening of asylum policies in the latter destination in an attempt to limit the influx of additional refugees, some of whom may end up staying rather than moving on to the initially intended country.

(a) Positive correlations (b) Negative correlations

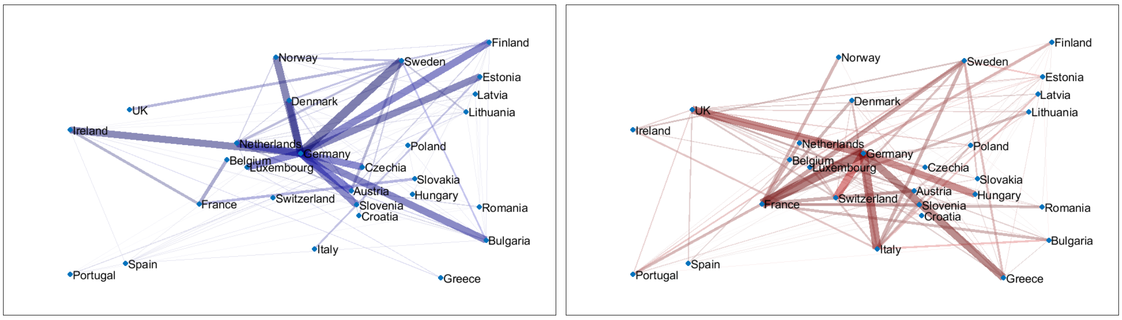


Figure 2: Correlations in residual variation in recognition rates across pairs of European destination countries after controlling for push factors (see Appendix A). Recognition rates for each destination country are calculated by quarter and origin country. In panel (a), lines connecting countries indicate positive correlations, lines in panel (b) negative correlations. Line thickness is proportional to the mean number of asylum applications decided. Source: Eurostat data for 2008-2018.

To confirm this pattern more directly, we plot, for each origin country, the quarterly recognition rates in one European Union destination country against the recognition rates in other countries of the European Union.

The lines in Figure 3 show the correlations in recognition rates between different destinations. Dots further indicate conditional mean recognition rates among destinations on the vertical axis within bins of one percentage point on the horizontal axis. In line with the geographic pattern in Figure 2, we distinguish different types of country pairs: (a) pairs of southern or southeastern European "border countries";[7] (b) pairs of northwestern European "non-border countries";[8] and (c) mixed pairs across the two sets. Again, we find a positive correlation among non-border countries, while the correlations among border countries, and between border and non-border countries are strongly negative.

Based on this evidence, our model explicitly accounts for the geographic context in Europe, distinguishing countries of first entry from countries further north. We do not, however, impose the strength or direction of strategic effects. Instead, we let the data—via the calibrated model—determine the strategic nature of policies, both in and out of equilibrium.

[7] We include Bulgaria, Croatia, Cyprus, Greece, Hungary, Italy, Malta, Portugal, Romania, Slovenia and Spain in this set.

[8] These include Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Ireland, Latvia, Lithuania, Luxembourg, The Netherlands, Poland, Slovakia, Sweden and the UK.

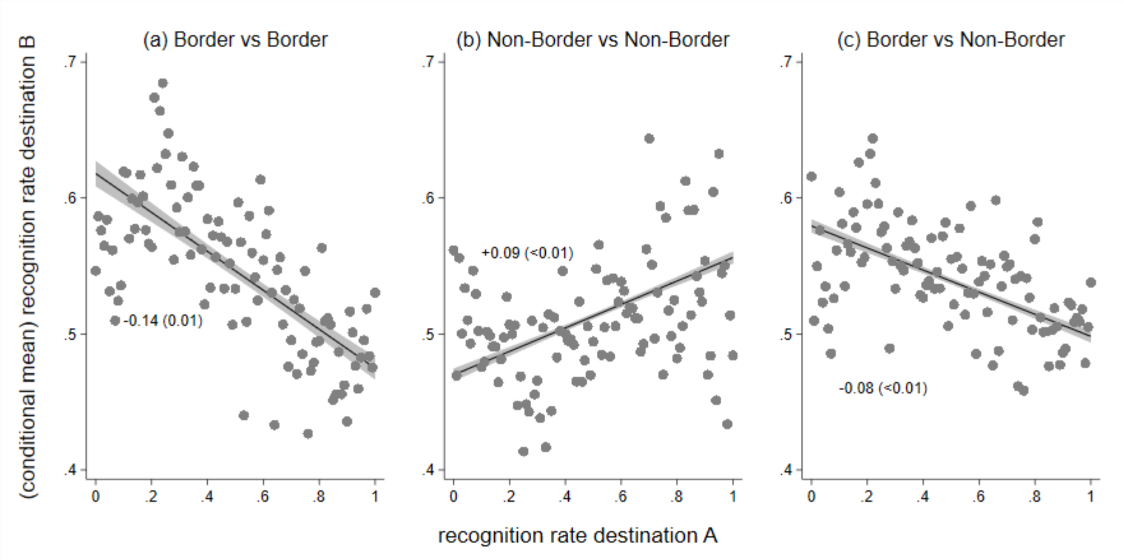


Figure 3: Recognition rates by origin country and quarter for pairs of European destination countries. The figure shows fitted lines indicating correlations and their 99% confidence intervals. Dots represent conditional means of recognition rates in destinations on the vertical axis within 100 equally spaced bins of recognition rates in destinations on the horizontal axis. Source: Eurostat data for 2008-2018.

The Syrian case. We focus our main analysis on the important case of Syrian refugee migration to Europe. In line with the severity of the conflict in Syria, Panel (a) of Figure 4 shows the high rate at which asylum applications by Syrians are decided positively in the European Union. Only Eritrean refugees reach a similarly high rate. By calibrating the model using information on Syrian refugees only, we avoid the need to extrapolate across very different contexts of forced migration.

Figure 4b shows the evolution of average recognition rates in Europe over time. Singling out refugees from Syria shows that the rise to the current level of recognition rates followed immediately after the outbreak of the Syrian civil war in 2011, with little variation since. Nevertheless, the same patterns of correlations in recognition rates illustrated in Figure 3 can be found when focusing on Syrian refugees only, as we show in Appendix A.

3 A Model of Refugee Migration

The correlations shown in Figure 3 point towards an interaction between different countries' asylum policies. Based on this evidence, we formulate a dynamic model

(a) Comparison across origin countries (b) Recognition rates over time

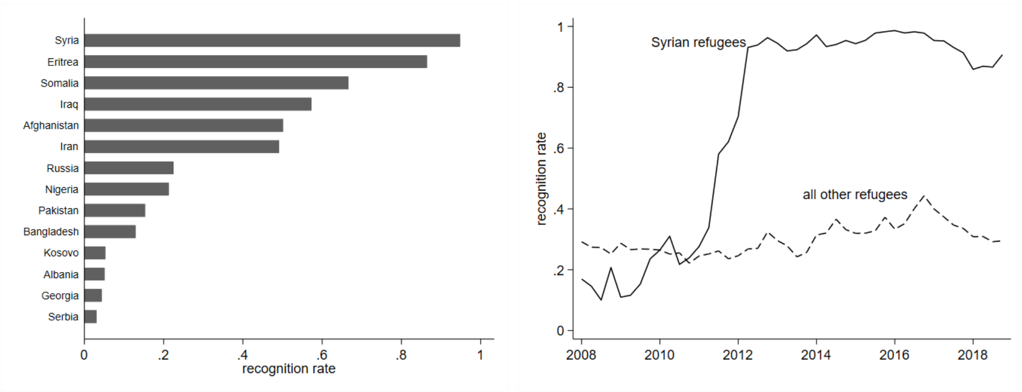


Figure 4: Fraction of asylum applications processed during 2008-2018 that have been decided in favor of the applicant. Panel (a) includes all countries of origin from which at least 100,000 applications have been filed in European Union countries. Panel (b) shows the evolution of recognition rates for Syrians and refugees from other origin countries over time.
Source: Eurostat 2008-2018.

of refugees' location choices, where one destination's asylum recognition rate may divert or enhance refugee flows, triggering a response by other countries. The model is tailored closely to the case of Syrian refugee migration, to which we calibrate its parameters.

The model has two layers with separate sets of decision makers. The first layer models individual refugees moving across locations. Their choices are determined by different flow utilities received in different locations, by whether a refugee is granted asylum, and by idiosyncratic preference shocks for different locations. We assume that recognition probabilities are known and taken as given by individual refugees. The second layer of the model acknowledges that these recognition rates are a choice of destination countries and an equilibrium outcome, which affects refugee flows and may trigger adjustments in other destinations' policies. We describe these two parts of the model in turn.

3.1 The Refugee's Location Problem

Most Syrian refugees are located in countries outside the European Union, with Turkey hosting the largest number. Among the Syrians who have entered the European Union, most have done so via one of its southeastern member countries, with a smaller number using the central Mediterranean route to enter via Italy. According to the Dublin agreement, refugees can only apply for asylum in the first EU country they reach, but in practice this rule has not been enforced for refugees from Syria during the period that our data is drawn from. Nevertheless, some refugees may be forced to request asylum in order to be allowed to enter an EU border country. Data from Eurostat in fact show that the share of asylum applications that is withdrawn is particularly high in border countries like Greece or Hungary (more on this below). In line with these observations, we assume that refugees who are located outside Europe may enter a border country in south or southeastern Europe. Subsequently, refugees can either file an application for asylum or travel further north within Europe. Once an application has been decided on, refugees can potentially move one final time. At that stage, however, re-applying in any other country is not permitted. Individuals thus choose whether and where to move, and whether to apply for asylum in a given location. The available choice sets as well as the payoffs associated with each choice depend on current location and on whether asylum has already been granted in some location.

3.1.1 Entering Europe

The initial location outside of Europe is denoted by T and the set of all possible destinations in Europe is given by $\mathcal{D}$. We will use both the letters ℓ and d to refer to elements of the set $\{T\} \cup \mathcal{D}$, where the letter ℓ is reserved for the current location when a choice is made, while d refers to a destination that can be reached in the future. The first choice an individual makes is whether to remain in T or to move on to Europe. The destinations that can be reached from T are collected in the set $\mathcal{D}_T \subset \mathcal{D}$. If an individual chooses to remain in T, this agent makes no further choices and receives the terminal value v_T plus an individual-specific shock ε^i_T. The choice of any destination $d \in \mathcal{D}_T$, on the other hand, is associated with a value $V_{d,F}$, which captures the general attractiveness of destination d, and an individual-specific shock ε^i_d. The state variable F indicates if the individual has the option to continue moving within Europe. If moving is still possible, F is equal to 0, while $F = 1$ implies that the chosen destination is final. Upon arrival in Europe, F is equal to 0 and switches to 1 when the person has completed their journey across southern Europe. Crossing the border into Europe entails a utility cost c. This cost reflects the fact that the journey to Europe often involves a perilous crossing of the

Mediterranean Sea. The initial value of a refugee is therefore given by

$$\max\left\{ v_T + \varepsilon^i_T,\ \max_{d\in\mathcal{D}_T}\ V_{d,F=0}\ +\ \varepsilon^i_d\ -\ c\ \right\}.$$

For any European destination d, the value of choosing this destination depends on subsequent choices described below.

3.1.2 Choices while in Transit

Arriving in a country while further movements are possible: When an individual enters a location $\ell \in \mathcal{D}$ and the state variable F is equal to 0, an individual can apply for asylum or move onwards. Asylum is granted with a location-specific probability p_ℓ. This probability is given from the perspective of the refugee, but will be set endogenously by country ℓ as we specify in Section 3.2. The value of entering a location ℓ under these conditions is given by

$$V_{\ell,F=0} = \mathrm{E}\left[\ \max\{p_\ell V^a_{\ell,F} + (1-p_\ell)V^r_{\ell,F} + \varepsilon^i_{\ell,s}\ ,\ V^m_{\ell,F} + \varepsilon^i_{\ell,m}\}\ \right]\ ,$$

where $V^a_{\ell,F}$, $V^r_{\ell,F}$ and $V^m_{\ell,F}$ respectively denote the continuation values of being accepted for asylum in location ℓ, being rejected, and of moving on from location ℓ. If the individual decides to move on and location ℓ is the last in a chain of transit countries, the state variable F switches from 0 to 1. The idiosyncratic preference shocks $\varepsilon^i_{\ell,s}$ and $\varepsilon^i_{\ell,m}$ for staying and moving on are revealed at the time when the choice has to be made. The expectation, which is taken with respect to these realisations, reflects that individuals do not know the value of the shocks before entering a location. Individuals are, however, aware of the distribution that shocks are drawn from.

When entering a country in the south of Europe, the individual is intercepted and forced to request asylum with probability f_ℓ. This application can be withdrawn and thus does not enter the agent's payoff. However, all forced applications, whether withdrawn later or not, count into the total number of applications received by a country, and therefore affect the moments used in the calibration.

Moving onwards prior to applying for asylum: The continuation value for moving on from a location ℓ with potential destinations $\mathcal{D}_\ell$ while $F = 0$ is given by

$$V^m_{\ell,F=0} = \mathrm{E}\left[\max_{d \in \mathcal{D}_\ell} V_{d,F=0} \;+\; \varepsilon^i_d\right] .$$

The value of moving on thus consists of the continuation value $V_{d,F}$ for the chosen destination d as well as an idiosyncratic shock ε^i_d.

Moving after an application has been decided: After having been accepted or rejected for asylum in a southern European location, individuals can still return to T or move to another destination within $\mathcal{D}$, though without the option to apply for asylum again. Subsequently, no further choices are possible. Hence, the values of being accepted or rejected in location $\ell \in \mathcal{D}$ are given by

$$V^a_{\ell,F} = \mathrm{E}\left[\max_{d \in \mathcal{D} \cup \{T\}} \mathbb{1}[d = \ell] v_{d,a} \;+\; \mathbb{1}[d \neq \ell] v_{d,r} \;+\; \varepsilon^i_{d,a}\right]$$

and

$$V^r_{\ell,F} = \mathrm{E}\left[\max_{d \in \mathcal{D} \cup \{T\}} v_{d,r} + \varepsilon^i_{d,r}\right] ,$$

where $v_{d,a}$ and $v_{d,r}$ are the terminal values associated with choosing location d as the final destination depending on the achieved legal status.

3.1.3 Arriving in a final destination

When an individual enters a location $\ell \in \mathcal{D}$ and the state variable F has switched to 1, the asylum decision cannot be further delayed. This decision will be final, and asylum is granted with probability p_ℓ. The individual's terminal value in this case is $v_{\ell,a}$, whereas it is $v_{\ell,r}$ if asylum is rejected. Thus, the value of reaching a final location ℓ is given by

$$V_{\ell,F=1} = p_\ell v_{\ell,a} \;+\; (1 - p_\ell) v_{\ell,r} .$$

The terminal values that individuals receive once no further choices can be made, such as $v_{\ell,a}$ and $v_{\ell,r}$ in the equation above, depend on a large range of factors, including cultural and economic ones, many of which are unobservable to the econometrician. Rather than specifying a parametric utility function with assumptions about the relative importance of observed and unobserved factors, we calibrate the payoff for each destination to match observed migration patterns. This approach is more flexible than, for instance, assuming that payoffs are proportional to average earnings in each country. In addition to these common payoffs, choices are valued differently across individuals, as captured by the idiosyncratic payoff shocks $\boldsymbol{\varepsilon}^i = \{\varepsilon_d^i, \varepsilon_{d,s}^i, \varepsilon_{d,m}^i, \varepsilon_{d,a}^i, \varepsilon_{d,r}^i\}$. We assume that these shocks follow a standardized extreme value distribution. The choices faced by refugees in the model are summarised in the decision tree presented in Figure 5.

3.2 The Game between Destinations

The asylum recognition rate p_d in any destination country d is taken as given by individual refugees, but set strategically by the country itself. The players of this game are given by the destinations in $\mathcal{D}$. Each of these countries chooses the fraction of received asylum applications that are approved. In the model of location choices described above, individual refugees' decisions depend on a comparison of all recognition rates. The number of arrivals in any one destination thus depends on the choices of other destinations and each country decides strategically, fully taking this interdependence into account.

We assume that each destination d aims at a specific number σ_d of Syrians applying for asylum within its territory. This number can be thought of as the result of a process of collective decision-making within the country. For instance, the government of each country may decide on a target number of arrivals taking the preferences of different voter groups or the country's economic capacity into account. Both the public discourse in Europe and reallocation attempts have focused on total numbers of asylum applicants rather than on asylum seekers who eventually are accepted.[9] Empirically, we observe positive numbers of recognized asylum seekers in all European destinations. This suggests that (conditional on the conditions in countries of origin) no country has a preference to host zero refugees. The model, however, does not make this restriction ex-ante.

[9] In practice, recognition rates vary across types of refugees from the same origin country. Yet, the public debate focuses on the numbers of arrivals overall. It therefore seems plausible to assume that it is also this number that matters to politicians. The determination of the guidelines that lead to different recognition rates for different types of Syrians, for example, would then be driven by the aim of achieving the overall target, rather than being an end in itself.

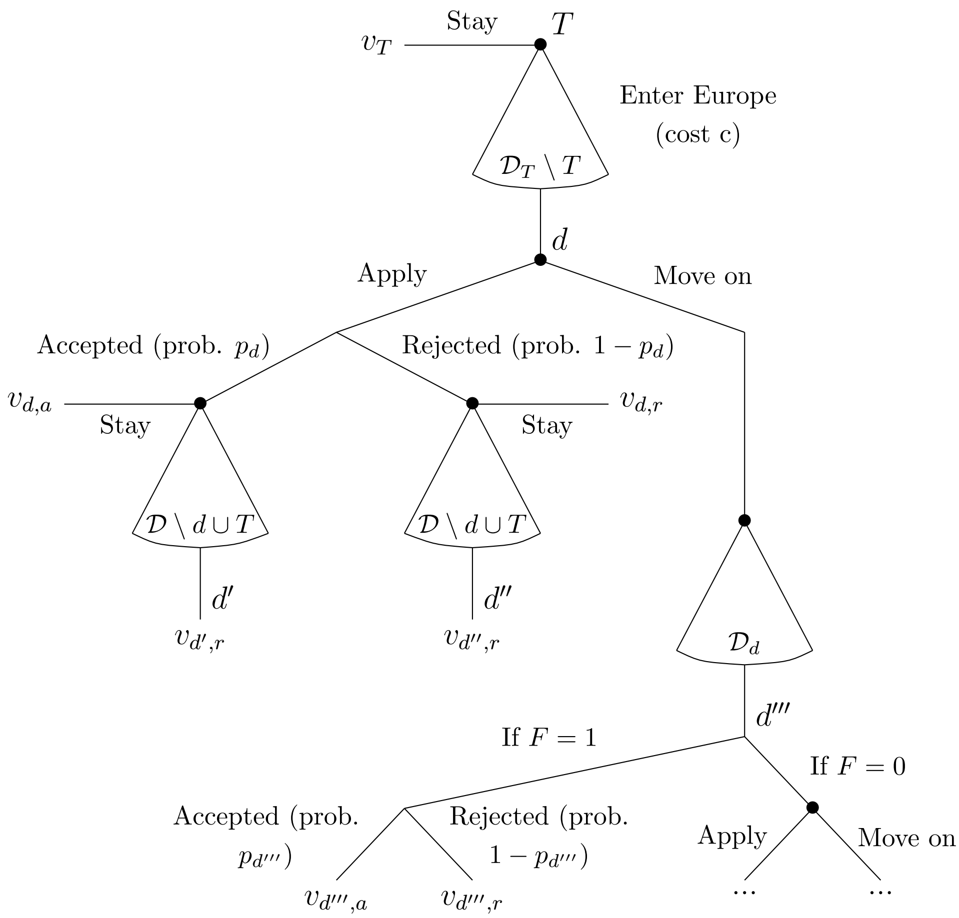


Figure 5: Decision tree summarising the choices Syrian refugees face in the model. Black dots indicate points where the refugee makes a decision. Choices over a set of destinations are represented by a sector of a circle, with the choice set given inside the segment. The state variable F indicates whether a final destination has been reached. In addition to the terminal value received at the final destination, the utility of a refugee is also affected by shocks associated with each choice made along the journey.

Formally, the action each country $d \in \mathcal{D}$ takes is to set its recognition rate $p_d \in [0, 1]$. Let $\mathbf{p}$ be the vector of all destinations' recognition rates, while $\mathbf{p}_{-d}$ denotes the vector of recognition rates of all countries other than destination d. The function $s_d(\mathbf{p})$ gives the number of arrivals in country d for any given vector of recognition rates. The objective of destination d is to choose p_d to maximise

$$\Gamma_d(p_d, \mathbf{p}_{-d}) = L(s_d(p_d, \mathbf{p}_{-d}), \sigma_d) \ , \tag{1}$$

where $L : \mathbb{R}^2_{\geq 0} \to \mathbb{R}$ achieves a maximum in s_d at $s_d = \sigma_d$ and is strictly monotone increasing (decreasing) in s_d on the interval $[0, \sigma_d)$ (on the interval (σ_d, ∞)).

We consider Nash equilibria in pure strategies of the game among destinations. A useful feature of this game is stated in Proposition 1.

Proposition 1. *The number of refugees $s_d(\mathbf{p})$ applying for asylum in a destination $d \in \mathcal{D}$ is strictly increasing in the rate p_d at which this country recognizes asylum applications.*

Proof. See Appendix B. ■

A consequence of Proposition 1 is that the best response $R_d(\mathbf{p}_{-d})$ of a country to other destinations' policies is always unique: either a destination achieves its desired number of arrivals at some interior recognition rate, or it chooses a recognition rate of zero (one) if the number of arriving refugees is too high (low). An observation that follows is that at any interior equilibrium $\mathbf{p}^* \in (0,1)^{|\mathcal{D}|}$ of the game, each destination achieves its optimal number of arrivals.

Proposition 2. *At any interior equilibrium $\mathbf{p}^* \in (0,1)^{|\mathcal{D}|}$ of the game, the actual number of arrivals $s_d(\mathbf{p}^*)$ is equal to the desired number of arrivals σ_d for every destination d.*

Proposition 2 follows, since Proposition 1 implies that if any destination achieved less (more) than the desired number of refugees, it could improve by setting a higher (lower) recognition rate. Hence, at least one destination would readjust its strategy, contradicting equilibrium. It also follows that the existence of at least one equilibrium in pure strategies is guaranteed, since best responses are continuous functions mapping from $[0,1]^{|\mathcal{D}|-1}$ into $[0,1]$. Brouwer's fixed-point theorem accordingly implies existence of an equilibrium, albeit not the existence of an interior one.

All other characteristics of the game depend on the parameter values in the model of location choices by refugees. Recognition rates may, for example, be strategic complements if a more generous policy in one country lowers the number of arrivals in another destination and therefore results in a higher recognition rate set by the latter. It is, however, equally possible that policy choices are strategic substitutes, or in fact that the externalities among destinations have varying signs. The reason for this is that the recognition rate set by one destination has a number of competing effects on the number of arrivals in the other destinations. The most direct effect is that an increase in the recognition rate set by destination d will make some individuals move to destination d who would have otherwise moved to some other destination d'. This reduces the number of arrivals in d'. However, a more generous asylum policy in a destination d also attracts more refugees to Europe as a whole, and in particular increases the option value of moving to a border country, as refugees can move on to apply elsewhere. As a consequence, the number of people deciding to move to Europe will increase, and subsequent realizations of preference shocks ε may interfere with a refugee's initial target destination. Hence, an increase in p_d may equally raise the number of arrivals in some other destination d'.

The fact that every country achieves its optimal number of arrivals at an internal equilibrium does not rule out that there could be benefits from cooperation, as is the case in Fernández-Huertas Moraga and Rapoport (2014) for example. In fact, the payoff function for destination countries used here is closely related to the one employed by those authors. While the first part of their utility function is a special case of our specification, theirs includes an additional term that depends on the numbers of refugees accepted in other countries. This additional term captures an (altruistic) benefit from the reduction in international poverty and implies that a non-cooperative equilibrium is inefficient, but has no impact on individual behaviour otherwise. Hence, in a non-cooperative context our results extend to the setting considered by Fernández-Huertas Moraga and Rapoport (2014). The failure of the EU system to relocate refugees across member countries indicates that so far cooperation has not been achieved.

4 Identification and Calibration

Our aim is to gain insights into the strategic element of policy choices regarding refugee flows across European countries. As a first step, this requires an adaptation of the model to European geography. Specifically, we need to specify the sets $\mathcal{D}_\ell$ of destinations that can be reached from any current location ℓ (see Section 3.1). As mentioned earlier, Syrian refugees typically enter Europe via one of the southern or southeastern member states of the European Union. We distinguish the two main routes of entry for Syrian refugees into Europe: one via southeastern Europe (often through either the Eastern Mediterranean or the Black Sea), from where most arriving refugees continue to northern Europe via the Balkans and Hungary, and a second one via the central Mediterranean route to Italy. For 2011-

2014, Frontex registered 54.1 percent of all 113,951 detected illegal border crossing into the EU by Syrians along the first, and 45.6 percent along the second route.[10] The number of asylum applications by Syrians reported by Eurostat for the same period is considerably higher at 192,080. The gap between the numbers of asylum applications and detected border crossings would be problematic for our analysis if it reflects a significant number of Syrians arriving in Europe by plane, since we do not allow for this route in the model. An alternative explanation is that some border crossings went undetected in the early period of the refugee crisis and before the budget of Frontex was substantially increased.[11] Consistent with the latter argument, detections of Syrians reported by Frontex equal 98% of the number of asylum applications recorded by Eurostat in 2015/2016. Ultimately, we cannot be sure which explanation is more relevant. It is noteworthy though that the number of Schengen visas issued to Syrians collapsed soon after the onset of the conflict in 2011 (European Union Agency for Fundamental Rights, 2015), making it substantially more difficult for Syrians to enter Europe along conventional routes.

Overall, we model a game between 19 European locations. We include all European Union member states plus Norway and Switzerland, however excluding the islands Cyprus and Malta. We further pool a number of smaller countries that received fewer than 100 applications in 2014 with a neighbouring country.[12] The resulting players comprised in $\mathcal{D}$ are Austria; Belgium and Luxembourg; Bulgaria; Czech Republic and Slovakia; Denmark; Estonia, Latvia, Lithuania, and Poland; Finland; France; Germany; Greece; Slovenia and Hungary; Ireland and the United Kingdom; Italy; Norway; the Netherlands; Portugal and Spain; Romania; Sweden; and Switzerland. Refugees can choose among these plus the non-European location T.[13] Table 1 shows how we define countries of first entry and the routes refugees

[10] FRAN data, accessible at https://frontex.europa.eu/along-eu-borders/migratory-map/.

[11] The budget of Frontex more than doubled between 2014 and 2016 while the budget for the important part of joint operations almost tripled (see the annex to Frontex Budget 2016, accessible at https://frontex.europa.eu/about-frontex/key-documents/).

[12] Due to the low numbers of applications that the countries in question receive, the results are largely independent of how we choose to pool smaller countries. We pool Luxembourg with Belgium, which receives fewer applicants than Germany or the Netherlands; Czech Republic with Slovakia on historical grounds; the Baltic States with Poland, which receives fewer applications than Finland; Slovenia with Hungary, which both were on the route for many refugees moving from southeastern Europe northwards; and Ireland with the UK and Portugal with Spain as the respectively closest neighbours.

[13] Due to our focus on the strategic interaction among European locations, we subsume refugees outside of Europe and internally displaced persons under the fraction of the Syrian population that has not moved to a country in the set $\mathcal{D}$.

can take. From any given country, the countries in the box(es) immediately below can be reached in one move. Once the last row of the table has been reached, the decision to apply for asylum can no longer be delayed.[14]

<table>
<tr><td colspan="2">Locations outside of Europe (Location T)
⇓ ⇓</td></tr>
<tr><td>Bulgaria, Greece, Romania
⇓</td><td rowspan="2">Italy
⇓</td></tr>
<tr><td>(Hungary, Slovenia)
⇓</td></tr>
<tr><td colspan="2">Any of the destinations in $\mathcal{D}$ as well as location T</td></tr>
</table>

Table 1: Migratory routes. Destinations in parenthesis are treated as a single country in the calibration due to small numbers of observations. Arrows indicate the direction of travel: from any given country, all of the countries in the box(es) immediately below can be reached.

Determining the strategic nature of policies requires identification of the vector of structural parameters in our model. These include the payoffs $\mathbf{v} = (v_{Austria,a}, ..., v_{Switzerland,a})'$ refugees attribute to being accepted in any given destination d, the cost c associated with entering Europe, the vector $\mathbf{f}$ of probabilities of being forced to apply for asylum upon entering a destination, as well as the fractions $\boldsymbol{\sigma} = (\sigma_{Austria}, ..., \sigma_{Switzerland})'$ of the Syrian population different European destinations aim at hosting.[15] We proceed by first describing the data we use before discussing the identification of the parameters and the calibration process.

4.1 Data

To identify the model's parameters, we use Eurostat data on asylum requests, application withdrawals, recognitions of applications and voluntary out-migrations by Syrians in European countries. We use data from the first years after the outbreak

[14]That is, the state variable F switches from 0 to 1 when an individual decides to move on from Hungary/Slovenia or Italy.

[15]Note that a normalization on both the scale and the location of utility flows is required, so that we set V_T, the value of not being in Europe to zero. The scale of utility flows and costs is normalized by the standardization of the variance of unobserved taste shocks ε. The data we have also do not allow an identification of the values attributed to being rejected, $v_{d,r}$, so that we set them to zero.

of the Syrian conflict, between 2011 and 2014, when refugee migration into Europe had picked up, but before a number of countries introduced border controls to neighbouring EU member states.[16]

Figure 6a shows the number of asylum applications by Syrian refugees the different European locations received between 2011 and 2014, whereas Figure 6b shows the share of applications withdrawn during this time.[17] The number of received applications tends to be highest in countries in northern Europe, while the share of withdrawn applications is generally highest in the south. A notable exception is Bulgaria, which receives a high number of applications and sees very few withdrawals. Figure 6c displays the share of positive decisions on asylum applications (among those that have not been withdrawn), again during the years 2011-2014. There is strong variation across countries, with Greece accepting less than half of all applications, while Bulgaria at the other extreme rejects less than 10 percent. Since the number of annual asylum applications has been increasing throughout our time window, these numbers largely reflect the recognition rates prevailing in 2013/2014, when the plateau in average recognition rates visible in Figure 4b had already been reached. In addition, we use information from Eurostat on the number of Syrian nationals who left the European Union voluntarily among those who received an order to leave. Orders to leave are issued when an asylum application has been rejected. This information is available only for a small set of countries, and we average across countries. The average ratio of recorded leavers to applicants across countries is 2.85 percent, which we use as an additional moment that allows identification of the cost c of moving to Europe.

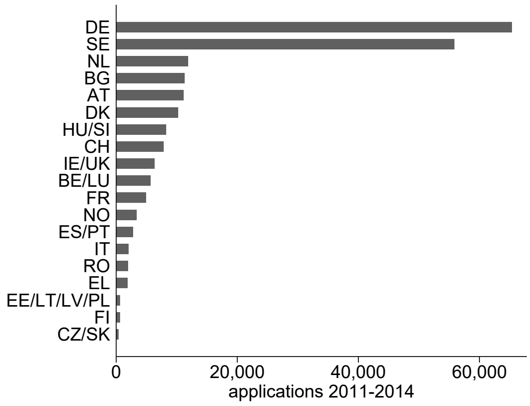
4.2 Identification

In this section we discuss the identification of the parameters based on the data described in the previous section. For this purpose, it is useful to distinguish the average level of the payoffs in $\mathbf{v}$ from their relative magnitudes. The latter can be

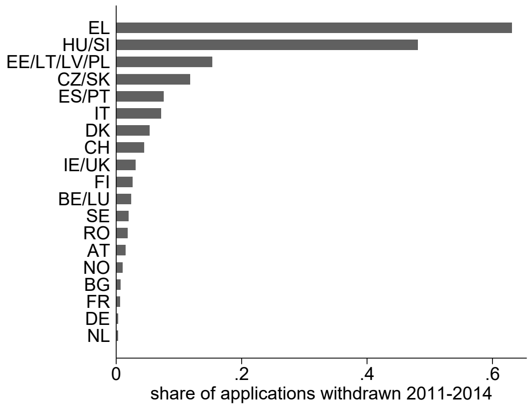
[16] Besides the successive introduction of border controls and the construction of physical barriers in 2015, a number of major events affected Syrian refugee migration that are beyond the scope of our model. The most important ones are the food supply crisis in refugee camps in Jordan and the beginning of Russian military intervention in Syria, both of which contributed to the surge in refugee numbers arriving in Europe in 2015.

[17] "Applications withdrawn" refers to applications for asylum having been withdrawn by the applicant during the reference period at all instances of the administrative and/or judicial procedure, as defined by Article 4.1(c) EU Regulation 862/2007.

(a) Applications filed



(b) Applications withdrawn



(c) Recognition rates

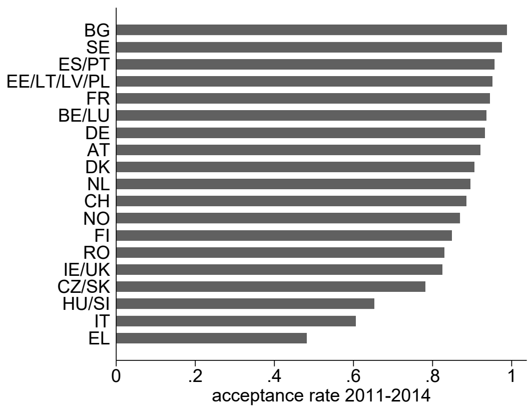


Figure 6: Asylum applications, fraction of applications withdrawn and recognition rates by Syrian refugees 2011-2014 in different European locations, corresponding to the players we consider in the game described in Section 3.2. Source: Eurostat.

identified from the observed distribution of the refugees who have entered Europe across the different countries. Note that the payoffs $\mathbf{v}$ are expressed relative to the payoff of remaining in T, which is normalized to zero. The average level of the payoffs $\mathbf{v}$ is thus identified by the number of individuals who voluntarily leave Europe and return to T. The cost c of entering Europe, on the other hand, is pinned down by the overall number of refugees arriving in Europe. Since the number of withdrawn asylum applications across destinations in the model is determined by the probability of being forced to apply, observing the former is informative about the latter set of parameters. Finally, the desired numbers of arrivals $\boldsymbol{\sigma}$ are identified by the observed policy choices.

4.3 Calibration

To calibrate the parameters of the model, we proceed in two steps. First, we calibrate the location choice part of the model that describes the decisions of refugees conditional on the observed policy equilibrium $\mathbf{p}^*$. This is possible since refugees are assumed to take recognition rates as given. This first step yields estimates of payoffs $\mathbf{v}$, the cost c, and the probabilities $\mathbf{f}$ of being forced to apply for asylum upon entry. In a second step, we use the observed policy choices (recognition rates)—or, equivalently, the insight from Proposition 2—to back out $\boldsymbol{\sigma}$, as we explain further below.

To solve the refugee's location choice problem we find optimal decision functions by backward induction. Given the assumption that the idiosyncratic preference shocks in $\boldsymbol{\varepsilon}^i$ follow standardized extreme value distributions, the choice probabilities at each step have closed-form expressions of the familiar logistic shape (see also Appendix B). Once we have derived these functions determining the movements of refugees, we can calculate the share of refugees arriving in any destination d that is forced to apply for asylum, f_d, such that the number of withdrawn applications is consistent with the data.[18] Adding forced applications to voluntary applications, we can construct counterparts to the data moments $\mathbf{m_D}$ listed in Table 2 and search for the value of parameter vector $\boldsymbol{\theta} = (\mathbf{v}, c)$ that minimises the (weighted

[18]Recall that being forced to apply does not influence refugees' payoffs, since such an application can be withdrawn. The share f_d can then be calculated as follows: Let A_d be the number of individuals who enter d while M_d denotes the probability that a refugee arriving in d wants to move on rather than apply for asylum. The number of withdrawn applications W_d is then equal to $A_d f_d M_d$. Accordingly, f_d can be calculated as $W_d/(M_d A_d)$, where W_d is the observed number of withdrawals and M_d and A_d are implied by the model.

squared) distance between these theoretical moments $\mathbf{m_M}(\boldsymbol{\theta})$ and their empirical counterparts $\mathbf{m_D}$. Accordingly, the objective function we minimize is given by

$$crit = (\mathbf{m_D} - \mathbf{m_M}(\boldsymbol{\theta}))'\mathbf{W}(\mathbf{m_D} - \mathbf{m_M}(\boldsymbol{\theta})).$$

Note that $\mathbf{m_D}$ contains not sample but population moments, based on administrative data supplied by European states to Eurostat rather than fractions computed from a sample. As such, we do not expect measurement error to be an issue here. It also implies that the moments in $\mathbf{m_D}$ do not have standard errors. In the absence of standard errors, a convenient choice for the weighting matrix $\mathbf{W}$ is a diagonal matrix with the inverse targeted empirical values $\mathbf{m_D}$ on the diagonal. The criterion thus measures the squared deviation between empirical and simulated moments in percentage terms (relative to the empirical magnitude of each element of $\mathbf{m_D}$).[19] Table 2 contrasts the theoretical and data moments, showing that despite its non-linearities the model is able to perfectly match the observed application and emigration numbers. Appendix E, where we display the criterion for different values of each parameter, shows that the criterion function obtains a local minimum at each estimated parameter, indicating local identification of parameter vector $\boldsymbol{\theta}$ through the moments in $\mathbf{m_D}$.

Whereas the part of the model which describes refugees' location choices can be calibrated taking countries' policies as given, a counterfactual evaluation of the effect of a change in policies that accounts for the strategic interaction across destinations requires knowledge of $\boldsymbol{\sigma}$. In a second step, we thus use the insight from Proposition 2 that each country achieves its optimal number of refugees in any interior equilibrium of the game among destinations. Empirically, we observe strictly positive recognition rates in all European destinations (see Figure 6c), which suggests that (given the conflict, international obligations and reputation) no country has a preference to host zero refugees. Since, furthermore, observed recognition rates are in fact strictly between zero and one, the observed outcome is an interior equilibrium and Proposition 2 applies. In line with Proposition 2, we thus set the desired number of arrivals σ_d equal to the number of arrivals predicted by the calibrated model for each destination d. Given that the model has a perfect fit, it follows that the desired numbers of arrivals are also equal to the actual numbers of arrivals.

[19]We have also used an identity matrix for weighting and obtain the same parameter estimates.

Moment	Data	Model
(a) Asylum requests/destination: (% of Syrian population)		
AT	0.053	0.053
BE/LU	0.027	0.027
BG	0.054	0.054
CZ/SK	0.002	0.002
DE	0.313	0.313
DK	0.049	0.049
EE/LT/LV/PL	0.003	0.003
EL	0.009	0.009
ES/PT	0.013	0.013
FI	0.003	0.003
FR	0.024	0.024
HU/SI	0.040	0.040
IE/UK	0.030	0.030
IT	0.010	0.010
NL	0.057	0.057

Moment	Data	Model
Asylum requests/destination: (% of Syrian population)		
RO	0.009	0.009
SE	0.268	0.268
NO	0.016	0.016
CH	0.038	0.038
(b) Emigration:		
% of applicants	2.846	2.846
(c) Applications withdrawn in border and transit countries:		
BG	0.66%	0.66%
EL	63.06%	63.06%
HU/SI	48.09%	48.09%
IT	7.13%	7.13%
RO	1.84%	1.84%

Table 2: Model fit for (a) the number of asylum requests by Syrians received by destinations 2011-2014, (b) the average share of Syrians leaving Europe per asylum application received 2011-2014, and (c) the rate at which asylum applications are withdrawn in border and transit countries. Note that we target population moments that do not have standard errors.

As argued in Section 3.2, an equilibrium in this game between 19 European destinations always exists. For all parameter values that we encountered, this equilibrium is also unique. However, this is not a theoretical result, and we cannot rule out the existence of multiple equilibria for all possible parameter combinations. Yet, this does not hamper our estimation: The individual location choice can be estimated given the observed policy equilibrium. The game we analyse is observed only once, and the observed policies directly map into preference parameters $\sigma_d = s_d(p_d, \mathbf{p}_{-d})$ for each destination d. As we consider pure strategy equilibria only, we can further check numerically for multiple equilibria given the estimated parameters using the best-response search algorithm with tabu lists proposed by Sureka and Wurman (2005). This procedure follows best-response dynamics in a loop over all players, avoiding circularity by using tabu lists that keep track of previously followed paths. We describe this algorithm in more detail in Appendix C. For

10,000 attempts with randomized starting vectors of choices $\mathbf{p}$, the algorithm never detected more than one equilibrium, while always identifying the same equilibrium coinciding with the observed policy choices.

5 Results

In this section, we first present the estimated parameters before analysing the strategic interdependencies in European recognitions rates. We also discuss the implications of our results for estimation frameworks relying cross-country variation.

5.1 Model Parameters

Table 3 lists the payoffs refugees derive from being accepted across destinations, the cost of moving to Europe, as well as the probabilities of being forced to apply for asylum in southern countries that allow our model to match the moments targeted in the calibration detailed above. As we use population moments rather than sample moments, the targeted fractions listed in Table 2 do not have standard errors. Hence, there are no standard errors for the estimated parameters either. Since our data only allow identification of the values of being accepted for asylum relative to not being accepted (which includes rejection and being in the non-European location T), v_d denotes the utility *gain* from being granted asylum in a given destination d. Migration decisions depend on shock realizations $\boldsymbol{\varepsilon}^i$. For individuals outside of Europe, these shocks summarize violent events in Syria as well as conditions in non-European host countries. The high cost of moving implies that in the absence of these shocks individuals would have no incentive for moving to Europe, in line with the very small number of Syrian migrants in Europe until 2011. In the presence of shocks $\boldsymbol{\varepsilon}^i$, the high cost further rationalizes why even after 2011 only a relatively small fraction of the Syrian population arrives in Europe. The low probabilities that a refugee is forced to file an asylum application on arrival in one of the southern destinations indicate that a large numbers of Syrians pass through these countries. This large transit migration explains that, for example, about 60 percent of all applications in Greece are withdrawn even though only two percent of arrivals apply against their will.

Parameter	Estimated value
(a) Payoffs by destination:	
v^a_{AT}	6.392
v^a_{BELU}	5.360
v^a_{BG}	5.732
v^a_{CZSK}	1.804
v^a_{DE}	8.754
v^a_{DK}	6.381
$v^a_{EELTLVPL}$	2.294
v^a_{EL}	2.537
v^a_{ESPT}	4.286
v^a_{FI}	2.469
v^a_{FR}	5.117
v^a_{HUSI}	4.247
v^a_{IEUK}	6.253
v^a_{IT}	4.924
v^a_{NL}	6.663

Parameter	Estimated value
Payoffs by destination:	
v^a_{RO}	3.736
v^a_{SE}	8.161
v^a_{NO}	5.015
v^a_{CH}	6.143
(b) Cost of entering Europe:	
c	19.387
(c) Prob. of forced application:	
f_{BG}	0.13%
f_{EL}	2.09%
f_{HUSI}	2.36%
f_{IT}	0.46%
f_{RO}	0.06%

Table 3: Parameter estimates. V_T is normalized to 0, so that estimates of utility flows in other destinations are relative to that in T. Note that because we target precise population moments that do not have standard errors, there are no standard errors for the calibrated parameters either.

5.2 Equilibrium and Best Response Functions

If several potential destination countries do not submit to a centralized asylum recognition and allocation scheme, spillovers from a unilateral change in one country's recognition rate may trigger an adjustment in another destination's policy. We use the calibrated model to examine the interdependency between asylum recognition rates in different European destinations. Within the model, a country's change in asylum policy may come about because of a change in a destination's preference for hosting asylum seekers, as captured by σ_d. At constant preferences $\boldsymbol{\sigma}$, policies further adjust if there is an exogenous shock to the supply of refugees, a situation we discuss further below.

When a country adjusts its recognition rate, two mechanisms are set in motion: If a rise in one destination's recognition rate attracts many refugees to Europe who end up applying for asylum in another destination, the latter may lower its recognition rate in response. If, on the other hand, a higher recognition rate primarily diverts refugee flows towards the destination in which the probability of being recognized has increased, a now relatively less attractive destination may see room for recognizing a larger fraction of the asylum applications it receives. Which of these two effects dominates will determine whether best response functions are upward or downward sloping, and thus whether recognition rates in this game between destinations are strategic complements or substitutes.

We can graphically trace out best response functions by simulating asylum applications in any given destination for a grid of its own and other destinations' recognition rates. Maximizing the resulting payoff to a destination, as given in Equation (1), yields the best response as a function of all other players' policies. We illustrate this graphically for two destinations, Greece and Sweden, keeping recognition rates for all other destinations at their actual values.

Figure 7 shows heat-maps of the payoffs for Greece and Sweden as a function of the two destinations' policies, with darker areas indicating higher payoffs.[20] The respectively other destination's recognition rate is denoted on the horizontal axis. A destination's best response function then is the recognition rate which, for any level of the respectively other destination's policy, yields the highest payoff.[21]

The downward sloping pattern in policy combinations that yield high payoffs for Greece in Figure 7a indicates that its recognition rate is a decreasing function of the recognition rate in Sweden. The horizontal pattern in Figure 7b, on the other hand, suggests that the best response of Sweden is largely independent of the recognition rate of Greece. Hence, whereas the recognition rate in Sweden is unresponsive to that in Greece, the recognition rate in Greece is a strategic substitute for the recognition rate of Sweden. Note that this is not imposed by the model. To the extent that a higher acceptance of refugees in one country reduces the incentive to apply for asylum elsewhere, other destinations may respond by raising their recognition rates. We show further below that recognition rates are indeed strategic complements for some countries. Thus, even though we use a fully specified structural model, we do not impose shape restrictions on destinations' best response functions. Best response functions can, depending on the estimated

[20]For the purpose of Figure 7, we assume that the payoff of a destination is given by the absolute value of the difference between the actual and the targeted number of arrivals. All other results, including the best response functions in Figure 8, can be derived from the more general utility function given in Equation 1.

[21]We simulate refugee numbers for 101×101 policy combinations, and use a cubic polynomial to interpolate payoffs between these grid points.

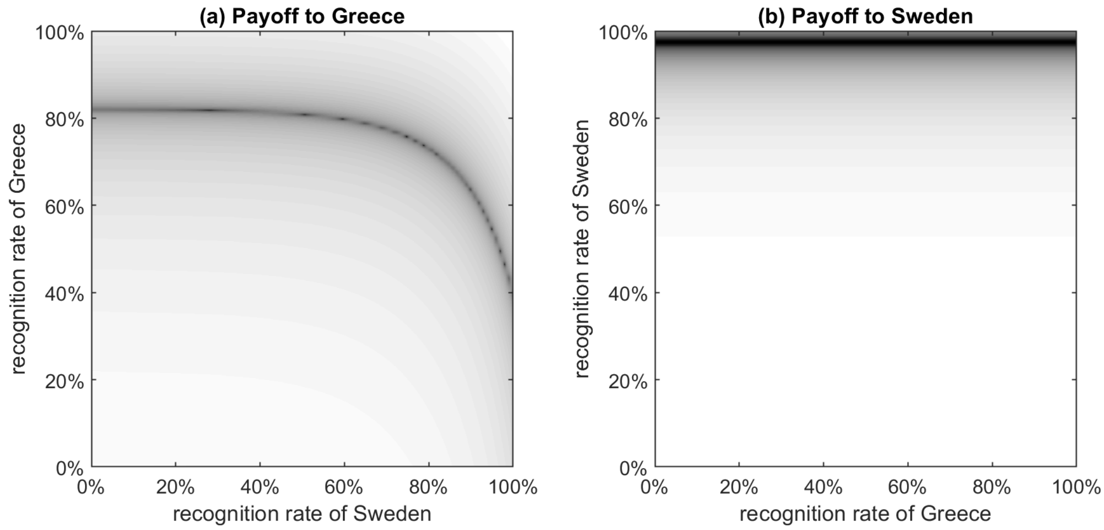


Figure 7: Example of destinations' payoffs as a function of own and other destination's policy, Greece and Sweden. The figure shows heat-maps that are darker the closer a destination is to its preferred number of asylum seekers, σ_d.

parameter values, be upward or downward sloping, or in fact be non-monotonic. We overlay the best response functions from Figures 7a and 7b in Figure 8. The solid line $R_{EL}(p_{SE})$ is Greece's optimal recognition rate (on the horizontal axis) given the policy of Sweden (on the vertical axis). Similarly, the dashed line $R_{SE}(p_{EL})$ depicts Sweden's best response. The two curves intersect at the game's Nash equilibrium.

Figure 9 shows the variation in the direction and strength of the responses of different destinations to changes in the recognition rate in another country, in this example Sweden. We present the reactions as semi-elasticities in the sense of percentage changes in a country's recognition rate in response to a change in Sweden's policy of one percentage point. We show the full matrix of semi-elasticities for all 19 destinations in Appendix D. Two aspects are worth highlighting: First, there is considerable variation in how strongly destinations respond, with major receiving countries like Germany responding least. That the strategic interdependence between Germany and Sweden—the countries with the largest numbers of arrivals—is particularly weak has an intuitive reason: Given that Germany is an attractive destination, policy changes there have a strong effect on the number of arrivals. Accordingly, a small response by Germany to a policy change in Sweden is enough to offset any undesired deviation in the number of arrivals. We discuss this effect in more detail below. Second, northern and western European countries tend to

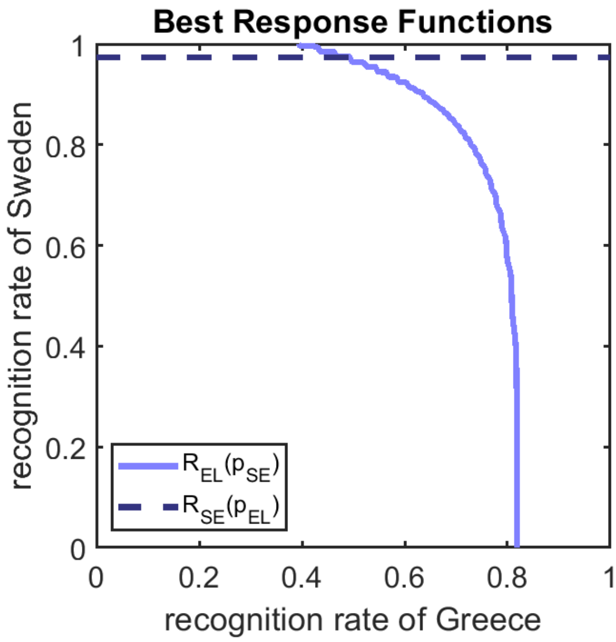


Figure 8: Example for mutually best responses in the game between destinations, Greece and Sweden. The figure shows the optimal recognition rate for Greece (solid line) as a function of Sweden's recognition rate, as well as the optimal recognition rate for Sweden (dashed line), keeping recognition rates for all other destinations at their actual values.

accept more refugees in response to a rise in the Swedish recognition rate, implying that for these countries recognition rates are strategic complements. The strongest reaction, however, is predicted for Greece, which in response to an increase in the recognition rates of northern European countries strongly tightens its own policy. Other southern and southeastern countries react similarly if less strongly.

Figure 9 distinguishes between individual responses, where one country reacts to the change in policy in Sweden while other countries' policies are held constant (dark bars), and responses that account for the reaction by all other countries (light bars). The latter results in a new equilibrium, given the higher recognition rate in Sweden.[22] As the figure illustrates, equilibrium responses may be either smaller or larger than individual responses. This is the case as reactions in other countries entail an attraction and a diversion effect, just as the original change in the Swedish policy does. In relative terms, the responses of some countries in the

[22]The new equilibrium, subject to a fixed change in the Swedish recognition rate, was calculated employing the best-response search with tabu lists explained in Appendix C. We ran the algorithm 100 times while randomising the order of best responses, always arriving at the same equilibrium.

north of Europe, such as Switzerland or Denmark, are magnified by a factor between three and four when allowing for simultaneous reactions. However, the elasticities in question remain small in either case and overall the differences are very moderate in absolute terms.

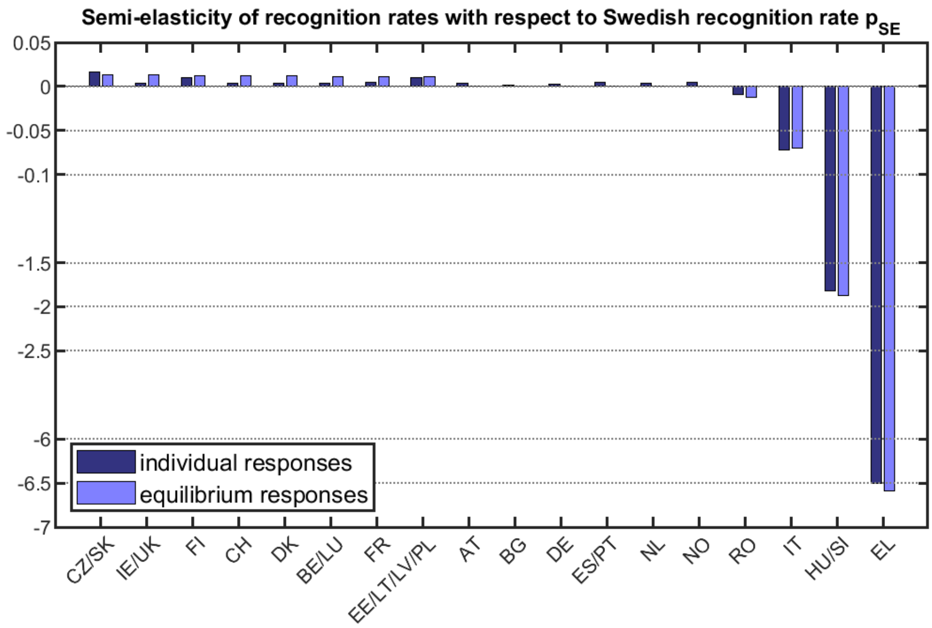


Figure 9: Example of strategic responses. The figure shows the semi-elasticity of each destination's optimal recognition rate with respect to the recognition rate set by Sweden. Responses are shown both for the case that one country responds individually and for the case that countries other than Sweden move to a new equilibrium.

As Table 4 illustrates, these examples are reflective of a broader pattern. Panel (a) displays the shares of positive responses by country groups. Among countries in the north policies are strategic complements while they are mostly strategic substitutes between countries in south and southeastern Europe. Between these two groups, on the other hand, increases in acceptance rates in the north generally provoke a tightening of policy further south. In reverse, northern countries shift their acceptance rates in the same direction as southern countries, even though these effects are almost negligible in magnitude.

How strongly a destination responds is related to a number of factors. First, the geographic location of a country, and in particular whether it has an external EU border, determines how many migrants pass through and potentially apply. Panel (b) of Table 4 shows that countries outside of the northernmost group generally react most strongly, and particularly so when responding to a policy change in a northern country.

Second, countries respond more strongly to changes in a country d if that destination has a high value $v_{d,a}$ that refugees attach to being accepted for asylum there. For destinations with a high value, any change in the recognition rate implies a large change in the expected payoff from applying for asylum, and thus a stronger effect on other destinations. This is irrespective of whether the attraction or the diversion effect dominates.

Third, also the attractiveness of the responding country matters. In this case, two competing effects are at play. Consider, for example, a decrease of the acceptance rate of a country in a situation where the diversion effect dominates. The refugees who in response file their application in a different location will tend to do so in other destinations with favourable conditions, leading to a stronger reaction there. However, changes in the recognition rate of a more attractive country have a stronger impact on application numbers as argued in the previous paragraph. The latter effect, in isolation, reduces the size of the policy change in the responding country. As the results indicate, the second effect dominates and countries with a higher value for refugees react less strongly.

Taken together, these factors explain the largest response, which occurs in the case of Greece reacting to a policy change in Germany with a semi-elasticity of -8.2. This strong effect is the result of a confluence of several factors, such as Greece's location on the southern border of Europe and Germany being the most attractive destination while the value that refugees attach to being accepted for asylum in Greece is relatively low.

Figure 10 shows the variation in how strongly different European destinations respond to an increase in push factors for Syrian refugees. Specifically, we simulate an increase in the number of Syrians arriving in Europe of 1 percent and compute the new equilibrium in recognition rates. The graph sorts destinations by their attractiveness to Syrian refugees ($v_{d,a}$), and shows a clear negative correlation between policy adjustments and the relative attractiveness of destinations. The deviation of the reactions of Hungaria/Slovenia and Greece from this pattern is driven by the relatively high probability that refugees who are merely passing through these countries are forced to file an asylum application. The higher the share of involuntary applications, the less effective the recognition rate will be as a means of controlling the number of applications overall. The general tightening of access to

Panel A— Shares of positive responses by country groups:

	Country of change	
	North	not North
Reacting country		
North	1.0000	1.0000
not North	0.3286	0.4500

Panel B— Means of semi-elasticities by country groups:

	Country of Change	
	North	not North
Reacting Country		
North	0.0013	0.0001
not North	-0.3713	-0.0630

Table 4: Summary of bilateral responses. Panel (a) shows the shares of positive responses by country groups. Panel (b) shows the average magnitude with which different country groups respond, displayed as semi-elasticities.

asylum when faced with an increase in immigration pressure has implications for the scope of reallocation policies the EU has tried to implement in recent years. In particular, countries may attempt to compensate such efforts by a reduction in the share of applicants who are granted asylum. This response will be stronger for less attractive countries that require a larger policy change to achieve any given reduction in refugees who arrive independent from the centrally allocated quota.

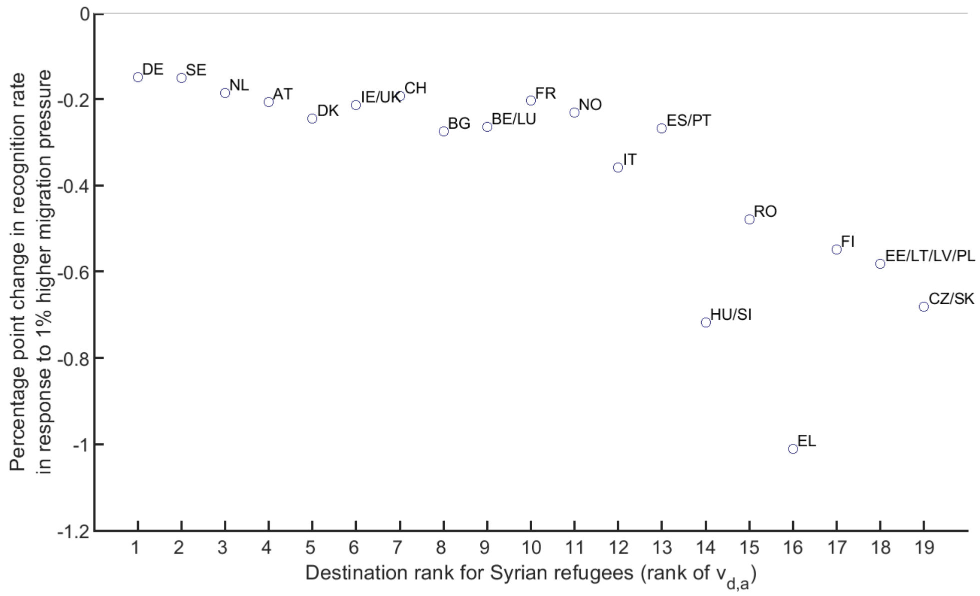


Figure 10: Responses in recognition rates to a 1% increase in migration pressure from Syrian refugees by the payoff refugees attribute to being accepted in a given destination. The vertical axis measures percentage point reductions in recognition rates, accounting for the response by all other destinations.

To conclude this section, we want to briefly discuss the effect of one of our assumptions on the results. In particular, we did not include any costs of moving between destinations beyond the cost c of entering Europe. While it is straightforward to include additional travel costs in the model, we lack the empirical moments that would allow us to identify these parameters. In general, increasing the cost of a particular journey would have the effect that the estimated value of making this journey has to increase as well, in order to match the observed number of arrivals. An increase in the value of being accepted in a country strengthens the effect that the recognition rate has on the number of arrivals. An additional cost of moving within Europe would therefore strengthen the effect that changes in the recognition rates in northern countries have on countries in the south. This would indicate that the policy changes that we calculate for countries in the south of Europe in response to adjustments in the north represent lower bounds on the actual effect. Note that our model does include the cost of crossing the Mediterranean Sea, which likely far exceeds the cost of moving within Europe. In contrast to migration costs within Europe, this cost of entering Europe can be identified through Eurostat data on voluntary outmigration to third countries.

5.3 Implications for Regression Frameworks

The strategic interactions across countries we highlight have important implications for common estimation strategies that rely on cross-country variation. An implicit assumption made when using cross-country variation within a regression framework is that outcomes across observations—in this context typically origin-destination country pairs—are independent, at least conditional on controls. In the context of asylum policies, this assumption is violated if one destination's policy affects not only the number of refugees applying there, but also the number seeking asylum in other destinations. Our results indicate that such an interdependence exists among European countries. Violations of the independence assumption have also been discussed in the literature using gravity equations to predict bilateral migration or trade flows. In that setup, locations are linked through "multilateral resistance" terms, typically accounting for the cost of migration or trade between alternative destinations (see Beine et al., 2016, for a recent survey). In our case, policies in alternative destinations enter individuals' destination choices. Such interdependence is complicated further if policies themselves are set strategically across countries.

Importantly, a violation of the assumption of independence of observations may induce a bias in regression estimates that does not stem from reverse causality. Concerns that a country's asylum policies are endogenous to asylum applications in the same country can in principle be addressed using suitable instruments, as in Hatton (2009). What instrumental variables cannot account for, however, are the spillovers to other destinations that effectively render observations interdependent. The direction of the bias arising from spillover effects is ambiguous and depends on the strategic nature of the policy in question. We show in Appendix F that if an increase in one country's recognition rate raises the number of refugees arriving elsewhere, a negative bias arises. If, on the other hand, the diversion effect dominates, spillovers will generate an upward bias in regression estimates.

6 Conclusion

Spillovers of asylum policies have been fiercely debated in the context of recent refugee migration to Europe, with sovereign states accusing others of attracting refugees into Europe through generous recognition policies. In this paper, we provide evidence on a correlation in asylum policies. Based on this, we formulate and calibrate a dynamic behavioural model, focusing on the important case of Syrian refugee migration to Europe. In particular, we account for the strategic interaction between different destinations and analyse a game between 19 players for whom we trace out best response functions to quantify strategic reactions. Our framework does not impose the strategic nature of asylum policies. Based on the calibrated model, we find that for countries that are points of first entry into European, recognition rates are generally strategic substitutes at the equilibrium, whereas they tend to be strategic complements for countries in northern and western Europe. Quantitatively, the strongest externalities arise in southeastern Europe, where some countries are induced to sharply reduce their recognition rates in response to more generous policies in major destinations such as Germany or Sweden.

While it was not our aim to quantify the benefits from policy cooperation, our model has implications for attempts of introducing a common asylum policy across countries. The reallocation of refugees from Italy and Greece to other countries decided by the EU in 2015, for instance, was not fully implemented due to the resistance of some member states. Our model highlights the possibility that, even if all quotas had been fulfilled, member states would have reacted by lowering their recognition rates and thus reducing the number of voluntary arrivals. Essentially, any partial harmonisation of asylum policies runs the risk of being subverted by changes in policies that remain under the individual control of member states. The same problem would apply to current proposals for a more permanent reallocation mechanism, under which decisions on individual applications would continue to be made by the potential host country.

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Appendix (for online publication)

A Eliminating Push Factors for Refugee Migration

Figures 2 and 3 in Section 2 show correlations in recognition rates for pairs of European destination countries. In raw data, these correlations are typically positive, as push factors in countries of origin and at given points in time affect recognition rates similarly across destinations. Our interest is in examining correlations in destination countries' policies net of these push factors. We thus predict residuals of recognition rates net of push factors through a regression

$$y_{odtq} = origin_o \times year_t + origin_o \times quarter_q + \tilde{p}_{odtq},$$

where o, d, t and q respectively label origin country, destination country, year and quarter, and y_{odtq} is a monotonic function of recognition rates. Since the residuals of this regression are not restricted to $[0, 1]$, we define $y_{odtq} = \Phi(p_{odtq})^{-1}$, that is, we apply the inverse normal CDF to observed recognition rates for refugees from origin o in destination d in year t and quarter q.[23] This yields residuals $\tilde{p}_{odtq} \in \mathbb{R}$, which we transform again using the normal CDF to obtain $\hat{p}_{odtq} \in (0, 1)$, which we visualize in Section 2. To avoid a mechanical correlation in residual recognition rates between destination countries and double counting of observations in Panels (a) and (b) of Figure 3, we randomly assign the axes for each destination pair.

Reproducing Figure 3 for Syrian asylum applicants during 2011-2014. Figure 3 in Section 2 is based on asylum applications from all major origin countries and the years covered by our Eurostat data. To show that the same patterns of correlations are present for Syrian asylum seekers we reproduce the figure for this population only. In line with our main analysis in Sections 3 to 5, we focus on the years 2011-2014. In doing so, we inevitably lose precision, but Figure A1 shows that the same pattern can be found as in Figure 3, with all correlations having the same sign.

[23] To avoid realizations for y_{odtq} at $-\infty/\infty$, we substitute recognition rates of 0% and 100% with 1% and 99%, respectively.

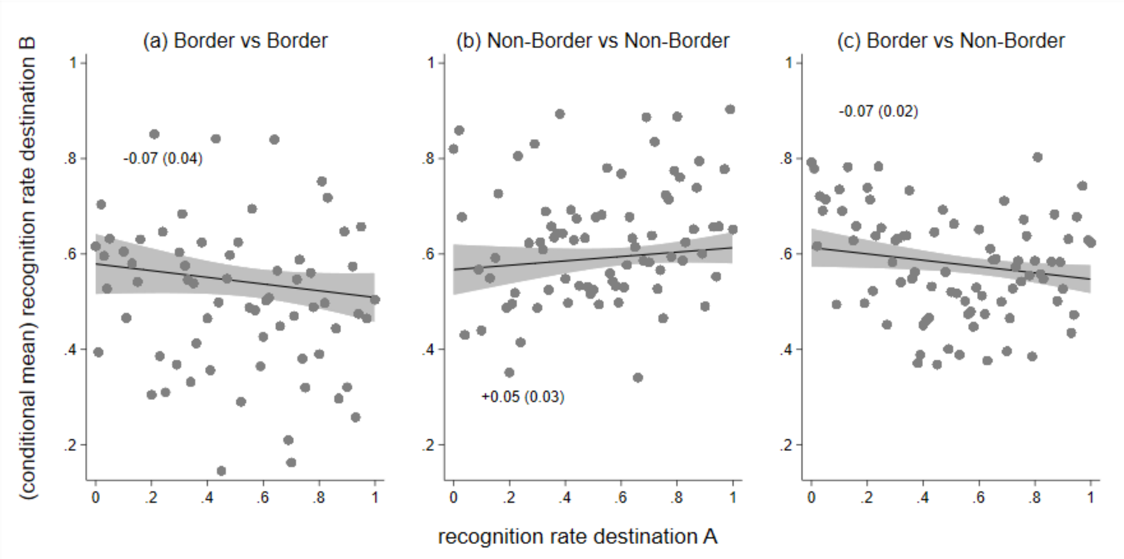

Figure A1: Recognition rates for Syrian asylum seekers by quarter for pairs of European destination countries. The figure shows fitted lines indicating correlations and their 99% confidence intervals. Dots represent conditional means of recognition rates in destinations on the vertical axis within 100 equally spaced bins of recognition rates in destinations on the horizontal axis. Source: Eurostat data for 2011-2014.

B Proof of Proposition 1

Recall that $\mathcal{D}_\ell$ denotes the set of destinations that can be reached directly from location ℓ. Let P_D denote a "path" leading from T to a particular destination $D \in \mathcal{D}$, that is, P_D is a set containing ordered sets of the form (ℓ, d) and the following conditions are satisfied:

i. There exists a unique $(\ell, d) \in P_D$ such that $\ell \in \mathcal{D}_T$.

ii. There exists $(\ell, d) \in P_D$ such that $d = D$.

iii. For all $(\ell, d) \in P_D$, $d \in \mathcal{D}_\ell$.

iv. For all $(\ell, d) \in P_D$ such that $\ell \notin \mathcal{D}_T$, there exists a unique $(\ell', d') \in P_D$ such that $d' = \ell$.

v. For all $(\ell, d) \in P_D$ such that $d \neq D$, there exists a unique $(\ell', d') \in P_D$ such that $d = \ell'$.

All possible paths leading to a destination D are collected in the set $\mathcal{P}_D$. Let $E(P_D)$ be the point of entry into Europe associated with the path P_D. That is, $E(P_D)$ is the location $\ell \in \mathcal{D}_T$ such that there exists an ordered pair $(\ell, d) \in P_D$. For any set of destinations $\mathcal{D}$, $\mathcal{D}(D)$ is the subset of $\mathcal{D}$ containing all destinations lying on a path to D. Denote by M_ℓ the probability that an individual moves on instead of applying for asylum when entering destination ℓ and let $Pr(\ell \to d)$ be the probability that an individual arrives in destination d conditional on moving on from location ℓ while $Pr(\ell \to d' \to d)$ is the probability that the individual does so passing through destination d'. The share of the Syrian population that applies for asylum in D can then be written as

$$\sum_{P \in \mathcal{P}_D} Pr(T \to E(P)) \left(\prod_{(\ell,d) \in P} M_\ell \, Pr(\ell \to d) \right) (p_D^f + (1 - p_D^f)(1 - M_D)) \ . \quad (2)$$

Since the idiosyncratic preference shocks associated with each choice whenever a decision has to be made are assumed to be drawn from an extreme value distribution, it follows that

$$M_\ell = \frac{\exp(V_{\ell,F}^m)}{\exp(V_{\ell,F}^m) + \exp(p_\ell V_{\ell,F}^a + (1 - p_\ell) V_{\ell,F}^r)}$$

and, if $d \in \mathcal{D}_\ell$,

$$Pr(\ell \to d) = \frac{\exp(V_{d,F})}{\sum_{d' \in \mathcal{D}_\ell} \exp(V_{d',F})} \ .$$

The values of arriving in and moving on from a destination ℓ can be written as

$$V_{\ell,F} = \gamma + \log(\exp(V_{\ell,F}^m) + \exp(p_\ell V_{\ell,F}^a + (1 - p_\ell) V_{\ell,F}^r))$$

and

$$V_{\ell,F}^m = \gamma + \log(\sum_{d \in \mathcal{D}_\ell} \exp(V_{d,F})) \ ,$$

where γ is the Euler constant (see for instance Berkovec and Stern, 1991).

Now suppose that the acceptance rate p_D of destination D increases. Repeatedly applying the product rule, the derivative of Expression (2) with respect to p_D can be written as

$$
\begin{aligned}
&(-(1-p_D^f)\frac{\partial M_D}{\partial p_D})) \sum_{P\in\mathcal{P}_D} Pr(T\to E(P)) \left(\prod_{(\ell,d)\in P} M_\ell \; Pr(\ell\to d)\right)\\
&+ \left(p_D^f + \left(1-p_D^f\right)(1-M_D)\right)\cdot\\
&\left[\sum_{\ell\in\mathcal{D}(D)} \sum_{P\in\mathcal{P}_D(\ell)} Pr(T\to E(P))\cdot\right.\\
&\qquad \left(\prod_{(\ell',d)\in P}\left(\mathbb{1}[\ell'\neq\ell]M_{\ell'} \; + \mathbb{1}[\ell'=\ell]\frac{\partial M_\ell}{\partial p_D}\right) Pr(\ell'\to d)\right)\\
&\quad + \sum_{\ell\in\mathcal{D}(D)} \sum_{P\in\mathcal{P}_D(\ell)} Pr(T\to E(P))\cdot\\
&\qquad \left(\prod_{(\ell',d)\in P} M_{\ell'} \; \left(\mathbb{1}[\ell'\neq\ell]Pr(\ell'\to d) + \mathbb{1}[\ell'=\ell]\frac{\partial Pr(\ell\to d)}{\partial p_D}\right)\right)\\
&\quad \left.+ \sum_{P\in\mathcal{P}_D} \frac{\partial Pr(T\to E(P))}{\partial p_D}\left(\prod_{(\ell,d)\in P} M_{\ell'} \; Pr(\ell\to d)\right)\right] .
\end{aligned}
\tag{3}
$$

It will be shown that this derivative is positive if $V^a_{D,F} > V^r_{D,F}$. Under the preceding assumption, the value of applying for asylum in D increases as a consequence of an increase in p_D, so that M_D decreases. The first line of Expression (3) is therefore greater than zero. Furthermore, the value of arriving in D is increasing in p_D, as is the value of any choice that includes the option of eventually applying for asylum in D. Consider a particular location ℓ lying on at least one path P towards D. Since applying for asylum in ℓ rules out the possibility of applying later in D, the value of applying for asylum in destination ℓ is not affected by the change in p_D, with the consequence that M_ℓ increases. The first term in brackets in Expression (3) is accordingly positive. The effect on the probability of choosing the subsequent destination d on the path P, $Pr(\ell \to d)$, is less clear-cut. We have

$$\begin{aligned}
& \frac{\partial Pr(\ell \to d)}{\partial p_D} \\
&= \frac{\exp(V_{d,F}) \frac{\partial V_{d,F}}{\partial p_D} \sum_{d' \in \mathcal{D}_\ell} \exp(V_{d',F}) - \exp(V_{d,F}) \sum_{d' \in \mathcal{D}_\ell(D)} \exp(V_{d',F}) \frac{\partial V_{d',F}}{\partial p_D}}{[\sum_{d' \in \mathcal{D}_\ell} \exp(V_{d',F})]^2} \\
&= Pr(\ell \to d) \frac{\partial V_{d,F}}{\partial p_D} \; - \; Pr(\ell \to d) \sum_{d' \in \mathcal{D}_\ell(D)} Pr(\ell \to d') \frac{\partial V_{d',F}}{\partial p_D} \; ,
\end{aligned}$$

which can be positive or negative if $\mathcal{D}_\ell(D)$, the subset of the destinations in $\mathcal{D}_\ell$ lying on a path towards D, contains more than one element. By the chain rule,

$$\begin{aligned}
\frac{\partial V_{d,F}}{\partial p_D} &= \frac{\partial V_{d,F}}{\partial V^m_{d,F}} \frac{\partial V^m_{d,F}}{\partial p_D} \\
&= M_d \frac{\partial V^m_{d,F}}{\partial p_D}
\end{aligned}$$

and

$$\begin{aligned}
\frac{\partial V^m_{d,F}}{\partial p_D} &= \sum_{d' \in \mathcal{D}_d(D)} \frac{\partial V^m_{d,F}}{\partial V_{d',F}} \frac{\partial V_{d',F}}{\partial p_D} \\
&= \sum_{d' \in \mathcal{D}_d(D)} Pr(d \to d') \frac{\partial V_{d',F}}{\partial p_D} \; .
\end{aligned}$$

Iterating forward yields

$$\begin{aligned}
\frac{\partial V_{d,F}}{\partial p_D} &= M_d \sum_{d' \in \mathcal{D}_d(D)} Pr(d \to d') \; M_{d'} \; \cdots \; Pr(d'' \to D) \frac{\partial V_{D,F}}{\partial p_D} \\
&= M_d \sum_{d' \in \mathcal{D}_d(D)} Pr(d \to d') \; M_{d'} \; \cdots \; Pr(d'' \to D)(1 - M_D)(V^a_{D,F} - V^r_{D,F}) \\
&= M_d \; Pr(d \to D)(1 - M_D)(V^a_{D,F} - V^r_{D,F}) \; .
\end{aligned}$$

The partial derivative above can thus be written as

$$\begin{aligned}\frac{\partial Pr(\ell \to d)}{\partial p_D} &= (1-M_D)(V^a_{D,F}-V^r_{D,F})\Big(Pr(\ell \to d)\ M_d\ Pr(d \to D) \\ &\quad - \ Pr(\ell \to d) \sum_{d' \in \mathcal{D}_\ell(D)} Pr(\ell \to d')\ M_{d'}\ Pr(d' \to D)\Big) \\ &= (1-M_D)(V^a_{D,F}-V^r_{D,F})\ Pr(\ell \to d) \\ &\quad \big(M_d\ Pr(d \to D) - \ Pr(\ell \to D)\big)\ .\end{aligned}$$

A specific element of the outer sum in the fourth line of Expression (3), corresponding to a particular ℓ, can then be written as

$$\begin{aligned}&Pr(T \to \ell) M_\ell \sum_{d \in \mathcal{D}_\ell(D)} \frac{\partial Pr(\ell \to d)}{\partial p_D}\ M_d\ Pr(d \to D) \\ &= (1-M_D)(V^a_{D,F}-V^r_{D,F}) Pr(T \to \ell) M_\ell \sum_{d \in \mathcal{D}_\ell(D)} Pr(\ell \to d) \\ &\quad \big(M_d\ Pr(d \to D) - \ Pr(\ell \to D)\ \big)\ M_d\ Pr(d \to D)\ .\end{aligned} \tag{4}$$

The sign of the final expression above is equal to the sign of the included sum. It will be shown that this sum is no smaller than zero. First, note that

$$\begin{aligned}&\sum_{d \in \mathcal{D}_\ell(D)} Pr(\ell \to d)\big(M_d\ Pr(d \to D) - \ Pr(\ell \to D)\big) \\ &= \sum_{d \in \mathcal{D}_\ell(D)} \big(Pr(\ell \to d \to D) - \ Pr(\ell \to d) Pr(\ell \to D)\big) \\ &= Pr(\ell \to D)\ - \sum_{d \in \mathcal{D}_\ell(D)} Pr(\ell \to d) Pr(\ell \to D) \\ &= Pr(\ell \to D)(1 - \sum_{d \in \mathcal{D}_\ell(D)} Pr(\ell \to d)) \\ &\geq 0\ .\end{aligned}$$

The sign of the sum thus depends on the "weights" $M_d\ Pr(d \to D)$. In particular, the sum will be positive unless at least one weight attached to a negative term is larger than at least one weight attached to a positive term. To see this, consider a finite sequence (a_n) with a corresponding sequence of weights (w_n) such that $w_i > 0\ \forall i$. Further, assume that $a_i < 0$ and $a_j > 0$ imply $w_i \leq w_j$. Let $\bar{w}$ be the largest weight attached to a negative element of the sequence (a_n). If $\sum_i a_i \geq 0$, it follows that $\bar{w}\sum_i a_i \geq 0$, which in turn implies $\sum_i w_i a_i \geq 0$. The final step is true as it involves reducing weights on negative elements and increasing weights on positive ones.

It will now be shown that the weighted sum on the right-hand side of Equation (4) is positive by showing that the weights satisfy the assumptions made in the previous paragraph. Towards a contradiction, suppose there exists $d \in \mathcal{D}_\ell(D)$ such that

$$M_d \; Pr(d \to D) - \; Pr(\ell \to D) < 0$$

and $d' \in \mathcal{D}_\ell(D)$ for which the reverse is true. Furthermore, assume

$$M_d \; Pr(d \to D) > M_{d'} \; Pr(d' \to D) \; ,$$

such that the weight on the negative term is larger. However, the last two inequalities imply

$$Pr(\ell \to D) > M_{d'} \; Pr(d' \to D) \; ,$$

contradicting

$$M'_d \; Pr(d' \to D) - \; Pr(\ell \to D) > 0 \; .$$

The second term in brackets in Expression 3 is therefore positive. The same logic also applies to the final term in brackets of the same expression, showing that the derivative of the number of arrivals in a destination D with respect to the recognition rate p_D is positive. ■

C Dynamic Best-Response Search with Tabu Lists

We investigate the existence of multiple equilibria using the algorithm proposed by Sureka and Wurman (2005). This procedure searches for pure strategy Nash equilibria and is suitable for games with many players. It sequentially follows the best responses of all players of a game. To avoid circularity and to guarantee convergence to a stable equilibrium, it uses so-called tabu lists that keep track of a given number of paths the search has already followed. Denote by $\mathbf{L}$ an $n \times \min\{k, l\}$ tabu list matrix, where n is the number of players, k is the number of paths already followed, and l is the pre-specified length of the tabu list. The algorithm can then be formulated as follows:

Choose a random starting solution, $\mathbf{p}$.
Until termination {
    take next player $\rightarrow d$
    find best response p_d to other players' $\mathbf{p_{d-}}$, conditional on $(p_d, \mathbf{p_{d-}}) \notin \mathbf{L}$
    remove oldest item in $\mathbf{L}$ if $k \geq l$
    push p_d onto $\mathbf{L}$
}.

The algorithm stops either when it has found a Nash equilibrium or when a maximum number of iterations has been reached. The length of tabu lists can be chosen freely. A shorter list implies a more thorough search, but too short lists may be unable to avoid running in circles. We use a length of 2, which is the shortest possible length that avoids circularity. We draw 10,000 random starting vectors $\mathbf{p}$. In all cases, the algorithm converged to the observed equilibrium without encountering any additional equilibria. In most cases, the equilibrium was reached after 4 iterations.

D Full Matrix of Predicted Elasticities

Table A1 shows the matrix of all destinations' strategic responses (rows) to a rise in a given destination's recognition rate (columns). Each entry displays for a given country pair the elasticity of a destination's optimal recognition rate with respect to the recognition rate set by another destination.

Reacting destination	AT	BE/LU	BG	CZ/SK	DE	DK	EE/LT/ LV/PL	EL	ES/PT	FI	FR	HU/SI	IE/UK	IT	NL	RO	SE	NO	CH
	Destination changing recognition rate																		
AT	1.000	0.000	0.000	0.000	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.004	0.000	0.000
BE/LU	0.001	1.000	0.001	0.000	0.005	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.004	0.000	0.000
BG	0.000	0.000	1.000	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000
CZ/SK	0.002	0.001	0.002	1.000	0.020	0.002	0.000	0.000	0.000	0.000	0.001	0.000	0.001	0.000	0.002	0.000	0.016	0.001	0.001
DE	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.000	0.000
DK	0.001	0.000	0.000	0.000	0.005	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.004	0.000	0.000
EE/LT/LV/PL	0.001	0.001	0.001	0.000	0.013	0.001	1.000	0.000	0.000	0.000	0.001	0.000	0.001	0.000	0.002	0.000	0.010	0.000	0.001
EL	-0.983	-0.417	-0.741	-0.009	-8.212	-0.905	-0.019	1.000	-0.163	-0.020	-0.346	-0.115	-0.542	-0.078	-1.093	-0.065	-6.505	-0.234	-0.666
ES/PT	0.001	0.000	0.001	0.000	0.006	0.001	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.005	0.000	0.001
FI	0.002	0.001	0.001	0.000	0.014	0.001	0.000	0.000	0.000	1.000	0.001	0.000	0.001	0.000	0.002	0.000	0.010	0.000	0.001
FR	0.001	0.000	0.001	0.000	0.005	0.001	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.001	0.000	0.005	0.000	0.000
HU/SI	-0.278	-0.118	-0.210	-0.003	-2.290	-0.256	-0.005	-0.002	-0.046	-0.006	-0.098	1.000	-0.154	-0.021	-0.308	-0.018	-1.819	-0.066	-0.189
IE/UK	0.001	0.000	0.001	0.000	0.005	0.001	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.001	0.000	0.004	0.000	0.000
IT	-0.011	-0.004	-0.008	0.000	-0.090	-0.010	0.000	0.000	-0.002	0.000	-0.004	0.000	-0.006	1.000	-0.012	-0.001	-0.072	-0.002	-0.008
NL	0.001	0.000	0.000	0.000	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.004	0.000	0.000
RO	-0.001	-0.001	-0.001	0.000	-0.011	-0.001	0.000	0.000	0.000	0.000	0.000	0.000	-0.001	0.000	-0.001	1.000	-0.009	0.000	-0.001
SE	0.000	0.000	0.000	0.000	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.000
NO	0.001	0.000	0.001	0.000	0.006	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.005	1.000	0.000
CH	0.001	0.000	0.001	0.000	0.005	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.004	0.000	1.000

Table A1: Semi-elasticities: Percentage change in recognition rates in row destinations in response to a one percentage point increase in the recognition rate in each column destination.

E Local Identification

In this appendix, we show local identification of the model parameters through our set of moments. Figure A2, which plots the (log) criterion against different values of the structural parameters, shows that the criterion obtains a clear local minimum at the given parameter values.

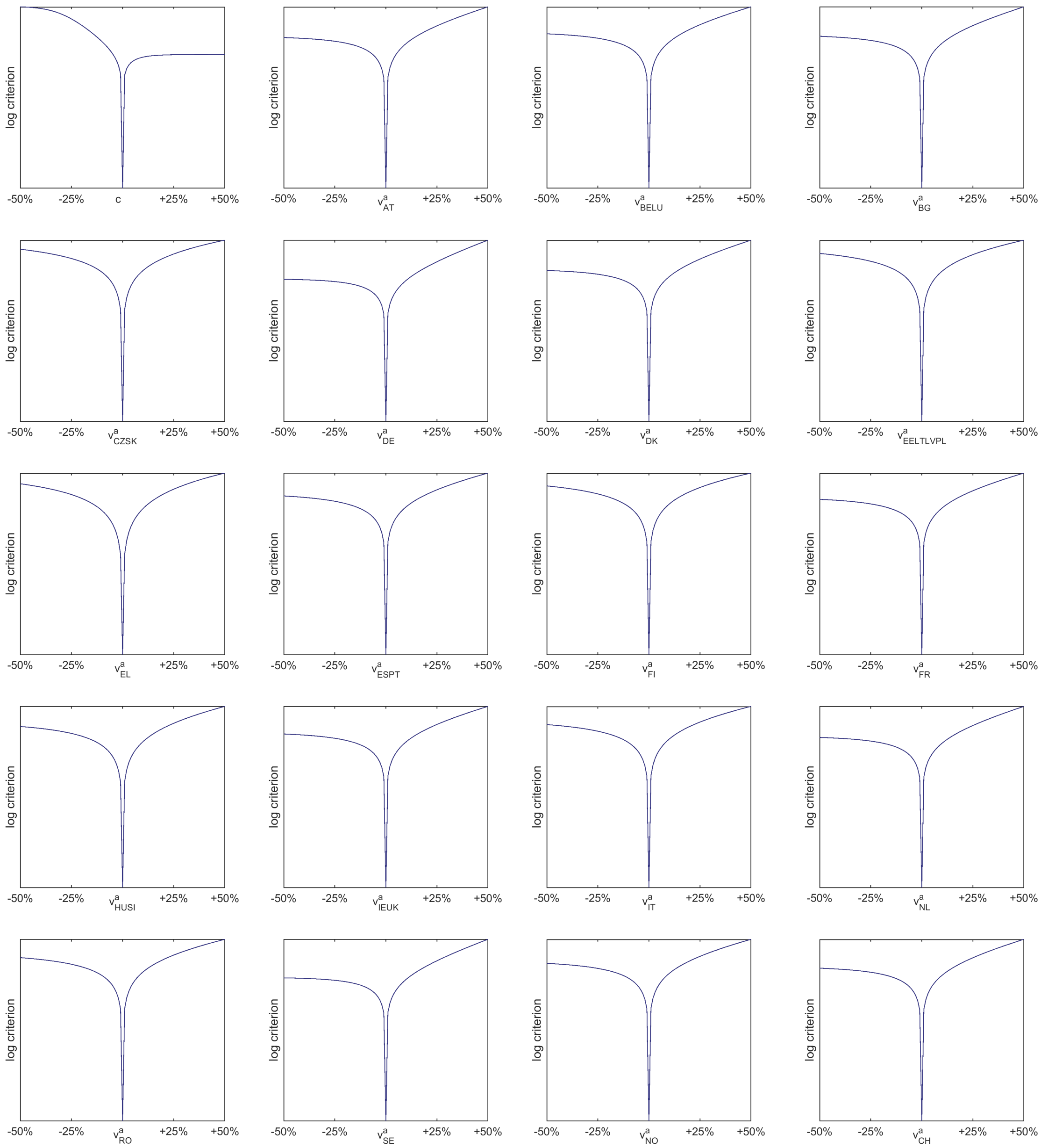

Figure A2: Local minima of the criterion function with respect to values of the structural parameters.

In order to show identification more clearly, Figure A3 further visualizes the gradient matrix $\frac{\partial \mathbf{m_M}'}{\partial \boldsymbol{\theta}} / \frac{\mathbf{m_M}'}{\boldsymbol{\theta}}$ of estimation moments with respect to the model's parameters. Darker shades indicate steeper gradients. Identification requires that gradient vectors for all parameters are linearly independent, and the figure clearly shows that this is the case. Hence, our set of moments point identifies the structural parameters under the model.

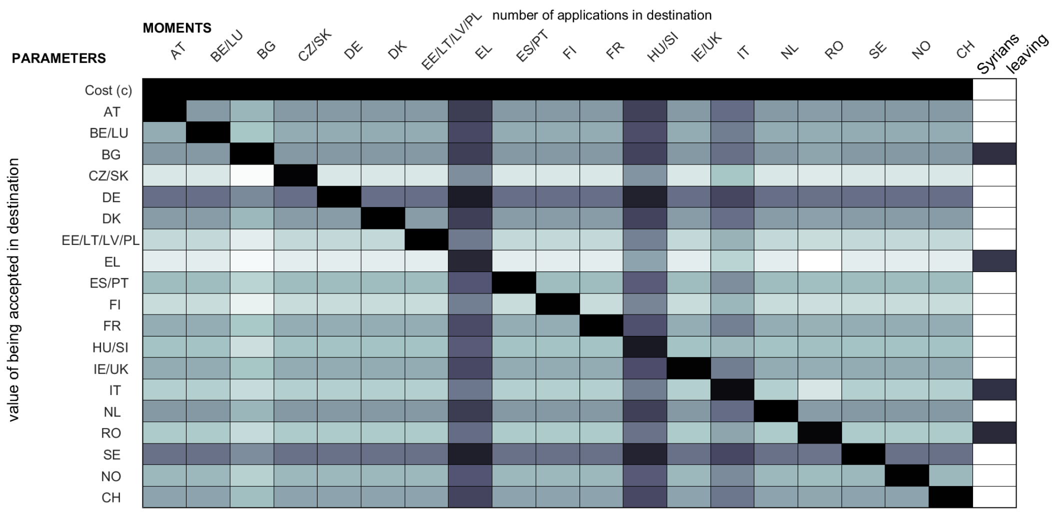

Figure A3: Gradient matrix of moments with respect to parameters, $\frac{\partial \mathbf{m_M}'}{\partial \boldsymbol{\theta}} / \frac{\mathbf{m_M}'}{\boldsymbol{\theta}}$.

F Relation to Non-equilibrium Frameworks

In this appendix, we illustrate the relevance of strategic interactions across countries for commonly-used estimation strategies which rely on cross-country variation.

Spillovers. An implicit assumption made when using cross-country variation within a regression framework is that outcomes across observations (origin-destination pairs) are independent (conditional on controls). In our context, this assumption is violated if one destination's asylum policy affects not only the number of refugees applying there, but also the number seeking asylum in other destinations. This very likely is the case, especially for destinations as geographically close as member countries of the European Union. Thus, a high recognition rate in Austria, Germany or Sweden will also affect the number of refugees arriving in Greece, Hungary or Italy.

To illustrate the problem more clearly, consider a simple linear setup that relates the number of asylum applications s_d to asylum policy p_d and unobserved factors u_d in destination d, as well as to asylum policy p_{-d} in the respectively other destination, $d = 1, 2$:

$$s_d = \alpha + \delta p_d + \eta p_{-d} + u_d. \tag{5}$$

A rise of one destination's recognition rate p_d in this setting not only affects applications s_d in destination d itself, but potentially also the number of applications $s_{-d} = \alpha + \delta p_{-d} + \eta p_d + u_{-d}$ in the respectively other destination. In addition, there may be reverse causality if asylum policies p_d react to application shocks u_d.

A simple regression that ignores any simultaneity and the spillover from asylum policies p_{-d} on applications s_d in destination d yields estimates[24]

$$\hat{\delta} = \delta - \eta + (u_d - u_{-d})/(p_d - p_{-d}). \tag{6}$$

Spillovers and reverse causality enter the ordinary least squares estimator $\hat{\delta}$ via η and $(u_d - u_{-d})/(p_d - p_{-d})$, respectively. If either destination tightens its asylum policy by lowering recognition rate p_d in response to a positive application shock u_d,

[24]The expression derives from the relation $\hat{\delta} = \delta + (\mathbf{X}'\mathbf{X})^{-1}\mathbf{X}'\tilde{\mathbf{u}}$, where $\mathbf{X} = \begin{bmatrix} 1 & p_d \\ 1 & p_{-d} \end{bmatrix}$ and $\tilde{\mathbf{u}} = \begin{bmatrix} \eta p_{-d} + u_d \\ \eta p_d + u_{-d} \end{bmatrix}$.

then the last term in equation 6 is negative, leading to a downward bias in standard OLS estimates $\hat{\delta}$. This can in principle be addressed using suitable instruments, as in Hatton (2009).

What the instrument cannot account for, however, are the spillovers to other destinations that effectively render observations interdependent. The direction of the bias arising from spillover effects is ambiguous: If a rise in the recognition rate p_d raises the number of refugees attracted to Europe as a whole, including to destination $-d$, then $\eta > 0$, reinforcing the negative bias due to reverse causality. If, on the other hand, a rise p_d diverts applications from $-d$ to d, so that $\eta < 0$, spillovers generate an upward bias. Importantly, the issue here is a dependency across observations rather than a direct endogeneity of a country's policy with respect to the asylum applications it receives. In other words, this source of bias still exists if $\text{cov}(p_d, u_d) = 0$ or if an instrument for p_d was available.

Strategic interaction between destinations. The interrelatedness of recognition rates and application numbers across locations further provides scope for strategic policy choices across different destinations.

To fix ideas, consider again the linear model in equation (5). The sign of η and thus the direction of bias is determined by the relative strengths of the attraction and diversion effects described above. Depending on which effect dominates, other destinations may respond by raising or lowering their own recognition of asylum applications. If a higher recognition rate p_d in destination d diverts refugees from the other destination $-d$, we would expect the latter to react by raising its recognition rate as well, so that p_d and p_{-d} are strategic complements. The opposite may occur if the attraction effect dominates. In that case, p_d and p_{-d} would be strategic substitutes. In the latter case, the last term in equation (6), $(u_d - u_{-d})/(p_d - p_{-d})$, will be negative in expectations, as the rise in p_d raises u_{-d}, but also triggers a downward adjustment of p_{-d}. When p_d and p_{-d} are strategic complements, on the other hand, the diversion effect lowers u_{-d} as destination d raises its recognition rate p_d. If the other destination furthermore is induced to raise recognition rate p_{-d} (though to a lesser extend than the rise in p_d), the term $(u_d - u_{-d})/(p_d - p_{-d})$ is positive in expectations, counteracting the bias deriving from the spillover effect trough η described above. Note that a suitable instrument for asylum policies can in principle break these links and render $\text{E}\left[(u_d - u_{-d})/(p_d - p_{-d})\right] = 0$. The spillover bias through η, however, will remain.