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Modelling Asylum Migration Pull-Force Factors in the EU-15

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Abstract: We model the relationship between asylum applications across the EU-15 and three key pull-force factors, GDP, the recognition rate (grants of refugee status as a percentage of all refugee decisions) and refugee stocks. A Dynamic Coefficient Random Effects Panel model is employed which captures both the country specific variance and temporal features. This model provides deeper insight into the relationship than has hitherto been possible. We show for Austria, Spain and possibly Belgium that the three predictive factors dominate while for other countries in the EU-15 country specific factors are more important. In relation to temporal effects we show both GDP and the recognition rate at the overall EU-15 level remain significant over time but refugee stock does not. We also show a downward level shift occurred in the elasticity of recognition rate in 2002 resulting in fewer refugees being recognised (i.e., granted refugee status) and, therefore, providing evidence that asylum policies have become more restrictive.

I INTRODUCTION

Modern migration tends to involve considerable temporary or permanent movements for economic or study reasons and social or family purposes. Among this general population of migrants is the subset of asylum seekers, those persons who claim they are fleeing persecution in their home country and seek to be recognised as refugees in another country. This paper examines the response of asylum applications in the EU-15 in the period 1985 to 2011,

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to three key factors that are believed to attract asylum applications. These factors identified in previous studies, notably by Neuymer (2005a) and Hatton (2004, 2009), are GDP, the refugee stock and the recognition rate (grants of refugee status as a percentage of all refugee decisions). Respectively these pull-force factors reflect economic, family/network/social and administrative conditions (largely based on the perceived ease of access for an asylum seeker to an EU country) in the EU country. The key question of interest in this paper is "in which instances do these three factors apply and in which cases do other unexplained factors dominate?". We focus on two key questions that have not been addressed in previous studies. First, we quantify the importance of each of these three pull-factors at the overall EU level in terms of variance explained. Importantly, where the overall variance explained by these three pull factors (even though it may be statistically significant) at the EU level turns out to be small, then country specific factors are the primary determinants affecting asylum application levels. In Section V of this paper we show this is the case and accordingly analysis and asylum policy at the overall EU-15 level are quantitatively less important than at the individual country level.

Second, we test whether the relationship between asylum applications and these pull factors changed over time and remained statistically significant throughout the period. If the relationship is time invariant then the conclusions of previous studies (largely based around fixed or random effect models that neglect time evolution) are likely to be sound. However, if the nature of the relationship is dynamic, then other possibilities arise and the conclusions of previous studies may be cast into doubt. For example, if as we show the elasticity (equivalently, log of gravity reflecting the pull-force) of GDP remains constant then the findings of previous studies which neglect time effects are likely reliable in respect of GDP. However, if as we alternatively show in Section V in relation to the recognition rate that its elasticity is lower now than in earlier times, then all other things being equal, it may be asserted that the coordination of administrative procedures results in fewer asylum applications in the EU-15. This insight into the change in elasticity cannot be gleaned from previous studies.

Our key contribution is to answer these two questions and, therefore, validate or otherwise the conclusions of previous studies. This we accomplish by modelling and estimating the temporal relationship between asylum applications and these three pull-force factors in a novel and sophisticated way, while simultaneously controlling for country specific effects.

The remainder of the article is laid out as follows: the next section gives an overview of the asylum and refugee framework and considers past research in this area. Section III reviews asylum application trends in the EU-15 and explores the relationship between asylum application numbers over time and the three pull-force factors. In Section IV we describe our modelling methodology which is based on a time varying random effects panel model with parameters estimated by maximum likelihood computed via the Kalman Filter. Then in Section V we discuss the results derived from applying our model to the data and in particular we focus on explaining the components of variance and the evolution of the elasticity between asylum applications and each of the pull factors. In Section VI we draw our conclusions. The annual data used in this study are taken from, the annexes to the UNHCR Yearbooks for both asylum and refugee stock time series (http://www.unhcr.org/pages/4a02afce6.html), Penn World Tables (http: //pwt. econ.upenn.edu/) for GDP per capita in PPS (constant volume) referred to afterwards simply as GDP, and for population data Eurostat at (http://epp.eurostat.ec.europa.eu/portal/page/portal/ statistics/search_data base).

II THE EUROPEAN ASYLUM SYSTEM AND RELATED RESEARCH

2.1 *The Asylum Question*

The question of what makes an asylum seeker a "genuine refugee" is contentious (Robinson and Segrott, 2002). According to the 1951 Geneva Convention:

> … a refugee is a person who owing to a well-founded fear of being persecuted for reason of race, religion, nationality, membership of a social or political group, is outside the country of his nationality, and is unable to, owing to such fear, or is unwilling to avail himself of the protection of that country.

Such persons enjoy the right of *non-refoulment* – that is they cannot be expelled or returned in any manner whatsoever to the frontiers of territories where their life or freedom is threatened. With this definition in mind and with considerable justification, refugee advocates argue that asylum seekers are pushed out of their home country by war, human rights abuses and/or the lack of a functioning government to provide protection. In such places of concern the sources of persecution are obvious. However, a key consideration is that most asylum seekers in these conflict regions of the world, about two-thirds of all refugees (Neumayer, 2005a) flee to neighbouring countries. Given this preference for neighbouring countries and the costs of migration, it is much less obvious that the roughly one-third that arrive in the developed world are in fact genuine refugees. So, rather than focusing on the pushfactors that generate asylum seekers in places of concern, there is in the developed world good reason to focus on the pull factors that drive asylum applications. The questions here, from the destination country perspective, are why we are attractive to asylum seekers and do our administrative procedures in any measureable way influence asylum applications. Or are these procedures largely irrelevant and that application numbers are determined mainly by economic reasons and family or communal connections that have evolved over time. If the deterrent effect of administrative procedures is small or negligible then asylum applications to Western Europe may only respond to economic or communal link factors. This in turn points strongly to the fact that some of those who seek asylum in Western Europe are in fact "bogus refugees" and may also partly explain why some asylum seekers look to "cheat the system" (Kibreab, 2004).

2.2 *The Common European Asylum System*

The international framework for asylum policy is the 1951 Geneva Convention and its 1967 protocol. Signing and implementing these is a prerequisite for membership of the EU. A person who enters a signatory state can apply for asylum and must be considered in light of the Convention irrespective of whether they entered the state illegally or not. A person who is granted refugee status under the Convention is guaranteed protection by that state and is generally referred to as a Geneva Convention Refugee or simply as a Convention Refugee.

In the EU the so-called Stockholm Programme sets out commitments to establish a Common European Asylum System (CEAS) by 2014. The CEAS is based on three pillars; first, bringing more harmonisation to standards of protection by further aligning the EU States' asylum legislation; second, ensuring effective and well-supported practical cooperation; and third, increasing solidarity and responsibility among EU States. The first of these pillars has been implemented in the period 1999 to 2005 and has four important aspects:

- the Directive on Reception Conditions for Asylum Seekers 2003/9/EC;
- the Qualification Directive 2004/83/EC which sets minimum standards on qualification for becoming a refugee or beneficiary of subsidiary protection: the latter applies to persons who fail to be recognised as convention refugees but if returned would be at risk of serious harm;
- the Asylum Procedures Directive 2005/85/EC;
- the Dublin II Regulation 2003/EC/343, which determines which EU State is responsible for examining an asylum application.

Also important was the strengthening of financial solidarity with the creation of the European Refugee Fund and in 2001, the Temporary Protection Directive 2005/55/EC which allowed for a common EU response to a mass influx of displaced persons unable to return to their country of origin. The Family Reunification Directive also applies to refugees. Collectively refugee, subsidiary protection and temporary protection are known as "International Protection". Further detail on all aspects of the CEAS and its development since 2005 is available at http://ec.europa.eu/dgs/home-affairs/what-we-do/policies/asylum/index_en.htm.

Many EU states also provide a non-harmonised protection status. In Ireland there are two non-harmonised protection statuses – programme refugees defined in Refugee Act 1996 are persons who are allowed to enter the state for temporary protection or resettlement. Alternatively, a person who failed to gain refugee status may ask the Minister for Justice for Humanitarian Leave to Remain (see Immigration Act 1999). In the EU, the EU Commission Policy Plan on Asylum Communication (COM 2008 (360)) notes that more and more people are being protected with non-harmonised statuses.

Throughout the EU the Qualification Directive provides a common basis for assessing refugee claims. However, there are differences for non-harmonised statuses. Many countries operate a so-called "single-procedure" whereby all aspects of a protection claim, refugee, subsidiary protection, humanitarian leave to remain and appeal of an initial protection or leave to remain decision are considered together. Ireland does not operate a single procedure. Here an asylum applicant progresses through three sequential stages beginning with a first instance application to the Refugee Applications Commissioner, followed in the event of refusal by a right to appeal to the Refugee Appeals Tribunal. If that appeal fails the applicant can apply for Subsidiary Protection. It is important to note that Ireland intends to provide for a single procedure for the determination of international protection claims during 2013. We also mention that detailed accounts of individual country procedures are set out in the Asylum Procedures Manual (IGC 2009).

2.3 *Asylum and Refugee Related Research*

Somewhat surprisingly, given the political, economic and social attention that asylum seekers attract, there is a lack of quantitative analysis of the causes of asylum flows. Where quantitative asylum research is available it focuses on places of concern that generate refugees in large numbers. This research demonstrates the main reasons people become refugees are related to political violence, civil war and concomitant human rights abuses (Edmonston, 1993; Gibney *et al.*, 1993; Schmeidl, 1997; Apodaca, 1998 and Davenport *et al.*, 2003). Moreover, when refugees flee, they tend to go to places where there is already a stock of refugees and in most cases this involves crossing a border into a neighbouring state (Neumayer, 2005a and Czaika, 2009).

With respect to destination country experiences of asylum migration only a few quantitative studies exist. In the main these concentrate on asylum movements from the third world to the EU. Here research shows per capita income, human rights violations, the existence of immigration groups and high infant mortality in the country of origin are significant predictors for asylum flows (Volger and Rotte, 2000 and Holzer *et al.*, 2000). Meanwhile, Theilmann (2004) shows the key destination country variables explaining asylum flows are the unemployment rate, the stock of foreign nationals, overseas development aid and asylum policy.

More recently, Hatton (2004, 2009) and Neuymer (2005a, 2005b) have conducted fairly extensive studies of the factors explaining asylum migration to the EU using a linear fixed effects and simple random panel effects models respectively. These studies showed GDP, unemployment, affinity (proportion of source immigrants in a destination country), asylum stock in the destination country and asylum policy, measured via a policy index or by the annual recognition rate are significant and positive. Importantly, Neuymer (2005a) found clear evidence that economic and social network factors mattered most. He also showed substantial origin-specific variation in recognition rates across the EU but qualified this quoting the UNHCR (2002) … "divergent recognition rates for the same nationality during the same period may be explained when the detailed profile of each case is taken into account".

The correlation study of Vink and Meijerink (2003) is also interesting as it emphasised the endogenous relationship between recognition rates and asylum applications over time (a high recognition rate correlated with high application numbers and one point in time can induce a policy backlash resulting in lower recognition rates and declining application numbers some time later). The emphasis of this study is both similar and more focused than previous studies in that the effect on asylum applications in the EU-15 over time of the three pull-force factors, GDP, the recognition rate and refugee stocks is examined in detail in the context of time and spatial considerations. We take the Geneva Convention recognition rate (lagged 1 year to instrument for endogenity) as our asylum policy measure as this is the longest and most consistently monitored procedure throughout the EU-15. Combined these pull factors reflect economic, social and political conditions in Western European states. How these have interacted geographically and shifted over time and their relative impact on asylum applications at subsequent times is the central and novel contribution of this paper.

In the general sphere of migration research spatial and temporal models are more common. Older methodology focuses on deterministic modelling of cross-country flows directly via age and gender cohort models, see Rogers (1975) and Keyfitz (1980). More recently stochastic models have become the norm, see Bijak (2005) for a survey. For example, Franzmeyer and Brucker (1997) built a gravity model of net migrations based on per capita GDP, meanwhile De Beer (1997) and Hyndman and Booth (2008) have used ARIMA time series methods while simple Bayesian models have been used by Congdon (2001). More sophisticated panel data models have been adopted by Mayda (2010) and in the Bayesian context by Brierly *et al.* (2008). We note that our Dynamic Coefficient Random Effects Panel model is a full likelihood approach and lies methodologically between Mayda's classical regression and the fully Bayesian approach of Brierly *et al.*. In contrast to Brierly *et al.* (2008) our model is dynamically robust and we mention their model cannot be robustly estimated unless a particle filtering based likelihood method is adopted, see Andrieu *et al.* (2010).

III ASYLUM APPLICATION TRENDS IN THE EU-15 AND EXPLORATORY DATA ANALYSIS

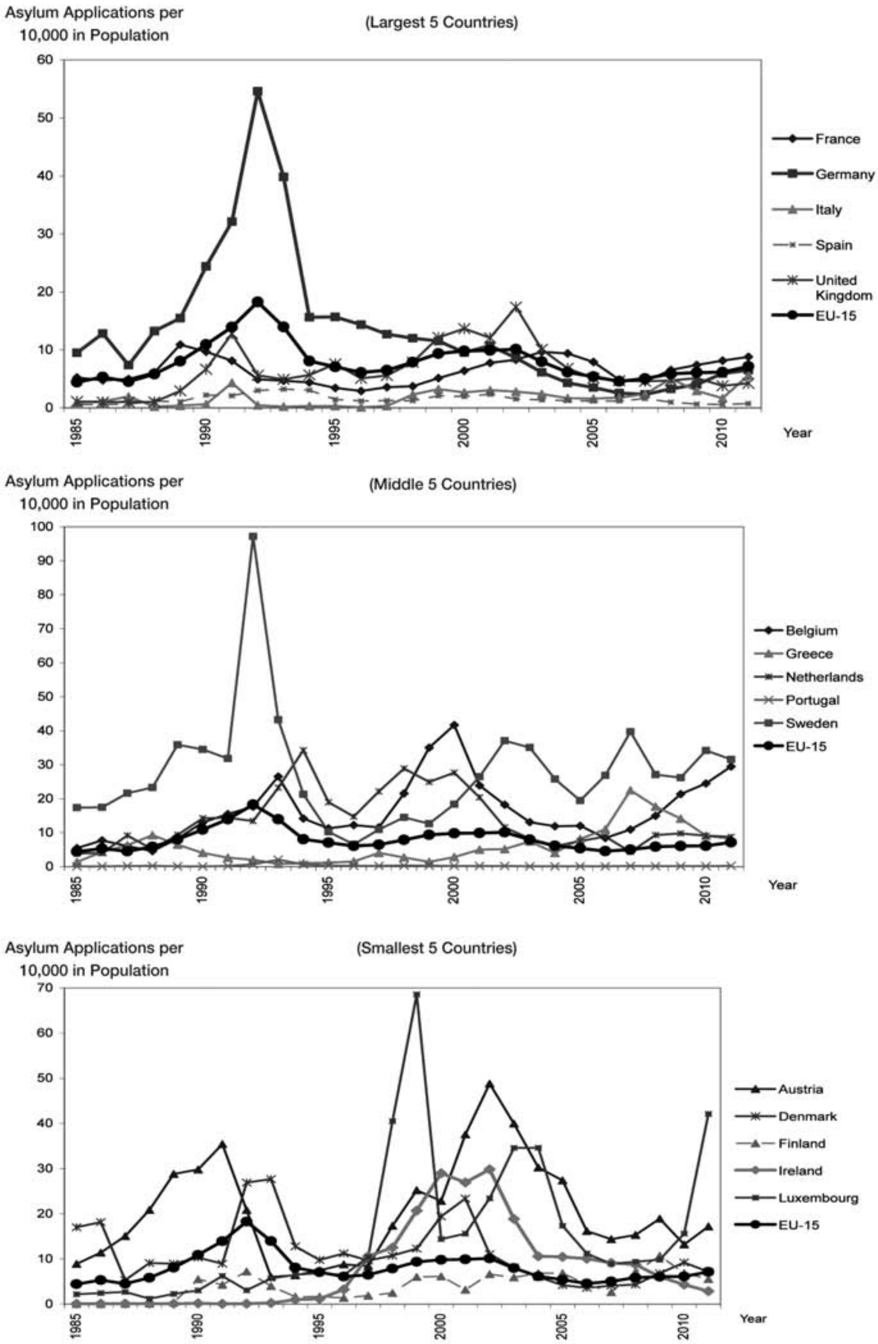
3.1 *Asylum Application Trends in the EU-15*

Figure 1 provides a series of three plots that show the relative comparison of asylum applications per 10,000 in population made in each EU-15 country. For clarity each of the three plots display five individual country graphs based on country size and for comparison the EU-15 average plot is also displayed.

Looking at the overall EU-15 plot in Figure 1 (largest five countries) two surges in asylum applications are visible. The first of these is rapid and occurred after the fall of the Berlin Wall with a large influx of persons from Eastern European countries. This surge reached a peak with over 672,000 applications in 1992. Following this, applications throughout the EU-15 rapidly dropped off to a minimum figure of about 228,000 in 1996. Then applications began to rise again causing a second surge that peaked in 2002 at about 386,000. This is followed by another decline to a second minimum in 2006 of 178,000 applications. Since 2006 applications have been on the rise again and reached nearly 286,000 in 2011. As a consequence of these movements *per capita* asylum applications are now similar to the levels experienced in 1988-1989, 1997-1998 and 2003-2004.

Among the individual graphs in Figure 1 (largest five countries) Germany stands out with asylum applications of 55 per 10,000 in the population in 1992. This is three times the EU-15 figure of 18 per 10,000 in the population. The actual number of asylum applications made in Germany in 1992 is about

Figure 1: *Applications per 10,000 in Population in the EU-15*



438,000 applications or 65 per cent of the 672,000 applications made in the EU-15. Meanwhile, among middle sized countries in Europe, Sweden with 92 applications in 1992 is particularly striking. Among all countries in the EU-15 this level is by far the largest and is five times the EU-15 figure of 18.

The last plot in Figure 1 displays graphs of asylum applications per 10,000 in the population in the five smallest countries in the EU-15. Reflecting on Ireland's application level, the plot shows that in period 2000 to 2002 applications per 10,000 in the population averaged about 30, or about three times the EU-15 level on the back of about 11,000 annual asylum applications. Applications in this period in Ireland are mainly from Romania and increasingly from Nigeria. Since 2002 Ireland's application levels have fallen back to mid-1990s levels. Some likely reasons for this fall include the referendum in 2004 on the rights of children born in the state, the accession of Romania to the EU and the opening up of Ireland's labour market to Romanians in 2007 and the general economic situation since 2008.

To summarise, asylum applications surged in the period following the fall of the Berlin Wall with the bulk of the burden borne by Sweden, Germany and Austria. These three countries accounted for nearly 539,000 or 91 per cent of all 672,000 asylum applications made in the EU-15 in 1992. After this many countries introduced procedures to control access to their territory, including carrier liability fines for allowing persons to board flights without landing cards, refusing leave to land at points of entry and the implementation of the Dublin Convention/Dublin II agreement to prevent "asylum shopping". Thereafter, asylum applications rapidly fell to 227,000 in 1996 and with some justification policymakers claimed some of the fall being attributable to their efforts to tackle abuses of the asylum system. Notwithstanding this applications surged again and peaked in 2002 with the brunt of this surge borne on a per capita basis mainly by Austria, Ireland, Luxembourg and Sweden. Relative to the first surge these four countries accounted for 85,000 applications or about 22 per cent of the 385,000 applications made in the EU-15. Once again this surge has been followed by efforts on the part of policymakers following the Tampere agreement in 1999 to ensure minimum standards and greater consistency in decision making leading, as described in Section II, to the development of the CEAS. Meanwhile in 2006 asylum applications reached 178,000, their lowest level since 1987, but more recently applications are on the rise again. The three key pull factors that lie behind and explain levels of asylum applications over time in the EU-15 are explored next.

3.2 *Exploratory Data Analysis*

The previous studies by Neuymer (2005a) and Hatton (2004, 2009), were based on straightforward linear fixed or a simple random effects models. However, the underlying relationship between asylum applications and GDP, the recognition rate and refugee stock is more complex. In Figures 2, 3 and 4 a series of plots are displayed showing the country by country relationship between (standardised logged values) of asylum applications and GDP, asylum applications and the recognition rate and asylum applications and refugee stocks respectively. Data scatterplots prove to be much cluttered and so to glean the trend each graph shows a heavily smoothed (smoothing parameter =2) Loess (locally weighted polynomial) trend line (Cleveland, 1979) with countries grouped based on population size. Statistically the standard error for the predicted Loess lines curves are small and the associated two standard error band is therefore quite narrow. Accordingly, all smoothed graphs provide acceptable representations of the underlying relationships.

In Figure 2 there are three basic types of relationship, namely convex, concave and positive. For countries displaying either a convex or a largely linear relationship, namely, France, Italy, Greece, Sweden, Austria, Finland, Ireland and Luxembourg the graphical evidence supports the view that higher GDP levels tend to be associated with higher asylum application levels. Meanwhile, for those in the concave group, namely Belgium, Denmark, Germany, Netherlands, Portugal, Spain and the UK, the plots suggest that when GDP levels were lower these countries were attractive to asylum seekers but higher GDP is associated with fewer asylum seekers. This could indicate that rather than use the asylum route migrants may feel a more direct application for a residence permit can be more effective is good economic times.

In Figure 3 the country by country Loess trend line relationship between asylum applications and the recognition rate is displayed. Careful scrutiny of the relationship at different lags reveals the recognition rate lagged one year provides the clearest overall window into the relationship between asylum applications and recognition rates. This is pleasing and facilitates instrumenting the recognition rate which as we noted in Section II is endogenous.

In respect of the recognition rate the response of asylum applications is more intriguing than is the case for GDP with broadly five types of relationship. Of particular interest are countries showing a concave response (Austria, Denmark, Finland, Germany and UK). For these countries as recognition rates increase applications tend to increase until a peak is reached before applications begin to fall back. As alluded to in Section II this may be evidence of a tougher policy environment in response to increases in applications.

Figure 2: *Loess Line Relationship (Standardised Logs) Between Asylum Applications and GDP*

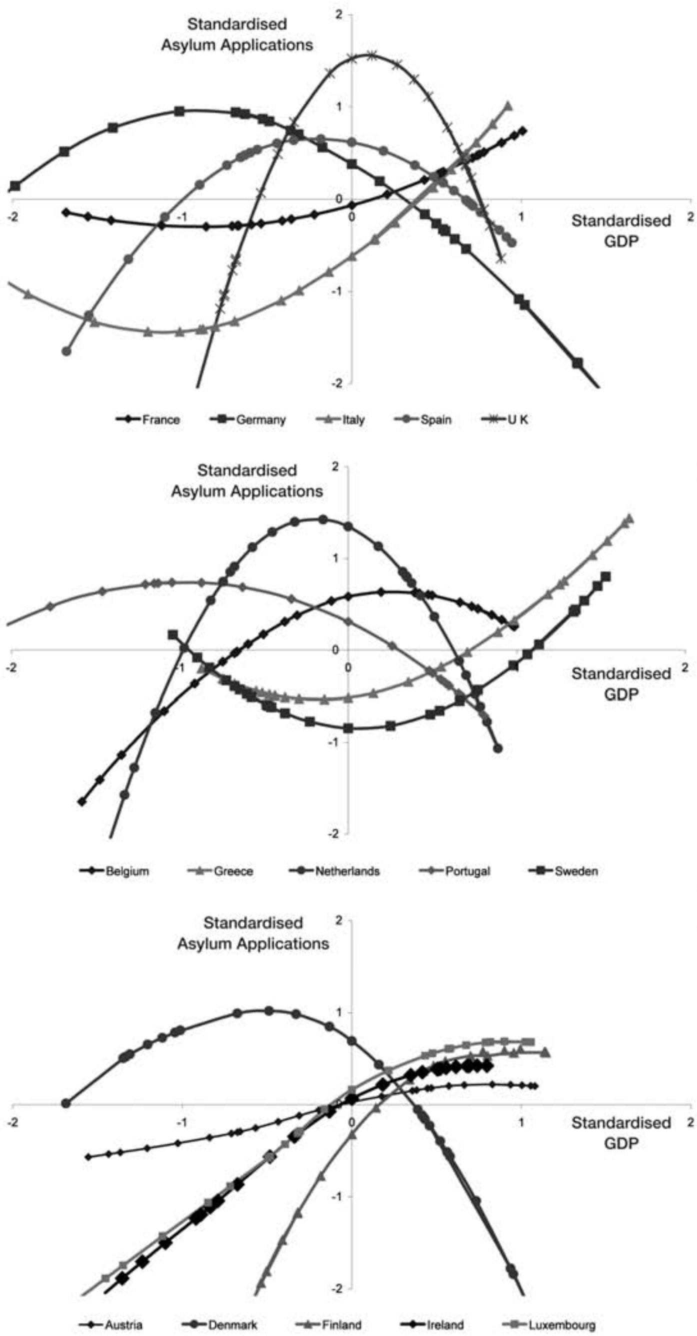


Figure 3: *Loess Line Relationship (Standardised Logs) Between Asylum Applications and the Recognition Rate (Lagged One Year)*

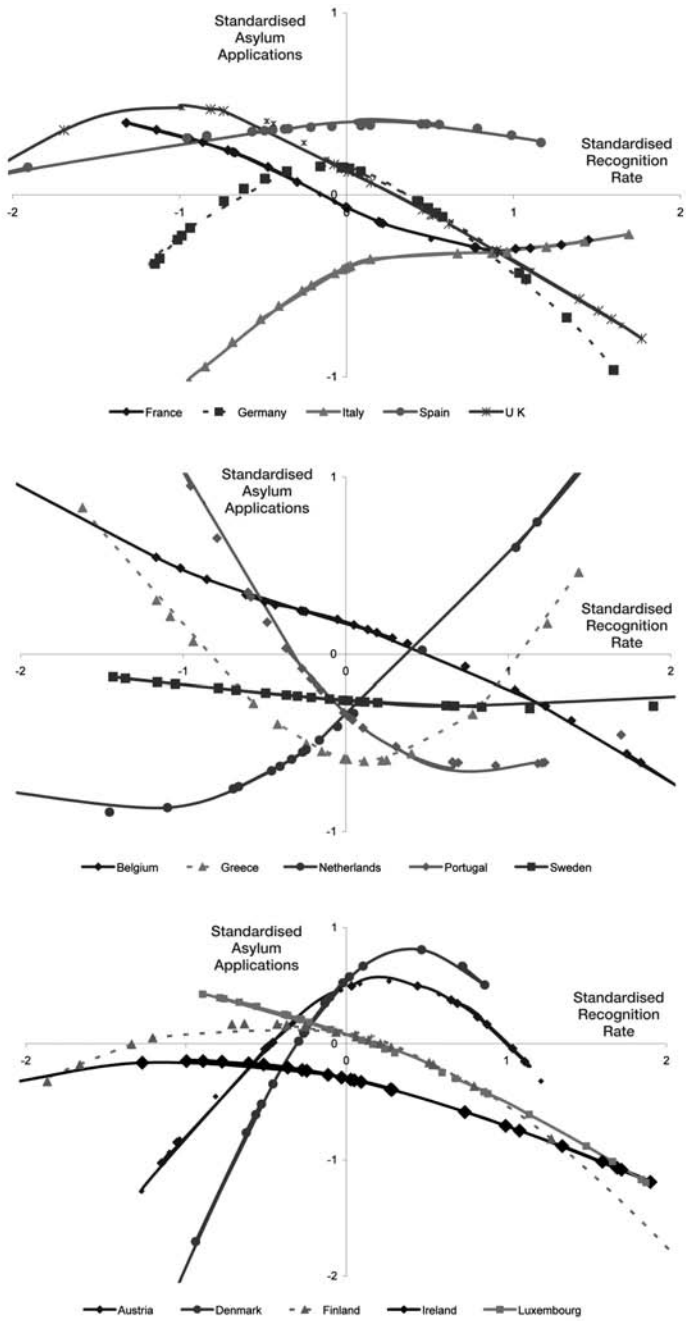
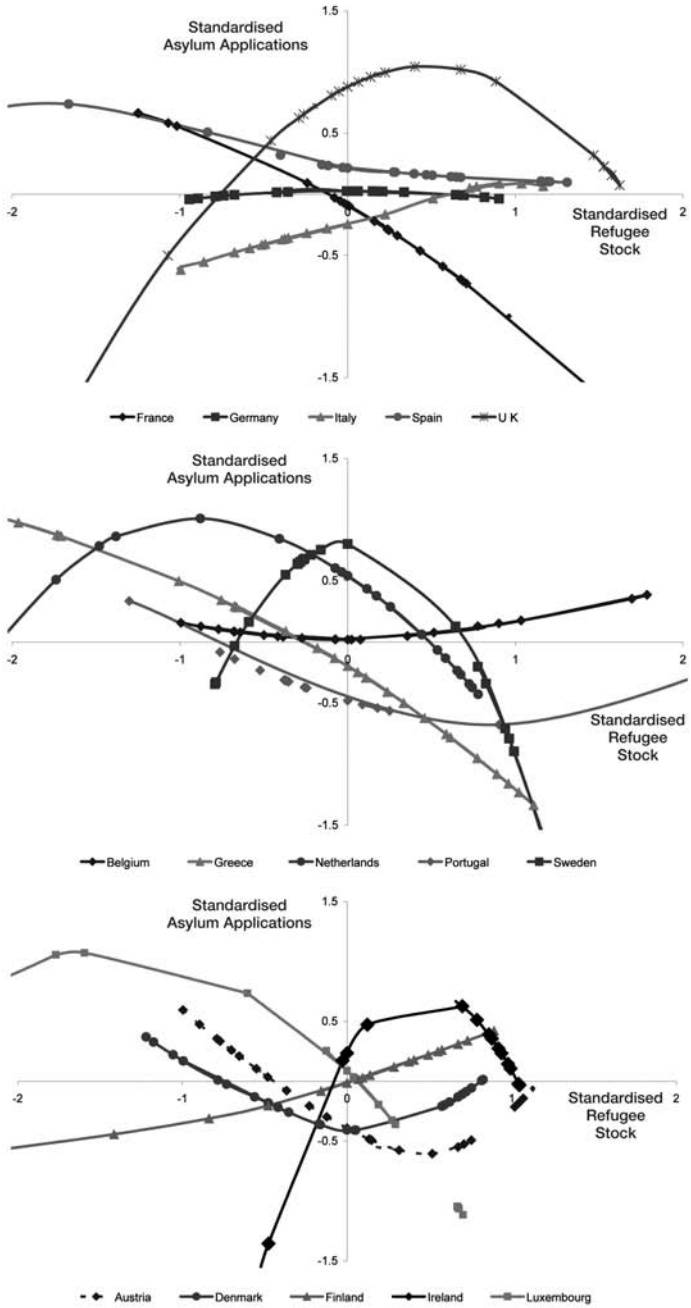


Figure 4: *Loess Line Relationship (Standardised Logs) Between Asylum Applications and Refugee Stock (Lagged Two Years)*



In Figure 4 the Loess trend line relationship between asylum applications and the refugee stock is given. Once again careful scrutiny of the relationship at different lags reveals that refugee stock lagged by two years provides the clearest view of the underlying relationship. Accordingly, we base our analysis on the refugee stock lagged two years and use it to instrument the refugee stock series in subsequent modelling later in this study.

Looking at the plots in Figure 4 the relationship between asylum applications and the refugee stock is once again varied. Interestingly, for both France and Greece refugee stocks have a strong negative effect on applications. One possible explanation for this inverse relationship may be the nature and long history of their country specific immigration. Another interesting group comprises Ireland, Netherlands, Sweden and UK, these show a concave "humped" response. This is intriguing and suggests that when refugee stocks are small the country may be attractive to asylum seekers but as refugee stock grows saturation occurs (as in predator-prey scenarios) and applications tend to drop off. This may reflect that attitudes in these countries harden as refugee stocks or more likely migrant population stocks grow and this in turn causes a drop off in asylum applications.

In conclusion, this exploratory analysis shows the relationship between asylum applications and economic, administrative (i.e., recognition rate) and social/family pull forces is nonlinear with intercepts, general slopes and curvature associated with the Loess lines varying from country to country. Clearly, the diverse and complex nature of the relationship between asylum applications and these three key pull force factors demands more flexible and robust methods of analysis than have been previously used (whether based on fixed or simple random effects models). Accordingly, in the next section our approach is to model the overall relationship using a Dynamic Coefficient Random Effects Panel model. Before describing the methodology we highlight the fact that modelling these data using a standard static coefficient two-way random effects model (e.g., using a linear mixed model in the lmer package available in R) failed to fit these data well due to the nonlinear and temporal nature of the relationships involved.

IV A MODEL FOR ASYLUM APPLICATIONS BASED ON A DYNAMIC COEFFICIENT RANDOM EFFECTS PANEL MODEL

4.1 *Random Effects Panel Model*

We consider the following two-way random effects panel model for the $k = 15$ dimensional vector of 15 EU countries at 25 time points $3 \leqslant t \leqslant T = 27$ (note the data from the first two time points is dropped as Refugee stock is lagged by two years)

$$\mathbf{a}_t = \mathbf{X}_t\boldsymbol{\beta}_t + \mathbf{u} + \boldsymbol{\tau}_t\mathbf{1} + \boldsymbol{\varepsilon}_t \qquad (1)$$

where $\mathbf{a}_t$ is the log of the asylum application level, $\mathbf{X}_t$ is a $k \times 4$ dimensional matrix of logged pull-factor predictor variables for GDP (g_t), the Recognition Rate (r_{t-1}) and Refugee Stock (s_{t-2}), and the vector $\boldsymbol{\beta}_t$ is a four dimensional regression parameter representing the elasticity between asylum applications and each of the three pull-factor predictor variables and an overall intercept respectively. The cross-sectional or country effects vector $\mathbf{u}$ is a k dimensional zero-mean Gaussian random vector with covariance $\boldsymbol{\sigma}_{\mathbf{u}}^2\mathbf{V}$ while $\boldsymbol{\tau}_t$ (which denotes time effects common across countries) is a sequence of uncorrelated zero-mean Gaussian random variables with common variance $\boldsymbol{\sigma}_{\tau}^2$ and $\boldsymbol{\varepsilon}_t$ is a k dimensional sequence of zero-mean Gaussian random vectors with covariance $\boldsymbol{\sigma}^2\mathbf{I}$. In this model $\mathbf{1}$ denotes a k dimensional vector of ones and the random sequences $\boldsymbol{\varepsilon}_t$ and $\boldsymbol{\tau}_t$ and the country effects random vector $\mathbf{u}$ are assumed to be mutually independent.

We note that this model is a time-varying generalisation on the approach adopted by Selukar (2011) when modelling airline cost data (Green, 2000). Additionally, in our implementation we also allow the regression parameter $\boldsymbol{\beta}_t$ to be time varying and adopt a general covariance structure in the country effects random vector $\mathbf{u}$ to be represented by the matrix $\boldsymbol{\sigma}_{\mathbf{u}}^2\mathbf{V}$. Importantly, this model allows the flexibility to: (a) examine the dynamic nature of the elasticity regression coefficients and crucially to see whether they have remained constant over time; and (b) understand whether country correlation effects have an impact on the estimated regression coefficients. This combined methodology is novel in the context of modelling the factors explaining asylum applications. Furthermore, it allows us to compare models according to increasing level of geographic complexity by assuming a country effects covariance matrix $\mathbf{V}$ of different forms, namely no covariance structure $\mathbf{V} = \mathbf{I}$, or hetroskedastic $\mathbf{V} = \mathbf{D}$ a diagonal matrix or more general country correlations. All previous studies (for example in Hatton (2004, 2009) and Neumayer (2005a) among others) whether based on fixed or random effects models have ignored or used rudimentary methods for both dynamic and geographic effects.

4.2 *State Space Representation*

The linear relationship described in (1) can be easily written in state space form as the vector time varying model

$$\text{Measurement Equation} \quad \mathbf{a}_t = [\mathbf{X}_t \;\; \mathbf{H}] \begin{bmatrix} \boldsymbol{\beta}_t \\ \mathbf{z}_t \end{bmatrix} + \boldsymbol{\varepsilon}_t$$

$$\text{State Equation} \quad \hat{\mathbf{z}}_{t+1} = \mathbf{F}_t\hat{\mathbf{z}}_t + \boldsymbol{\eta}_t \quad \text{with} \quad \hat{\mathbf{z}}_t = \begin{bmatrix} \boldsymbol{\beta}_t \\ \mathbf{z}_t \end{bmatrix} \qquad (2)$$

Here $\mathbf{X}_t$ is a $k \times 4$ dimensional matrix of logged pull-factor predictor variables and $\mathbf{H}$ is a $k \times (k + T - 2) = 15 \times 40$ dimensional matrix of the form

$$\mathbf{H}[\mathbf{I}_k \quad \mathbf{0}\cdots\mathbf{0} \quad \mathbf{1}_t \quad \mathbf{0}\cdots\mathbf{0}]$$

where $\mathbf{I}_k$ is a $k \times k$ diagonal matrix for the cross-sectional country effects random vector $\mathbf{u}$ and time effects are represented by the $1 \times (T - 2) = 1 \times 25$ vector of 1's in column t. The state matrix $\mathbf{F}$ is a $(4 + k + T - 2) \times (4 + k + T - 2) = 44 \times 44$ dimensional matrix of the form

$$\mathbf{F} = \begin{bmatrix} \mathbf{I}_4 & \mathbf{0} & \mathbf{0} \\ \mathbf{0} & \mathbf{I}_k & \mathbf{0} \\ \mathbf{0} & \mathbf{0} & \mathbf{0}_{T-2} \end{bmatrix}$$

The disturbance vector of $\boldsymbol{\eta}_t$ comprises 19 zero mean random Gaussian disturbances with variances $\boldsymbol{\sigma}^2_{\beta,1:4}$, $\boldsymbol{\sigma}^2_{u,1:k}$ for the 4 regression predictor variables and the 15 cross-sectional country effects random variables in the vector $\mathbf{u}$. Meanwhile a single zero mean random Gaussian disturbances with variance $\boldsymbol{\sigma}^2_{T-2}$ applies to all 25 time point effects. Accordingly, we are assuming that the overall mean, the three pull-factor predictor variables and the 15 cross-sectional country effects random variables are allowed vary independently as a random walk parameters. In contrast the 25 time effects vectors are treated as constants. So, along with variance $\boldsymbol{\sigma}^2_{\varepsilon}$ of the measurement error disturbance vector $\boldsymbol{\varepsilon}_t$, the model has a total of 20 tuning parameter disturbance variances – that is 21 variance parameters to be estimated. To ensure these remain positive we parameterise the log of each variance. We estimate these parameters by optimising the full likelihood of the data which is readily computed via the Kalman Filter (see Harvey, 1990, 1993 and for further detail in respect of estimating time varying parameter models in particular see Kim and Nelson, 1999). Inserting these estimated values and re-running the Kalman Filter (i.e., state smoothing) gives the time varying regression estimates of three pull-factor predictor variables $\boldsymbol{\beta}_t$, the 15 cross-sectional country effects $\mathbf{u}$ and the individual time effect parameters $\boldsymbol{\tau}_t$ along with standard errors for these parameter estimates. The outcome of applying this model to the asylum data is examined in the next section.

The modelling approach adopted here has two important technical features. First, the regression parameters are "hidden" or "latent" in the likelihood. The likelihood is a nonlinear function of the variance parameters given a set of regression parameter values. Each iteration of the optimisation procedure updates both sets of parameters. Second, a key feature of this modelling approach is the regression parameter coefficients, for GDP say ($\boldsymbol{\gamma}_t$)

are not fixed but can evolve according to the stochastic equation $\boldsymbol{\gamma}_t = \boldsymbol{\gamma}_{t-1}$ + random error. This allows the GDP regression parameter to stochastically adapt to any nonlinearity in the slope/curve of the regression as time evolves. This flexibility allows us to model the data in a way that addresses the diverse and complex nature of the relationships revealed in the exploratory data analysis.

In our implementation this state space model is coded in R (Ihaka R. and Gentleman R., 1996). Accordingly, to estimate each tuning parameter variance it is necessary to provide initial values of these parameters to the procedure optimising the likelihood. In this application the likelihood function is based on 21 tuning parameters and $100 = (T-2) \times 4 = 25 \times 4$ regression parameters $\boldsymbol{\beta}_t$, and is highly complex. So, to get good starting values we conducted a grid seach over the domain of –10 to 10 for the log of the 21 variance tuning parameters.

The model described has 21 variance tuning parameters of which 15 are individual country effects variances. It is relatively straightforward to reconfigure the model so that all 15 country effects variance parameters equal – country effects covariance sub-matrix $\mathbf{V} = \mathbf{I}$ and $\boldsymbol{\sigma}^2_{u,1:k} \equiv \boldsymbol{\sigma}^2_u$ giving a model with seven variance tuning parameters. Comparing the results from these two models allows us to see whether the extra complexity associated with the more complex 21 parameter individual country variance model, is worthwhile when compared to the simpler model based on seven equal country effects variance parameters. The results obtained by applying these two models are discussed in the next section.

V RESULTS AND DISCUSSION

5.1 *Model Variance Parameter Estimates*

In Table 1 we show the outcome of optimising the likelihood of the variance parameters for the two models defined above. The deviance (–2 X log likelihood, also known as the log likelihood ratio statistic) for the models is –34.9 and –80.8. The difference between these two values is greater than the associated $\chi^2_{0.95}(15) = 25$ showing the individual country variance model is better as it has a significantly lower deviance.

However, the R^2 values for both models exceeds 99 per cent and so, there is little to choose between these two models in terms of overall fit. Moreover, simply testing at the 5 per cent level the hypothesis that the mean of the individual country effect variances (0.447) given in Table 1 is different to the equal country effect variance of 0.478, we find no significant difference. So, even though the deviance statistic shows a difference, this has little or no effect on the quality of fit or the individual country variances. As a consequence it makes sense to choose the simpler model. Accordingly, we base the remainder of our analysis and results on the simpler equal country variance dynamic random effects panel model.

Table 1: *Model Tuning Parameter Variance Estimates*

Model	*Deviance*	*Residual Error*	*Intercept*	*GDP*	*Recognition Rate*	*Refugee Stock*	*Overall Country Effect*	*Time Effect*
Equal Country Variances	–34.87	0.068	0.089	0.009	0.014	0.008	0.478	0.024
Individual Country Variances	–80.82	0.051	0.152	0.006	0.009	0.004	0.447	0037

Country Effect Variances

Individual Country Variances		*Individual Country Variances*	
Austria	0.378	Italy	0.818
Belgium	0.263	Luxembourg	0.576
Denmark	0.362	Netherlands	0.297
Finland	0.724	Portugal	0.622
France	0.208	Spain	0.284
Germany	0.264	Sweden	0.435
Greece	0.556	United Kingdom	0.365
Ireland	0.546		

The figures in Table 1 provide valuable insight into the nature of the relationship between asylum applications and the three pull factor variables. The large R^2 value noted above is reflected in Table 1 by the very small size of the residual variance which is 0.068. Also, all three regression parameter variances are very small indicating that the associated time varying regressions coefficients are going to be smooth. Furthermore, the variance attributable to the time effects is small. All together these factors sum to 0.19 while the variance estimates for the country effects sum to 0.48, giving an intra or country to country correlation coefficient of 72 per cent (i.e. ((0.19/(0.48 + 0.19)) × 100 per cent). This is a novel and key finding that is particularly surprising as only 28 per cent of the variation is associated with effects describing the relationship at the EU-15 level. Accordingly, asylum applications are explained by other country specific factors and moreover, this suggests that analysis at the individual country level is likely to yield further insight than modelling and analysis at the EU-15 level as a whole. This finding has important implications for the results derived both in this and in previous studies based on panel data.

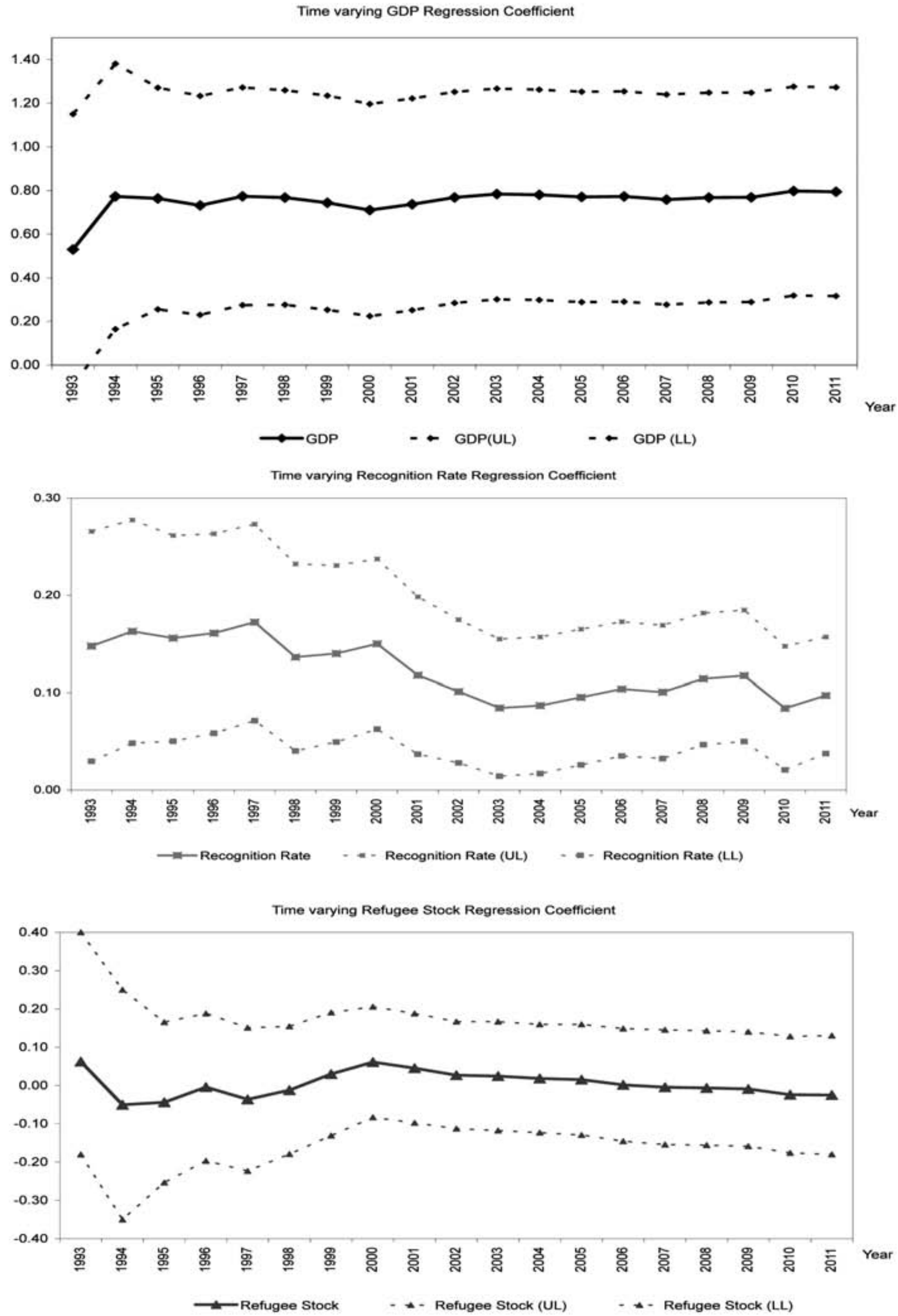
5.2 *Temporal Effects*

Notwithstanding the conclusion above a central question in this study is whether the regression coefficients between asylum applications and the three pull factors is constant over time. Allowing for the fact that this study concentrates on destination countries only, if the answer to this question is true then the conclusions available from previous studies, whether based on fixed or random effect models, are likely to be sound. Otherwise, the conclusions from previous studies may need to be reconsidered.

In Figure 5 plots of each of the time varying regression coefficients are displayed. Looking first at GDP, the median value of the coefficient is about 0.77 and the associated two standard error (s.e.) prediction interval upper and lower limits exceed 0. Accordingly, we can infer the GDP regression parameter is significantly different from 0 with an estimated constant value of 0.77 (s.e. = 0.25 per cent). On average then a 1 per cent increase in GDP in the EU-15 is associated with a 0.77 per cent increase in asylum applications across the EU-15. This finding is in line with Hatton (2004, 2009) and Neuymer (2005a) where 0.2 per cent and a full 1 per cent response respectively were recorded. Our results reinforce their findings by virtue of the fact that the regression coefficient is to all intents and purposes constant.

The second plot in Figure 5 shows the regression coefficient for the recognition rate lagged by one year. Overall from 1994 onward the median value is 0.12 and the two standard error prediction interval is always greater than zero. Thus at the EU-15 level there is a positive correlation between the recognition rate in one year and asylum applications in the next. Here a 1 per cent increase in the recognition rate is associated with 0.12 per cent (s.e. = 0.035 per cent) increase in asylum applications across the EU-15. Importantly, however, closer examination of the plot reveals that during the 1990s the median value regression coefficient is about 0.16 while from 2002 onward it is about 0.1. Meanwhile, since 2002 the median of the two standard error upper limit of the regression coefficient is 0.17, that is, only just above the 1990s median value of 0.16. This indicates a level shift in the regression coefficient. Across the EU-15 this shows that since 2002 this coefficient is significantly lower than in the 1990s. In fact in the 1990s a 1 per cent increase in recognition rate is associated with 0.16 per cent (s.e. = 0.05 per cent) increase in asylum applications across the EU-15. By comparison since 2002 a 1 per cent increase in recognition rate produced a 0.1 per cent (s.e. = 0.03 per cent) increase in asylum applications across the EU-15. All other things being equal this statistically significant change is strong evidence to support the view that

Figure 5: *Time Varying Regression Coefficients*



the actions of policymakers on foot of the Tempere Agreement in 1999 has resulted in fewer asylum applications throughout the EU-15. This is a new and important finding from a policy perspective. It is worth noting that Hatton (2009) using a standard fixed effects regression model found the elasticity of the recognition rate on asylum applications is small but significant and commented that these results "… fly in the face of those who suggest policy has been ineffective". In addition, our findings show the influence of the recognition rate on asylum applications is time dependent as suggested in the correlation analysis of Vink and Meijerink (2003).

Looking at the refugee stock plot in Figure 5 a different picture is evident. Since 1994 this coefficient is marginally positive with a median value of just 0.04. However, the median standard error is 0.07 and so based on this model there is no statistical evidence that refugee stock levels influence asylum application numbers. This finding conflicts with the results of both Neuymer (2005a) and Hatton (2009) who found an effect. Nevertheless, this result must be considered in light of our exploratory analysis in Section III. Our observations there suggested that the relationship between asylum applications and refugee stock is nonlinear, complex and most importantly country specific. Our approach captures the bulk of the signal associated with these characteristics and attributes it to individual country level effects. In contrast, previous approaches (e.g. Neuymer, 2005a and Hatton, 2009) confound country effects with the overall EU-15 and time effects and this drawback must be factored into any consideration of their findings.

5.3 *Geographic Effects*

One of the features of the Dynamic Coefficient Random Effects Panel approach adopted here is that we can explicitly account for each individual country effect. These effects signify the dynamic country specific correction to the overall mean level of asylum applications in the EU-15 when we control for the effect of the three pull factor variables.

In Table 2 the individual country regression coefficient effect size estimates along with their standard errors are given. In the table countries highlighted in grey-scale show a country effect that is positive and significant at the 95 per cent confidence level and included here are the three largest countries Germany, France and the UK. So, for these three countries when we control for the effect of the three pull factors their remains a substantial country specific variance associated with the level of asylum applications over the 25 year time period. This is typically 1.5 times higher than the EU-15 average level (e.g., EU-15 average = 20,547 = 8.77 on log-scale; so for France the log scale correction = 1.6 and we get relative correction = exp(8.77 + 1.6)/20,549 = 1.55).

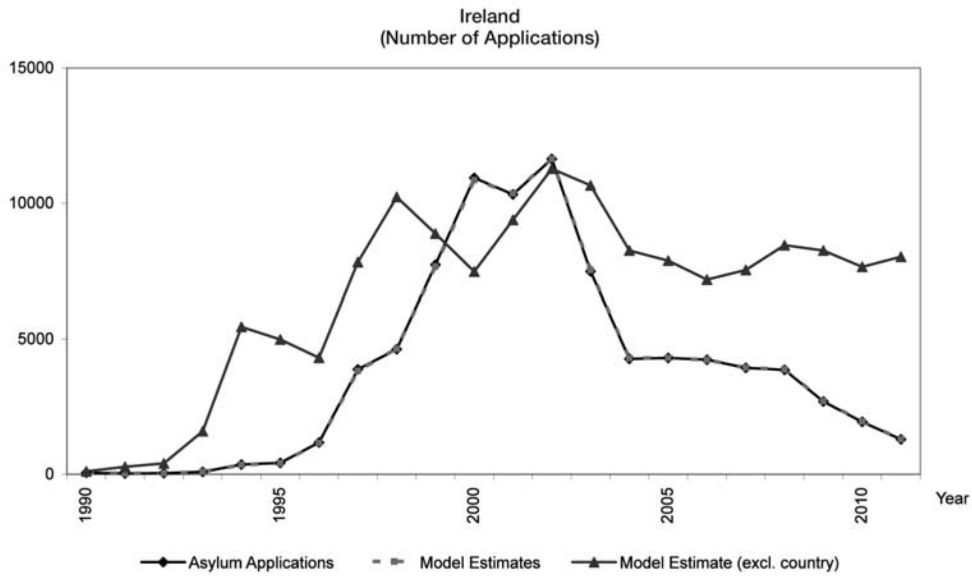
Table 2: *Median Country Effects Regression Coefficient Estimates and Standard Errors*
(Grey Scale Indicates Positive Effect Significant at 5 Per Cent Level)

Country	*Effect Size*	*Standard Error*
Austria	0.54	0.69
Belgium	0.78	0.69
Denmark	–0.66	0.69
Finland	–0.85	0.69
France	1.60	0.70
Germany	1.79	0.76
Greece	0.10	0.68
Ireland	–0.68	0.73
Italy	0.45	0.68
Luxembourg	–2.91	0.79
Netherlands	0.77	0.71
Portugal	–3.32	0.73
Spain	–0.11	0.68
Sweden	1.23	0.71
United Kingdom	1.75	0.70

Equally interesting in Table 2 is the fact that for most of the remaining countries the median effect size estimate is about the same absolute size as its standard error. Thus, even though the effect is not significant at the 95 per cent level, it is substantial enough not to be ignored in all cases except for Greece and Spain. Importantly, when we control for the effect of the three pull factors there is evidence that asylum applications over the 25 year time period to Denmark, Finland and Ireland have been lower than the EU-15. In light of the applications per 10,000 of population considered in Section III, this conclusion is certainly true for Finland and for Ireland in the period up to 1996. However, it is not true for Denmark nor is it true for Ireland since 1997. This suggests that the three pull factors have become more important in explaining asylum applications to Denmark and to Ireland in the period since 1997.

In Figure 6 we show the impact of the country specific effect for Ireland. The actual model estimated values are computed from the equal country variance Dynamic Coefficient Random Effects Panel model. This estimate tracks the actual asylum application trend almost exactly (red dotted line with square marker) showing the model tends to "over-fit" the data. This is no accident and simply reflects the fact that the country specific indicator variables in the model adapt to account for almost all of the unexplained variance leaving only a very small amount of residual variance. Note, on a

Figure 6: *Model Estimate for Ireland*



purely technical point, the model does not specify an actual country predictor variable (e.g., a particular country's unemployment rate) but only an indicator variable that collects together the country specific component of variance which is estimated directly via the Kalman Filter full likelihood – a facility not available in classical regression.

Also shown (triangle marker) in Figure 6 is the model estimate computed without the geographic effect, that is based on the regression coefficients for the three pull-force factors alone and the overall mean. The difference between these two estimates is the amount of variation in asylum applications directly attributable to the "Ireland" specific effect. In the period up to 1998 and again from 2004 it is clear that the difference between these two estimates is substantial suggesting that asylum applications in Ireland in these periods is explained by factors that are specific to asylum applicants in Ireland (e.g., a preponderance of Romanians and Nigerians). This observation also adds weight to the cautionary note on interpreting country specific recognition rates (UNHCR, 2002) referred to in Section II.

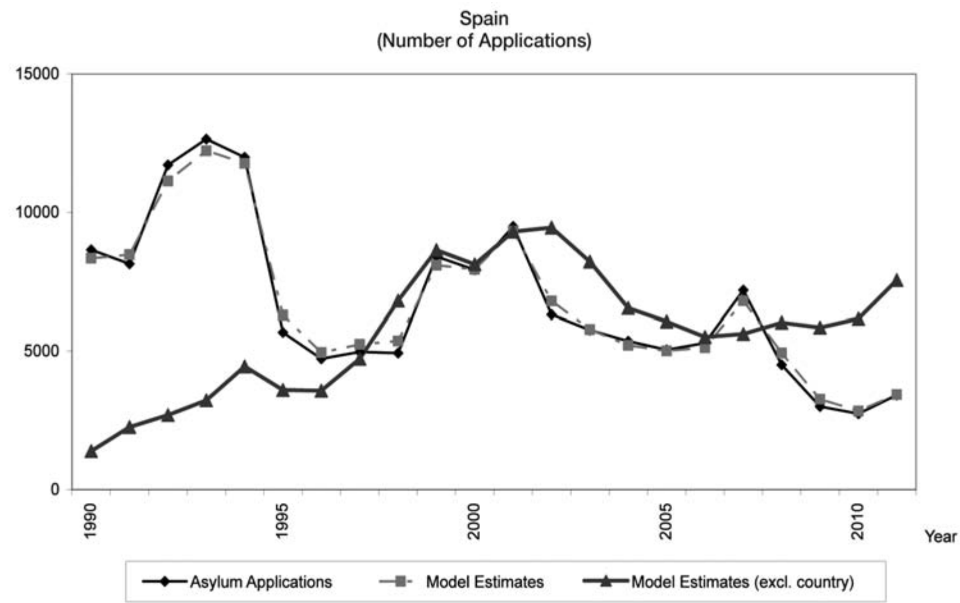
In Table 3 we give the percentage R^2 value associated with unexplained variation due to the country specific effect for each country – this value reflects the impact of the effect given in Table 2 on the overall country specific asylum application figure. For Germany, France and the UK the R^2 value is fairly high showing that the country specific factors dominate in the three largest countries in the EU-15. In most cases the country specific factors account for around half of the variation and so asylum applications to most EU-15 countries are explained by other factors (i.e., not the three pull factors considered here) specific to that particular EU country. Noticeably for three countries, Finland, Luxembourg and Portugal the R^2 value is 100 per cent reflective of the fact that there is an inverse country effect correction to the EU-15 mean level dominates as evidenced by the large negative country effect coefficient for these three countries given in Table 2.

Table 3: *R^2 Values Associated with Unexplained Country Specific Effects*

Country	*R^2 Percentage*
Austria	31.9
Belgium	39.2
Denmark	52.5
Finland	100.0
France	58.6
Germany	74.6
Greece	55.0
Ireland	50.6
Italy	42.3
Luxembourg	100.0
Netherlands	51.9
Portugal	100.0
Spain	32.9
Sweden	54.9
United Kingdom	70.6

Given the results in Table 3 it is instructive to contrast Ireland with another country having a smaller percentage R^2 value associated with unexplained variation due to the country specific effects. Figure 7 shows the plot for Spain which has the second lowest R^2 and an average application level of about 5,500 since 1995, a value roughly similar to Ireland's at about 5,000. As before the "Model Estimate" fit is very good. However, in contrast to the Irish case the "Model Estimate (excluding country)" plot computed using only the three pull-force factors and the overall mean follows the asylum applications trend reasonably well from 1995 to 2008. In this period, the country specific effect for Spain is quite small and the associated country specific R^2 value is just 6 per cent. This is not surprising given that per capita applications in Spain stay fairly constant about one quarter of the EU-15 level throughout these years. By comparison Ireland's per capita applications range from as low as 0.2 to a high of 3.5 times the EU-15 level. Thus, in Ireland's case the influence of country specific factors cannot be overstated while for Spain and indeed Austria and possibly Belgium (see Table 3) based on the country specific R^2 value, the three pull-factors are more relevant.

Figure 7: *Model Estimate for Spain*



Overall this analysis points to the conclusion that asylum applications at the EU-15 level are explained by the three pull-force factors only in respect of Austria, Spain and possibly Belgium. Outside of these three countries the effect of the three pull-force factors remains relevant but conditions specific to each individual country are just as or even more important. Indeed for Finland, Luxembourg and Portugal it seems likely that the economic, social and administrative pull-force factors considered here are largely irrelevant in determining asylum application numbers. Accordingly, we can generalise the conclusions of Hatton (2004, 2009) and Neuymer (2005a) and say that while economic and policy factors matter, aggregate numbers of asylum seekers coming to Western Europe are determined by country specific factors. From a destination country perspective the implication of this is that explaining asylum applications in terms of other predictors is likely to yield deeper insight when conducted on a country-by-country basis.

VI CONCLUSIONS

In this article we have re-examined from a destination country perspective only the relationship between asylum application trends across the EU-15 and three key pull-force factors, namely GDP, the recognition rate and refugee stocks. The choice of these three factors as determinants of asylum applications is based on a review of previous studies where these factors are significant predictors. A key drawback of these previous studies is the limited nature of the regression methods used to arrive at estimates and on which to base inferences. In particular, the methods did not or did not fully account for temporal and spatial features in the data. In Section III of this study our exploratory data analysis showed that the underlying features are complex, curvilinear and stochastic in nature. To address this we proposed modelling the relationships using a Dynamic Coefficient Random Effects Panel model and applied the Kalman Filter to estimate the unknown parameters.

The results we obtained from applying the model and the associated insights gained are revealing. First, we gained a new insight into the relative importance of these three pull-force factors in terms of explaining asylum applications to the EU-15. We have been able to show that less than 30 per cent of the overall variation in asylum applications is explained by these three factors and most of the other 70 per cent is due to country specific factors. From a destination country perspective this suggests that further explaining asylum applications will only yield deeper insight when conducted on a country-by-country basis using country specific factors.

Looking at the role of the three pull-force factors we found that both GDP and the recognition rate are substantial and significant predictors of asylum applications. This finding agreed with previous studies. Importantly, we have also been able to show a level shift in the recognition rate in or around 2002. Prior to this rates are higher and the fall after this date we suggest provides evidence that coordinated policies adopted across EU states reduces the flow of asylum seekers. In respect of refugee stock we did not find a significant relationship and this conflicted with previous studies. By way of explanation we suggested that the refugee stock effect is subsumed into the country specific effects in our model.

A key strength of the approach we adopted is that we could measure the country specific effects while controlling for the regression effects of the three main pull-force factors. We found only three countries (Austria, Spain and possibly Belgium) where economic and policy factors alone largely determine aggregate numbers of asylum seekers. However, these aside, country specific factors associated with applicants to a particular country become more relevant in determining aggregate numbers of asylum applications. This reinforces the observation made above that further explaining asylum applications will only yield deeper insight when conducted on a country-by-country basis using country specific factors. As a consequence we suggest that further research in relation to asylum applications in the EU-15, or indeed widening it to the EEA as a whole, might profitably be conducted on country-by-country basis. Outside the EU-15, however, we mention that reliable data series are very short and this is the key reason why we have restricted our analysis to the EU-15.

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