Titel/Title: A network analysis of intra-EU migration flows: how regulatory policies, economic inequalities and the network-topology shape the intra-EU migration space

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A network analysis of intra-EU migration flows: How regulatory policies, economic inequalities and the network-topology shape the intra-EU migration space

Using a network approach, we investigate the determinants of intra-EU migration flows between all 28 EU member states in the years 2001, 2005, 2008 and 2013. Our descriptive analysis of intra-EU migration flow-networks shows that the EU migration space is dominated by two core destination countries (Germany and United Kingdom). The results of our cross-sectional exponential random graph models (ERGM) reveal that the status of Germany and the United Kingdom (UK) as core destination countries remains a robust characteristic of the network of intra-EU migration flows over time, even when controlling for GDP, unemployment rates or shared geographical borders between destination and source countries. Furthermore, our results point to the differentiated effects of national economic performance on outgoing and ingoing flows: GDP per capita mainly affects intra-EU inflows, while unemployment rates tend to influence outmigration. Lastly, regulatory linkages – measured with the accession to the EU of source countries and the opening of the labour market of destination countries – exert a moderate effect on intra-EU migration flows when taking into account the national economic performances of source and destination countries, the core status of Germany and the United Kingdom, and the shared borders between destination and source countries.

Introduction

The European Union constitutes a unique migration space shaped by its own institutions and governance: the free movement rights, European citizenship and institutionalised educational mobility have facilitated workers' mobility in unprecedented ways and have democratised the access to migration opportunities (Ballatore 2011). These particularities of the EU migration space have led some scholars to conceptualise intra-EU migration as a new type of migration, as it blurs the boundaries between internal and international migration (e.g., King 2002) (but see Deutschmann 2017 Chap. 3). The EU thus represents a unique migration space with open borders between EU member states on the one hand but closed external borders on the other.

Assessing the patterns of this migration space comprises a fascinating empirical enquiry and is of high societal relevance for the EU integration project. We will follow a network approach to investigate the determinants of migration flows within the EU at the macro (i.e. national) level over a twelve-year period, which enables us to provide a fine-grained analysis of the EU migration space and to make a twofold contribution to the migration research debate. First, our network analysis encompasses the outflows and inflows between each pair of EU member states within a twelve-year period. Compared to previous studies (e.g., Ortega and Peri 2012; Kahanec, Pytliková, and Zimmermann 2014), we are able to assess the determinants of both intra-EU emigration and immigration flows between all pairs of EU member states within the same analysis. We can therefore investigate whether macro determinants exert a differentiated effect on intra-EU inflows and outflows by considering all migration movements[i] within the EU migration space. Moreover, considering all source-destination pairs within a migration space in the same analysis enables the development of models that are likely to better reflect the choices immigrants face, as migrants within the EU migration space have the ability to choose among multiple potential destinations (Palmer and Pytliková 2015). Bilateral migration is affected by the attractiveness of alternative destination countries, which highlights the importance of taking into account the conditions in alternative destinations when assessing source-destination pairs of flows (Bertoli and Fernandez-Huertas Moraga 2011). Social network analysis is a useful approach for considering the effects of the embeddedness of bilateral migration into the surrounding migration

system. Second, we take the intrinsic network characteristics of the intra-EU migration space into account when analysing these intra-EU inflows and outflows and their evolution over time. Intra-EU migration does not happen in a vacuum. Instead, it takes place in a pre-existing intra-EU migration space (Delhey et al. 2019). The intra-EU migration network topology (Centola 2015) is composed of two core countries (United Kingdom and Germany) characterised by a considerably higher gravity (metaphorically speaking) in terms of their ability to attract immigrants. Our analysis shows that this core status of Germany and United Kingdom remains a significant determinant of intra-EU migration flows, even when controlling for various macro-factors such as national economic performance, regulatory policies or common borders between sending and receiving countries. We thus highlight the importance of the topology of intra-EU migration network – such as the role of core countries – for a better understanding of intra-EU migrant flows.

Our paper also assesses an important empirical research question in migration and policy research. We investigate the effectiveness of policies aiming to regulate labour migration by comparing their influence on intra-EU inflows and outflows to the influence of migration network characteristics and of classical economic push and pull factors (such as GDP or unemployment rates) for the years 2001, 2005, 2008 and 2013. Results of our network analysis confirm those of existing studies which have shown the significant but moderate role of policies in regulating labour migration within the EU migration space, even when controlling for economic push and pull factors (see for instance the groundbreaking work of Palmer and Pytliková 2015), and at the same time point to the important role of the network topology of the migration system in the EU.

This article is structured as follows: First, we will embed our research question within the conceptual approach of the migration systems theory. Then, we will discuss three types of contextual determinants that might affect intra-EU inflows and outflows: regulatory policies, economic characteristics and network-based characteristics. In the second part of our paper, we will describe the data, methods and present the results. We will conclude this paper by highlighting the main results and discussing the added-value and weaknesses of our approach for migration research. In the final section, we briefly discuss possible implications of our results for the EU migration space, but also for global migration in general.

Theoretical Framework and Hypotheses

A migration system is conceptualised "as a set of places linked by flows and counter-flows of people, goods, services and information, which tend to facilitate further exchange, including migration, between the places" (de Haas 2010: 1593). Migration flows are embedded in a system of relations and exchanges between source and destination countries. Each migration system has its own genesis, characteristics and dynamics (Salt 1989: 432). Mabogunje (1970) introduced this concept to analyse rural-urban migration and conceptualised migration as "a circular, interdependent, progressively complex, and self-modifying system in which the effect of changes in one part can be traced through the whole of the system" (Mabogunje 1970: 16). Meanwhile, migration systems theory has become popular in the current migration sociological literature (e.g., King 2012) and shares many similarities with the definition of transnational social spaces put forward by scholars at the foreground of the debate on transnationalism (e.g., Faist 2010).

Despite its vagueness and its inability to make concrete predictions about migration trends (Hagen-Zanker 2008: 8), migration systems theory is a useful framework to conceptualise the intra-EU migration space. A better understanding of current intra-EU migration flows requires considering the characteristics derived from the pre-existing intra-EU migration space, such as the core status of Germany and United Kingdom, within the intra-EU migration network. Furthermore, migration flows depend more on the relational than on the absolute characteristics of both source and destination

countries. For instance, immigration flows are more affected by the relative economic differential between source and destination countries than by the absolute level of economic prosperity of either the source or destination countries. This refers to the concept of relational linkages introduced by Fawcett (1989) in his attempt to map all potential characteristics of a migration system. Accordingly, relational linkages are linkages derived from the comparison of two places or conditions and are among the most powerful forces in a migration system (Fawcett 1989: 677). With regard to the relational linkages, we will differentiate between *network-based relational linkages* (i.e. characteristics of the migration system) and *economic relational linkages* (i.e. GDP per capita and unemployment rates of both source and destination countries). Furthermore, we will assess the importance of two distinct *regulatory linkages* in explaining intra-EU migration patterns (i.e. accession to the EU and transitional measures for opening national labour markets).

Regulatory Linkages

Since the free flow of capital and labour and the harmonisation of basic regulations is one of the institutional guiding principles of EU integration (Palmer and Pytliková 2015), one might expect that becoming an EU member would have a considerable effect on migration. Overall, the new member states that joined the EU from 2004 onwards were economically less developed than the long-established members, so that entering into the liberal institutional regulations of labour mobility in the EU might have increased rates of out-migration for the new member states. New members in the year 2004 were Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Slovakia, Slovenia and Poland (CYP, CZE, EST, HUN, LVA, LTU, MLT, SVK, SVN, POL). New members *after* 2004 were Bulgaria, Croatia and Romania (BGR, HRV, ROU). The EU accession status implies a reduction of migration costs and constraints for citizens from these new EU member states, which in turn has been shown to enhance intra-EU migration flows (DeWaard, Kim, and Raymer 2012). However, due to worries of excessive immigration from the newer member states to the EU-15 member states, most of the EU-15 member states introduced transitional measures to temporarily restrict the access of citizens from the 2004 member state cohort to the labour market (with the exception of Cyprus and Malta)[ii]. While the changing membership status over time might be related to out-migration because of the promise of free labour movement, the receiving countries could have facilitated the immigration of EU citizens by opening the labour markets and allowing these citizens to work on a regular basis. Right after the enlargement of the EU in 2004, Sweden, Ireland and United Kingdom (SWE, IRL, UK) opened their labour market for the new EU members. Portugal, Finland, Greece, Italy, Spain, the Netherlands, Luxembourg and France (PRT, FIN, GRC, ITA, ESP, NLD, LUX, FRA) opened their labour markets between 2005 and 2008, while the "late openers" Germany, Austria, Belgium and Denmark (DEU, AUT, BEL, DNK) allowed regular employment of the new EU citizens after 2008.

These transitional measures and the variation in their duration have been shown to have impacted Eastern-Western migration flows after the 2004 EU accession of the new member states (Palmer and Pytliková 2015), even when controlling for the EU accession status (Kahanec, Pytliková, and Zimmermann 2014). We therefore expect emigration flows from EU member states to increase with the accession to the EU of the respective member states, and expect an increase in immigration flows to destination countries shortly after the opening of their labour market to citizens from the new EU member states. However, when investigating the role of regulatory linkages in mitigating intra-EU migration flows, other determinants of migration flows need to be considered.

Economic Relational Linkages

The economic performances of both source and destination countries – referred to as economic relational linkages – are likely to play a major role in explaining intra-EU migration patterns. According

to the neoclassical economic perspective, different economic situations between countries are an incentive for actors seeking to maximize their income by immigrating to a more prosperous country. The neoclassical economic push and pull factors in the migration decision are based on the comparison and evaluation of the economic conditions in the source and destination countries (Clark 1986; Hadler 2006; Massey et al. 1993), which are differentials in earnings (e.g., Kaczmarczyk and Tyrowicz 2015; Massey et al. 1993) and unemployment rates (e.g., Massey et al. 1993; Verwiebe et al. 2010). Kahanec, Pytliková, and Zimmermann (2014), for instance, pointed to the importance of GDP growth and the unemployment rates of the *destination* countries in explaining Eastern-Western intra-EU migration – even when controlling for GDP growth and unemployment rates of the *source* countries (see also Palmer and Pytliková 2015; Ortega and Peri 2012). They argued that employment opportunities and a dynamic economy in destination countries are strong determinants for explaining the predominantly labour-related immigration of citizens from Central and Eastern European member states (Kahanec, Pytliková, and Zimmermann 2014: 24).

With respect to our setting, the new member states showed comparatively low levels of economic development in terms of GDP per capita, and some of them had higher unemployment rates compared to EU-15 member states when joining the EU. Since both GDP per capita and unemployment rates are strongly related to migration between countries, regulatory linkage effects of EU membership and transitional measures could be spurious. This is because of the strong correlation of economic development and membership starters, as well as domestic labour market policies, which is why we control them in our models.

However, the aforementioned studies are either based on immigration stock data or on unidirectional immigration flows data; i.e. data on the inflows from countries with a net out-migration into countries with a net in-migration (such as from Central and Eastern EU member states into the EU-15 member states). However, for a comprehensive picture of patterns of the intra-EU migration space it is crucial to analyse data containing both inflows and outflows between each pair of EU member states and to take into account the embeddedness of each pair into the wider network. Thus, network-based data of migration inflows and outflows linking each pair of EU member states can provide a more fine-grained assessment of the role of economic push and pull factors for the intra-EU migration space.

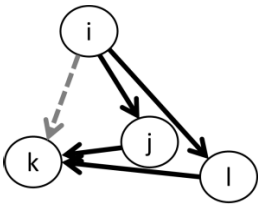
Network-based Relational Linkages

As our descriptive analysis of the intra-EU migration network will show, Germany and United Kingdom became core destination countries in the migration space. The reasons why some countries come to be regarded as core within a migration network are various. Within the EU migration space, language-related and geographic reasons might be of particular importance. German as a Foreign Language is a common subject in secondary schools in Eastern European countries such as Poland, Slovakia, Hungary and Croatia (Goethe Institut 2016). In addition, German language skills constitute – after career prospects – the second most important reason for highly skilled Europeans to immigrate to Germany (Teney 2019). English has become the "hegemonic language" in many parts of the globalised world (Vögtle and Windzio 2016). Hence, language proficiency facilitates the out-migration from the Central and Eastern EU member states to the United Kingdom in particular but also to Germany. Moreover, the central location of Germany within the enlarged EU renders it an easy destination country for migrants from many member states. In combination with its flourishing economy, its welfare system, its geographic location and the migrants' basic language proficiency, Germany became the most popular country for EU migrants in 2016 (BAMF 2018). Our descriptive analysis of intra-EU flow-data will show that the network of inter-EU migration presents a *topology* similar to the power-law distribution of network ties described by Barabási (2003). According to this distribution, network ties

are concentrated on a small number of nodes, Germany and United Kingdom in our case, whereas the majority of nodes only have a few links to other countries.

In addition to the unequal distribution of network ties between the core and the rest, countries might be more or less attractive for reasons that remain unobserved in the data. Existing research has shown that migration ties between countries show considerable levels of transitivity (Vögtle and Windzio 2016; Windzio 2018). Transitivity indicates the embeddedness of ties in the wider surrounding network: if country i sends migrants to country j and country j sends migrants to a third country k, it is very likely that i also sends migrants to k, because k seems to be even more attractive than j (dashed line in Figure 1), so that the hierarchy in attractiveness is i < j < k.

Figure 1: Latent hierarchies and transitive triads



In friendship networks this hierarchy (Windzio 2015) can be illustrated by the adage "friends of my friends are my friends". Since a dyad is often embedded in a multitude of transitive triads, the effect of each additional triad should be down-weighted, which is why the network statistic is called geometrically weighted edgewise shared partners (`gwesp`). Given that there is a latent hierarchy between countries, this term should occur *more* often in the network then by chance, whereas the geometrically weighted dyadwise shared partners (`gwdsp`), where there is no tie between i and k in Figure 1 (dashed line removed), should occur *less* often (Harris 2014; Lusher, Koskinen, and Robbins 2013). An additional advantage of the social network perspective is that it considers these indicators of embeddedness in conjunction with the surrounding network. Even though this embeddedness does not represent the migration system as a whole, it captures an important part of its *effects* and is thus an important supplement to the "core" indicator of the network topology (Centola 2015).

Data and Methods

Source of intra-EU Flows Data

Given that intra-EU mobility patterns are of interest in this paper, the units of analysis are the EU28 member states and their migrations flows. The period of analysis spans from the year 2001 to the year 2013 including four observation time points (2001, 2005, 2008, and 2013), thereby covering the recent EU enlargements incorporating the Eastern European countries into the Union. However, data on intra-EU migration flows is hard to come by because information tends to be incomplete (i.e. data on whole countries are missing completely or are not available for the years of interest). Therefore, we had to combine several data sources to assemble the data set used in our analysis. Since the classification of migrants based on *citizenship* is the most comprehensive across sources, we opted for this definition. Occasionally, however, we had to rely on *prior residence* due to missing data. Quite generally, our data set is comprised of countries' reports on the number of immigrants and their categorization according to their citizenship or, occasionally, to their prior residence (for an overview of data sources see Table A1 in the online appendix).

Our most important data source is the migration flow data provided by The United Nations (2015). This source provides data on migration flows for the majority of countries and measurement years. While this source provides broad access to data on migration flows, issues with the variation in definition of 'foreigners' across countries as well as different national data sources remain. Data sources vary from population registers to residence permits to passenger surveys, and the minimum duration of stay to be classified as an immigrant ranges from only three months to a stay that lasts longer than a year. Different definitions and data sources result in immigrants being counted differently, thus affecting the comparability of data – an issue that comparable studies also face (see for example Palmer & Pytliková 2015). For example, population registers and residence permits provide a more accurate picture than passenger surveys, which may have a bias due to selectivity in survey participation. However, counting immigrants via population registers and residence permits requires foreigners to register, which they might not necessarily do, thus also potentially biasing the reported number of immigrants. While the UN provides a rich data set, we occasionally had to rely on data from a year adjacent to the measurement year due to missing information in the current year.

There are, however, some gaps in the UN data such as the fact that it does not provide any information on intra-EU migration flows for some countries or certain years[iii]. For these cases, we had to substitute the missing data with data from other sources. For instance, missing data for Cyprus, Latvia and the United Kingdom was replaced by migration flows provided by Eurostat (2018b). Lastly, to complement our migration flow data set for countries with no or few available data points, we had to rely on aggregate data from the Census Hub – also provided by Eurostat (2018a). The Census Hub provides information on the total amount of migrants from one EU country to another EU country for the whole period from 2000 to 2011 combined. Furthermore, it contains data available on the amount of all EU citizens who moved to a country in each single year from 2000 to 2011. We used this second piece of information to calculate the share of EU immigrants by year in order to weigh the information on the immigrants who immigrated during the period of 2000 to 2011 by country. This weighed data helped to approximate migration flows for Bulgaria, France, Greece, Malta, Poland, and Portugal. The fact that we had to rely on different sources for complementing our dataset of intra-EU migration flows implies that our dataset is not based on a uniform definition of migrants, but it captures the immigrant counts based on the respective country's definition (see above). To evaluate our approach of relying on different data sources, data for countries with existing UN data was compared to the weighted data from the Census Hub (see Table A1 in online appendix): For most of these countries, the correlation between these two data sources is above .90. We have to concede, however, that for some countries, the weighted data show less resemblance to the presumably more accurate accounts from the UN migration flow data ($r = >.60$). However, our approach is conservative: migration between two countries must be at a considerable level to define a link, which downweights the effect of measurement error. Table A1 in the online appendix provides an overview of the data used for each country and each measurement year.

Operationalisation of the Dependent Variables

Our outcome variable results from the share of out-migrants in the years 2001, 2005, 2008 and 2013 relative to the overall population in a source country. The result of this procedure is a continuous variable called "sent-home-ratio" (SHR) (Windzio 2018). Since we analyse the European migration space as a network, we recoded the SHR into discrete categories according to its distribution in the data. The categorisation into comparatively high or low values of the SHR can only be done in relative terms, since there is no objective criterion for defining either high or low migration. We categorise the SHR in two different ways: first we code the highest quartile of the SHR distribution into 1, and

otherwise into 0. Consequently, a binary tie in the network is only established if there is a substantial share of a population migrating from country A to country B in relative terms. The second approach also takes the *intensity* of a migration flow between two countries into account. Accordingly, we split the SHR distribution into eight quantiles. In order to avoid too many outcome categories which could otherwise negatively affect the estimation procedure, we summarised these quantiles into six discrete categories ranging from 0 to 5 in a way that approximately results in a Poisson distribution. If **n0**, **n1** … **n5** are the numbers of nominations in the resulting Poisson distribution and q1, q2…q8 are the quantiles, then the categorization is done in the following way: (0 < **n0** < q2 < **n1** < q3 < **n2** < q4 < **n3** < q5 < **n4** < q7 < **n5** >= q8).

Operationalisation of the Independent Variables

The definition of transitivity is more complicated in valued networks (Krivitsky 2012), since it must also take into account the particular value of the tie in each dyad. For this purpose, we use the nested function "transitive weights" explained in Figure A1, online appendix, but the general interpretation is similar to the `gwesp` effect in binary models: if the respective network statistic shows a positive effect, it occurs more often in the empirical network than is expected by chance. If the effect is negative, it will occur less often. In addition, the models for valued ties also include the "mutuality" term, which indicates the occurrence of sending and receiving reciprocal ties in the network. The difference in model specification between the binary and the valued ERGM is due to convergence issues.

We use yearly unemployment rates from the Eurostat database and GDP per capita (US$, divided by 1000) from the World Bank (2018) database. We match both country attributes to the respective network with a time-lag of one year. In other words: we explain the network in the years 2001, 2005, 2008 and 2013 with the respective country attribute one year before. The effects of GDP per capita and unemployment are estimated as effects of continuous variables on indegree and outdegree (`nodeicov`, `nodeocov`). As indicators for institutional effects we use the respective year a country officially joined the EU ("new member"), as well as the country-specific regulation when immigrants got full access to the domestic labour markets (LM) ("open LM"). Both effects are estimated as effects of binary variables. Effects of new members are estimated on outdegree (`nodeofactor`) and effects of opening the labour market are estimated on indegree (`nodeifactor`). Categories of the variable "new member" distinguish between countries who became a member in the year 2004, after the year 2004 and before 2004 (reference group). In contrast, categories of the variable "open LM" indicate either the year 2004, which is when the new members joined the EU, between 2006 and 2008, or the "late openers" after 2008 (reference category) (see section "Regulatory Linkages"). The attribute "Core (UK, DEU)" is a dummy variable with value 1 for these two countries and 0 for the other countries. In our model, this dummy variable provides an effect on indegree (`nodeifactor`). Finally, a matrix consisting of zeros and ones indicates whether two countries share a border.

Statistical Modelling Strategy

Not taking statistical non-independence of observations and unobserved hierarchies in networks into account could lead to a severe bias in the statistical analysis. This is why our regression models of ties in the EU migration network are based on exponential random graph models (ERGMs) (Harris, 2014). These models explain the probability of observing the empirical network relative to other possible networks in a given set of nodes. Comparing the distribution of network statistics such as transitive closure or similarity in node attributes can explain why it is more likely to observe the given empirical network. Hence, in its standard (binary) version, the ERGM can be regarded as a logistic regression model which explains the *occurrence of a tie* in a dyad and accounts for the statistical non-

independence of (dyadic) observations, albeit the estimation procedure is based on the simulation of *networks*. In contrast, a valued outcome indicates the *strength of a relationship* on a discrete scale (Krivitsky, 2012).

In the first variant of the ERGM, the dependent variable is binary (1= tie between two countries; 0=no tie). In the second variant, a discrete count variable indicates the intensity of a migration, called a "valued tie" in network analysis.

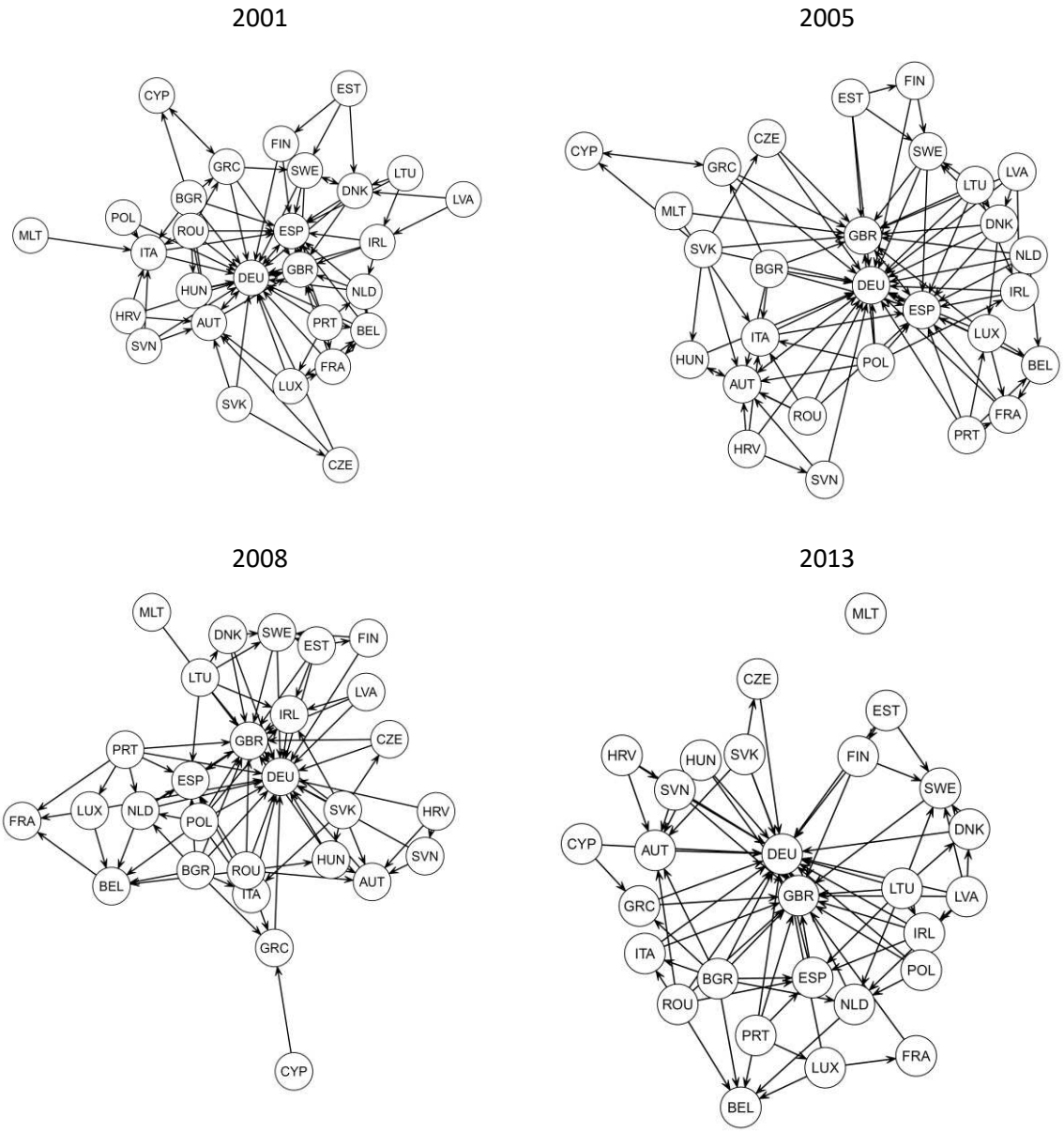
Results

First, we present the descriptive analysis of the EU migration networks for the years 2001, 2005, 2008 and 2013. Subsequently, we present the results of ERGMs for the *binary* and for the *valued* network.

Descriptive Analysis of the EU Migration Networks 2001-2013

Figure 2 presents the visualisation of the network of internal EU migration for each year. The topology of the network is organised around Germany and the United Kingdom, which constitute the core of these networks. Compared to the other EU member states, both countries attract intra-EU migrants from a comparatively large number of countries. As previously argued, the main reasons behind this core status are likely to be the predominance of German and English being taught as foreign languages in most EU member states, but also the central location of Germany in the enlarged EU.

Figure 2: The EU Migration Networks 2001-2013, Binary Ties



However, the favourable labour market situation and the rather prosperous economy of these two countries might also explain their attractiveness as destinations for EU migrants. It is therefore important to control for the national economic performance when investigating the role of the "core" status of countries within a migration network, which we do in multivariate network models.

Multivariate Network Analysis of Intra-EU Migration Flows (2001-2013)

Table 1 presents the results of models for the binary network and Table 2 and 3 for valued networks. For all four years we find the expected effects of `gwesp` and `gwdsp` in the binary network (Table 1): the effect of 2-path (`gwdsp`) is significantly negative, we observe fewer open triads (non-hierarchical) in the empirical network than expected by chance. In addition, the effect of `gwesp` is significantly positive and indicates a latent hierarchy of attractiveness among European countries as destinations of migration. In addition, we find strong and positive effects of a shared border in all models, so spatial proximity is obviously important for migration within the EU.

Besides “shared border”, there is only one significantly positive effect in Model (1): the higher the GDP per capita, the higher the tendency of a country to get an indegree. Unsurprisingly, countries with strong economies are more attractive for migrants, but this effect vanishes after controlling for the “core” effect on indegree in Model (2). The “Core (UK, DEU)” has a strong, significant and robust effect in all four time-points and once again indicates a highly centralised topology of the EU migration network. This basic pattern slightly changed in the year 2005. In Model (3) we find a positive effect of “opened labour market in 2004” on indegree, but only significant at the 10% level. While this effect becomes insignificant after controlling for the “Core (UK, DEU)” in Model (4), the positive effect of GDP per capita on indegree remains stable and significant. Also, as per the theory of economic relational linkages, high unemployment rates increase the propensity to send a tie in the migration network in Model (4). Hence, a good economy is a pull factor and high unemployment is a push factor.

With one exception, Model (5) for the year 2008 is very close to our theoretical expectations: there is a positive effect of becoming a new member after the year 2004 on outdegree (significant at the 10% level only) and also a significantly positive effect of “opened labour market in 2004” on indegree. At the same time, the positive effect of GDP per capita on indegree is significant as well, which has been expected according to the economic relational linkages. Not in line with the expectations is the positive effect of unemployment on indegree in Model (5). The question of whether this effect is somehow related to the emerging financial crisis in the EU must remain open in this study. When controlling for the “Core (UK, DEU)” in 2008 (Model (6)), only the positive economic relational linkage-effect of GDP per capita on indegree remains marginally significant (10% level). In contrast, in 2013 the positive effect of “new member after 2004” on outdegree remains significant after controlling for the “core”. It seems that the regulatory linkage of becoming a new member in 2004 required some time to robustly develop its effect on outmigration. In addition, it shows that regulatory linkages do not trigger migration per se but require some additional conditions to unfold their effect. Yet the interpretation should consider the confoundedness of “Core (UK, DEU)” and “opened labour market in 2004”: the United Kingdom was already part of the core in 2001 but opened its domestic labour market right when the new countries joined the EU in 2004.

Consequently, EU membership and the opening of labour markets have an effect on internal migration within the EU system in 2013, but this effect is outperformed by the gravity of the “core” of the EU internal migration system. The effect of the “Core (UK, DEU)” is not just the result of a well-performing economy, since the positive effect of GDP per capita on indegree is still significant after controlling for the core in 2013.

Table 1: Determinants of Binary Network Ties in the EU Migration System, 2001, 2005, 2008 and 2013. Cross-sectional ERGM Models of sending a considerable Share of Population to other Countries

	2001		2005		2008		2013	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
edges	-2.519***	-2.189*	-3.475***	-4.110***	-4.074***	-3.803**	-2.501**	-5.218***
gwesp(decay=0.3)	1.421***	1.291***	1.294***	0.992***	1.665***	1.379***	1.806***	1.094**
gwdsp(decay=0.3)	-0.535***	-0.440***	-0.685***	-0.522***	-1.165***	-1.009***	-1.472***	-1.091***
network topology								
nodeifactor: Core (UK, DEU)		1.631***		1.785***		1.445***		2.530***
Regulatory linkages								
outdeg.: new member in 2004	-0.274	-0.494	0.257	0.132	0.383	0.334	0.464	0.791
outdeg.: new member after 2004	0.205	0.218	0.526	0.512	0.696+	0.739	0.856*	1.391*
indeg.: opened labour market in 2004	0.215	-0.441	0.348+	0.052	0.636*	0.529	0.568*	0.062
indeg.: opened labour market in 2005-8	-0.015	0.217	-0.057	0.341	-0.066	0.318	-0.100	-0.226
economic linkages								
outdeg.: gdp/cap. t-1	-0.004	-0.011	0.014	0.010	0.006	-0.002	0.011+	0.011
indeg.: gdp/cap. t-1	0.025*	0.010	0.018**	0.017*	0.016**	0.013+	0.011	0.023*
outdeg.: unempl. t-1	-0.010	-0.017	0.040	0.069*	0.053	0.037	0.026	0.075*
indeg.: unempl. t-1	0.009	-0.017	0.046	0.048	0.165*	0.122	-0.028	0.065
proximity								
edgecov: shared border	1.797***	1.973***	1.665***	1.841***	1.856***	1.980***	1.919***	2.110***
Akaike Inf. Crit.	393.679	371.775	409.159	379.457	350.455	330.297	331.408	290.944
Bayesian Inf. Crit.	449.215	431.939	464.695	439.622	405.992	390.461	386.944	351.109

+p <=0.1; *p <=0.05; **p*p <=0.01; ***p<0.001

Model variant two (valued networks) tests the effects on the *intensity* of a migration flow. Table 2 shows valued ERGM Poisson models of sending population to other countries (Krivitsky 2012). These models are unconditional, which means that they do not take into account network structural effects. In addition to the effect of "nonzero", which captures possible deviations from the underlying Poisson distribution, only the effect of GDP per capita is included. Except for the year 2001 where the effect of GDP is insignificant for outdegree, results are well in line with the pattern of GDP as a push-pull factor as according to the theory of economic linkages. From 2005 onwards we find significantly negative effects of GDP per capita on outdegree, as well as significantly positive effects on indegree. The richer a country is, the lower the intensity of outmigration, or conversely, poorer countries sent out migrants with higher intensity. Again, the effects are well in line with predictions from traditional economic push-pull theories of migration between countries. However, the models in Table 2 do not control for further covariates.

Table 2: Determinants of Network Ties in the EU Migration System. Valued ERGM Poisson Models of sending a considerable Share of Population to other Countries. Gross Effects of GDP per Capita.

	tie count 2001	tie count 2005	tie count 2008	tie count 2013
	(1)	(2)	(3)	(4)
edges	0.463***	0.902***	0.832***	0.386***
nonzero	-7.033***	-8.011***	-7.413***	-5.734***
outdegree: gdp/cap.	0.002	-0.003*	-0.004***	-0.006***
indegree: gdp/cap.	0.017***	0.010***	0.008***	0.008***
Akaike Inf. Crit.	-3,317.3	-3,313.4	-3,101.8	-2,966.9
Bayesian Inf. Crit.	-3,298.8	-3,294.9	-3,083.3	-2,948.4

+p <=0.1; *p <=0.05; **p*p <=0.01; ***p<0.001

Table 3: Determinants of Binary Network Ties in the EU Migration System, 2001, 2005, 2008 and 2013. Cross-sectional valued ERGM Models of sending a considerable Share of Population to other Countries

	tie count 2001		tie count 2005		tie count 2008		tie count 2013	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
edges	-0.069	-0.036	0.078	0.019	-0.005	0.019	-0.326	-0.974***
nonzero	-6.334***	-6.119***	-7.454***	-6.919***	-6.797***	-6.227***	-5.151***	-4.656***
mutual(min)	0.260	0.299	-0.018	0.045	0.135	0.149	0.185	0.333*
transitive weights(min,max,min)	0.540***	0.476***	0.332***	0.315***	0.373***	0.345***	0.337***	0.296***
cyclical weights(min,max,min)	-0.362***	-0.344***	-0.238***	-0.221***	-0.260***	-0.246***	-0.329***	-0.307***
network topology								
indegree (core: DEU UK)	-	0.708***	-	1.162***	-	1.356***	-	1.366***
Regulatory linkages								
outdegree (new memb. in 2004)	-0.081	-0.194*	0.078	0.040	0.063	0.120	0.088	0.160
outdegree (new memb. after 2004)	0.067	0.014	0.116	0.096	0.202*	0.298**	0.296**	0.436***
indegree (open LM in 2004)	0.092	0.007	0.130*	0.063	0.252***	0.237**	0.242**	0.040
indegree (open LM in 2005-8)	0.019	0.188**	0.013	0.160**	0.018	0.243**	0.010	0.081
economic linkages								
outdegree: gdp/cap.	0.007*	0.005	0.006*	0.003	0.002	0.002	0.003	0.002
indegree: gdp/cap.	0.012***	0.007	0.009***	0.006**	0.005**	0.003	0.005**	0.008***
outdegree: unemp. t-1	0.002	0.004	0.015*	0.016*	0.007	-0.004	0.007	0.012
indegree: unemp. t-1	-0.004	-0.007	0.013	0.001	0.029*	-0.004	0.003	0.018*
proximity								
edgecov: shared border	0.627***	0.621***	0.494***	0.558***	0.520***	0.616***	0.526***	0.568***
Akaike Inf. Crit.	-3,254.154	-3,520.176	-3,448.423	-3,566.650	-3,262.497	-3,399.376	-3,100.819	-3,256.921
Bayesian Inf. Crit.	-3,189.362	-3,450.756	-3,383.630	-3,497.230	-3,197.705	-3,329.955	-3,036.027	-3,187.500

+p <=0.1; *p <=0.05; **p*p <=0.01; ***p<0.001

According to models for valued networks in Table 3, there is significantly more transitive closure in the data than expected by chance and also significantly fewer cyclic triads (which are non-hierarchical). Taken together, these results are in line with the hypothesis of latent hierarchies. We find significantly positive effects of GDP per capita on both outdegree and indegree in Model (1) for the year 2001. Since the positive effect on indegree is around twice as strong as the positive effect on outdegree, internal migration within the EU tends to be an issue particularly for countries whose economies perform well. While high GDP per capita definitely attracts more migrants from other EU countries, people in economically prosperous countries are also more mobile and therefore also emigrate. However, the positive effect on outdegree becomes insignificant after controlling for "Core (UK, DEU)" in Model (2). In addition, we once again see strong and robust positive effects that having a shared border can have on the intensity of migration flows, which holds for all years and all models.

Also of interest with regard to our research question are the effects of new member states and the opening of labour markets by the EU-15 states. In 2001, countries that became members in 2004 showed a significantly negative effect on outdegree (Model (2)): as expected, their populations were less mobile. Furthermore, the effect of opening the labour markets in 2005-08 becomes significant as early as 2001. In the year 2005 we find a significantly positive effect of opening the labour market in 2004 on indegree (Model (3)), but this effect becomes insignificant if we control for the core countries in Model (4). In Model (4), the effect of "opening the labour market 2005-08" on indegree is now significantly positive.

Again, the year 2008 fits well to our theoretical expectations: in Models (5) and (6) we find a significantly positive effect of being a new member after 2004 on the intensity of outmigration. At the same time, there are significantly positive effects of labour market opening in 2004 on the intensity of immigration. In Model (6), the effect of labour market opening between 2005 and 2008 is also significantly positive when compared with the group of late openers (after 2008). The effect of being a new member after 2004 on the intensity of outmigration remains significant in the year 2013, even though we control for "Core (UK, DEU)" in Model (8). However, the positive effect of labour market opening in 2004 on immigration is significant in Model (7) but becomes insignificant in Model (8). And while the effect of GDP per capita on indegree is positive and significant in Models (7) and (8), which is in line with our expectations, we also find a positive effect of the unemployment rate the year before on indegree, which is unexpected regarding our theoretical arguments.

To sum up, according to our results, new members after 2004 started to have significantly increased outmigration from 2008 onwards, whereas we find mixed evidence for the effect of labour market opening. Conditional on the other covariates in the model, compared with the reference group of late-openers (DEU AUT BEL DNK), countries opening their labour market between 2005-08 (PRT FIN GRC ITA ESP NLD LUX FRA) received higher levels of population from sending countries over the whole period observed in our data, except for 2013. The early-openers, who allowed access to their labour markets as early as 2004, received the most intense immigration flows in 2008, whereas the high inflow in 2013 was probably driven by the United Kingdom, which belongs to the "Core (UK, DEU)". This might be the reason why the effect of labour market opening in 2004 on indegree becomes insignificant in 2013. In addition, we find significantly positive effects of GDP per capita on indegree in all models, so that the institutional processes of becoming a member and of opening labour markets, as well as the core country effect are not just spurious effects of economic performance.

Conclusion

A better understanding of the European migration space is of particular relevance for European stakeholders seeking to manage the challenges of the European integration process (Verwiebe, Wiesböck, and Teitzer 2014). For this purpose, the migration systems theory (Mabogunje 1970; King 2012; de Haas 2010) provides a fruitful framework, as it enables us to consider the EU as a migration system of relations between source and destination countries with its own genesis, characteristics and dynamics. Indeed, our descriptive analysis of the networks of intra-EU migration flows in the years 2001, 2005, 2008 and 2013 shows that the EU migration space is dominated by a core of two destination countries, namely Germany and United Kingdom. This core status of Germany and the United Kingdom remains a robust characteristic of the network of intra-EU migration flows over time, even when controlling for GDP, unemployment rates or shared geographical borders between destination and source countries, as showed in the results of our exponential random graph models (ERGM) (Krivitsky 2012; Harris 2014). Interestingly, the effects of the core status of Germany and the United Kingdom in the models for valued network ties increase from 0.708 in 2001 to 1.356 in 2008 and to 1.366 in 2013. Even though effect sizes should not be directly compared across different models when the residual variance is fixed – which is true for Poisson regression ERGMs – this increase seems to be quite remarkable. Thus, the core destination status of Germany and the United Kingdom seems to have become an intrinsic characteristic of the EU migration space as it remains robust over time and cannot be accounted for by either the economic performances or by the geographical situation of these two countries within the EU migration space. These findings highlight the importance of considering the particular patterns of intra-EU migration as a *network* (Windzio 2018) and its topology (Centola 2015). Taking the embeddedness of country-dyads into the wider network into account captures the effect of the surrounding migration system on flows between two countries. Network analysis is a genuinely relational paradigm. It goes beyond a dyadic perspective and accounts for the surrounding network. We highlighted patterns of statistical non-independence, e.g. in terms of hierarchies, indicated by the tendency towards triadic closure. Not appropriately considering this non-independency would lead to unreliable estimates (Harris 2014).

Our results point moreover to the differentiated effects of indicators of national economic performance on outgoing and ingoing migration flows. Indeed, GDP per capita affects mainly intra-EU inflows and thus acts as a pull factor, while unemployment rates tend to influence outmigration and can thus be interpreted as a push factor. Interestingly, GDP per capita positively affects migration inflows in 2013, rather than in 2008. Thus, economically prosperous countries became increasingly attractive for EU-migrants, especially in the wake of the financial crisis after 2008. The question of whether the crisis itself was a causal effect or a mediator must remain open in the present study and should be investigated in future research.

When turning to our main research question on the influence of regulatory linkages on intra-EU migration flows, our analysis shows contrasting results. Regulatory linkages were measured with two indicators: accession to the EU and the opening of the labour market to citizens from new member states. When controlling for the national economic performance and shared borders between destination and source countries, the accession to the EU significantly increased migration outflows, though only for the member states that joined the EU after 2004 and not for the 2004 EU member states. Moreover, destination countries that opened their labour market to new EU citizens right after the EU 2004 enlargement (i.e. Sweden, Ireland and the UK) received significantly higher migration inflows than countries that maintained transitional measures until 2009 and beyond. Furthermore, this effect remains significant for the intra-EU migration inflows of 2005, 2008 and even 2013 when also controlling for the national economic performances and shared borders. However, the effect of opening the labour market to new EU citizens in 2004 on migration inflows become insignificant once

the core status of Germany and the United Kingdom is accounted for. This is likely due to the confoundedness of these two dummies, as the UK is simultaneously one of the two core destination countries and one of the three countries that opened their labour market in 2004. Thus, the category "new member states after 2004" is the only category among our indicators measuring regulatory linkages to show a robust significant effect on intra-EU migration flows when we introduce all controls in our model (including the "core" status variable). All in all, regulatory linkages (measured by the accession to the EU of source countries and the opening of the labour market of destination countries) exert at most a moderate effect on intra-EU migration flows when taking into account the national economic performances of source and destination countries, the topology of the migration network (with the core status of Germany and the UK) and the shared borders between destination and source countries.

The extrapolation of these findings to forthcoming regulatory linkages within the EU migration space constitutes an open and highly interesting research question. The creation of a transnational space for the free movement of migrants can be regarded as a quasi-experiment of how changes in institutional regulations can affect migration (Verwiebe 2011; Verwiebe et al. 2014). Becoming member of the liberal migration space did indeed increase migration outflow, but only for new member states after 2004. By contrast, opening labour markets to citizens from the new EU member states had only weak effects on intra-EU migration inflow, at best. Thus, while borders considerably matter in regulating migration flows, labour market regulations do not play a significant role. Despite these changes in migration regulations, the effects of economic performance, unemployment rates and the "core" status of Germany and the UK remained rather stable over the studied period of intra-EU migration. According to our results, Germany and the UK already constituted the core of the EU migration system *before* the introduction of the regulatory policies of EU accession and labour market opening. This core status remained unchanged despite the introduction of these migration regulatory policies. It is of course tempting to extrapolate these results to the forthcoming restrictive rights of free movement and restrictive access to the British labour market to EU citizens that will derive from Brexit. On the one hand, we would expect an influence of the Brexit´s restrictive intra-EU migration policies on the migration patterns in the EU, as previous migration regulations within the EU migration space showed some significant effects on intra-EU migration flows. However, the forthcoming Brexit´s restrictive migration polices might not fundamentally alter the migration system-topology, if the UK retains its economic performance after having left the EU. Of course, we will only be able to provide an answer to this fascinating research question once the exact migration regulations deriving from the Brexit will be implemented and once the effects of the Brexit on the British economic performances will be observable. Lastly, our results point to the merit of some expectations provided by the neoclassic economic theory of migration: the experiment of creating a liberal EU migration space shows that inequality in economic performance between source and destination countries retains its effect on migration *despite* changes in migration regulations. If borders become even more permeable in already established migration systems, such as between Germany and Turkey or between Mexico and the U.S., economic inequality in the world system might trigger huge migration flows, which in turn can be self-reinforcing (Massey et al. 1993).

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[i] We use the terms migration, movement and mobility interchangeably.

[ii] These regulations had to be in line with an overarching statutory framework, according to which the legal situation of these immigrants must not be downgraded and must still be better when compared to that of immigrants from outside of the EU (Palmer and Pytliková 2015). APalmer and Pytliková 2015). Accordingly, the EU-15 member states were allowed to postpone citizens from the 2004 new member states from full accession to their labour market for a maximum period of seven years. This transitional measure then had to be reviewed two years after enlargement.

[iii] Bulgaria (2001, 2005), Cyprus (2013), France, Germany (2013), Greece (2001, 2005, 2013), Ireland (2001, 2005), Malta, Poland (2001, 2005, 2013), Portugal, Sweden (2008), United Kingdom (2008, 2013).