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Do EU regional funds hamper or foster interregional migration? A panel data analysis for Poland

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WORKING & DISCUSSION PAPER
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**Do EU Regional Funds Hamper or Foster
Interregional Migration?**

A Panel Data Analysis for Poland

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Vorwort der Herausgeberin dieser Ausgabe

In diesem Papier werden die Auswirkungen der regionalpolitischen Transfers der Europäischen Union (EU) auf die Binnenmigration zwischen polnischen Regionen untersucht. Mit Hilfe der Paneldaten für die Periode 2004-2014 wird empirisch geprüft, ob die im Rahmen der EU-Regionalpolitik erhaltenen Transfers das Niveau und das Muster bilateraler Migrationsströme beeinflussen.

Für die ersten elf Jahre der EU-Mitgliedschaft Polens konnten keine statistischen Belege dafür gefunden werden, dass die EU-Transfers die interregionale Mobilität in Polen reduzierten. Im Gegenteil, in ärmeren Regionen Polens waren die erhaltenen EU-Transfers mit dem Ausmaß der Auswanderung positiv korreliert. Zudem trugen höhere empfangene EU-Transfers zu mehr Zuwanderung aus anderen Regionen bei. Beide Effekte verstärkten sich im Laufe der Zeit. Die EU-Regionaltransfers behinderten also nicht, sondern förderten die Binnenmigration in Polen. Die Folgen dieser Entwicklung sind eine höhere regionale Konzentration der Bevölkerung und der Einkommen. Gerade aber die regionale Konzentration steht im Widerspruch zum Ziel der EU-Regionalpolitik, das bestehende wirtschaftliche und soziale Gefälle zwischen den Regionen abzubauen. Hiermit zeigen sich Migrationseffekte, die jenen ähneln, die nach der deutschen Wiedervereinigung zwischen Ost- und Westdeutschland aufgetreten sind.

Untersuchungen zu Migrationseffekten sind nicht nur aus wirtschaftspolitischer Perspektive interessant, sondern auch im Zusammenhang mit Standortentscheidungen der Unternehmen. So zeigt sich auch am Beispiel der neuen Bundesländer, dass Standortentscheidungen westdeutscher Unternehmen zugunsten Ostdeutschlands nach der Wende häufig vor der Mustererkennung der Migrationsbewegung getroffen wurden. Die intertemporale Entwicklung und Verfügbarkeit von Infrastruktur und Humankapital in einer gewählten Region kann also suboptimal sein, was mittel- und langfristig hohe Standortkosten erzeugt, die dann Standortschließungen erzwingen können und neue Ansiedlungen abschrecken. Aus wirtschaftspolitischer Perspektive ist dies mit einer nachhaltigen ökonomischen Entwicklung förderungsbedürftiger Regionen nicht vereinbar.

Für Unternehmen sind Kenntnisse über Zusammenhänge zwischen Transferzahlungen in Regionen (Wirtschaftsförderung) und regionaler Entwicklung im Kontext einer langfristig angelegten Standortwahl insbesondere dann zu berücksichtigen, wenn das Wohlstandsgefälle zwischen Regionen sehr stark ist. Denn in solchen Fällen scheint ein Eintreten der in diesem Beitrag vorgestellten Effekte wahrscheinlich.

Lörrach, Oktober 2017

Heike Walterscheid

Do EU regional funds hamper or foster interregional migration?

A panel data analysis for Poland

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Abstract:

This paper studies the effects of the European Union (EU) regional policy transfers on internal migration across regions in Poland for the period 2004-2014. Based on a gravity model of migration, it tests empirically using the Poisson Pseudo-Maximum Likelihood (PPML) estimator whether EU transfers affect the level and the pattern of bilateral migration flows. For the first eleven years of the EU membership, the study finds no evidence of EU funding discouraging residents' mobility. On the contrary, residents of regions with higher EU transfers attracted are relatively more likely to leave. This effect is especially significant in poorer regions. In addition, EU transfers help regions attract more migrants. Both the "push" and the "pull" effect of the EU transfers on migration intensified over time. Hence, EU regional funding did not hamper, but rather fostered internal migration in Poland leading to a higher regional concentration of population and prosperity. This, however, works against the objective of the EU regional policy, which is to promote economic and social convergence across regions.

JEL Classification:

E62, F15, F22, J61, O15, R12, R58

Keywords:

EU regional policy, EU structural funds, internal migration, migration determinants, Poland, panel data, gravity model, PPML

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1 Introduction

The two waves of the European Union (EU) enlargement in 2004 and 2007 brought together a group of ten Central and Eastern European Countries (CEEC) in transition to a market economy with a group of fifteen old EU member states (EU-15). However heterogeneous in terms of prosperity the EU-15 was at that time, the EU enlargement magnified these differences, as the accession countries added 20% to the EU population, but only 5% to its output. One of the most spectacular reactions to the EU enlargement was the unprecedented surge in emigration from the CEEC – between 2004 and 2014, more than 5 million citizens of the CEEC became permanent residents in the EU-15 (Fihel et al., 2015).

In reaction to tremendous regional differences in the enlarged EU, the EU regional policy was extended to the new member states. Between 2004 and 2006, almost 22 billion Euro was made available to the CEEC, whereas in the period 2007-2013 the funds for these countries increased eight times to more than 177 billion euro or 50% of all EU regional funds (EC, 2017a). The main instruments of the EU regional policy are the European Structural and Investment Funds (frequently referred to as *regional funds*). They are spent by individual countries according to the objectives of the common EU regional policy, which is to “support job creation, business competitiveness, economic growth, sustainable development, and improve citizens’ quality of life” (EC, 2017b).

Although a large body of research on various aspects of the EU regional policy exists, only a small number of empirical studies looked at the impact of this policy on internal EU migration. Egger et al. (2014) were the first who examined the effects on net bilateral migration across national borders in the EU-15. They found that over the period 1986-2004 EU regional policy spending hampered mobility of the EU population. In contrast, Schmidt (2016) concluded from his analysis for the EU-28 over the period 1985-2013 that the EU transfers spur instead of hamper internal migration.

The relation between the EU regional policy and internal EU migration is important insofar that, according to neoclassical theory, migration can be a powerful albeit gradual mechanism for regional convergence of productivity, standard of living, and labor market performance. If convergence happens at a satisfactory speed, redistribution of income within the EU through regional transfers could prove unnecessary. If EU regional transfers, however, weaken labor mobility across EU regions, these transfers are detrimental to market-driven adjustment through relocation of labor force and to regional convergence, increasing the overall cost of higher standard of living in the enlarged EU.

In this empirical study, I investigate the impact of EU regional transfers on interregional mobility in Poland over the period 2004-2014. There are at least two reasons for choosing Poland for this analysis.

Firstly, Poland is the largest CEE country in terms of both the area (312,700 square km) and population (over 38.5 million). It is divided into sixteen administrative regions called a “voivodship” (see Fig.1) with a substantial level of migration across them. Secondly, in terms of EU regional funds attracted, Poland is by far the most important beneficiary of the EU financial support since the pre-accession period. In the first 10 years of the EU membership, Poland received 92.4 billion euro from the EU budget that corresponds to around 25% of Poland’s gross domestic product (GDP) in 2013. This is over 40% of all transfers allocated from the EU budget to the new member states (MSZ, 2014). However, regional distribution of funds obtained by Poland was highly uneven. This poses a question about actual impact of EU funding on interregional migration.



Figure 1: A map of voivodships in Poland

Note: Polish names of voivodships and their abbreviations used in this paper along with the position of mayor cities in Poland are attached to the image of the voivodship.

Source: Author’s own elaboration based on CODGIK (2017)

Interregional migration in Poland in the 1990s and in the 2000s was subject to a number of econometric analyses. Fidrmuc (2004), Ghatak et al. (2008), Pietrzak et al. (2012) and Thomas (2013) among others investigated an impact of various economic and socio-demographic factors on interregional flows of migrants within a gravity model framework. These studies show that Polish migrants responded mainly to labor market conditions, housing market conditions, and differences in the development level across regions. In addition, internal

migration was strongly discouraged by longer distances both measured in physical sense and in socio-cultural sense (Ghatak et al. (2008), Pietrzak and Wilk (2014)).

To my best knowledge, Thomas (2013) is the only econometric study on the impact of the EU accession on interregional migration in Poland. The study shown that over the period 2004-2009 the EU funding significantly changed the pattern of bilateral migration flows between regions by lowering outflows of people from regions with higher EU regional support and by attracting more migrants to such regions. The author concluded that, contrary to official objectives of the EU policy, these funds magnify regional divergence in Poland enhancing spatial concentration of qualified labor, investment, and infrastructure.¹

This article contributes to the existing empirical literature in a number of ways. Firstly, it updates the study by Thomas (2013) and extends the investigation period to 2014. This allows tracing the impact of the EU funds over the first eleven years of the EU membership. Secondly, I adopt a random utility maximization (RUM) model of migration based on differences between origin and destination regions (Beine et al., 2016) and incorporate EU funding as a potential determinant of the location-decision problem faced by prospective migrants. The estimation of the derived gravity model of interregional migration is based on a balanced panel with bilateral annual migration flows between multiple origins and multiple destinations. The applied Poisson Pseudo-Maximum Likelihood (PPML) estimation technique together with inclusion of region-by-time dummies allow to control more carefully for heteroscedasticity, common trends and the so-called *multilateral resistance to migration* (Bertoli and Fernández-Huertas Moraga, 2013). Thirdly, in addition to traditional control variables like regional income and labor market conditions, I include other forms of spatial mobility like emigration and commuting which may affect interregional migration.

The remaining part of this paper has the following structure. Section 2 starts with the description of main characteristics of interregional migration flows in Poland and continues with facts on distribution of EU regional funds across voivodships. In Section 3, I first outline the RUM model of migration and then develop arguments behind empirical hypotheses to be tested. Section 4 discusses the applied econometric approach. All indicators constructed for the analysis and the relevant data sources are given in Section 5. Section 6 presents the results under alternative specifications. In addition to a brief summary, the last section contains policy conclusions and some recommendations for further empirical studies.

1 Leszczynska et al. (2009) use an indirect approach to evaluate the impact of EU regional funds redistributed to Poland regions in the period 2004-2006. This study did not find evidence for a statistically significant impact of EU regional funds on the pattern of interregional migration in this early period after accession.

2 Spotlight on interregional migration and distribution of EU regional funds in Poland 2004-2014

2.1 Patterns of interregional migration in Poland

This study focuses on permanent interregional migration between voivodships which is when people give up their previous place of residence in one voivodship (*origin* region) and settle in another voivodship (*destination* region) – an act which in Poland involves registration for permanent stay.

From 2001 to 2007, the total number of permanent movers between voivodships increased by 22.7% and reached almost 118,000 per year.² In 2008, however, the number of interregional migrants plummeted by almost 18% to below 97,600 and stayed close to 100,000 for the next years. Since 2013, total numbers of migrants within Poland went down again to slightly less than 88,300 movers in 2016.

In order to compare migration flows from voivodships different in size, I focus on internal *out-migration rates* defined as the number of people who permanently left the origin voivodship (to all other internal destinations) per 100,000 inhabitants per year. As presented in Fig. 2, the average out-migration rate for all regions increased substantially from 305.6 in 2004 to 345.1 in 2007, then dropped to 281.6 in 2008 and had a quite similar level in 2014.

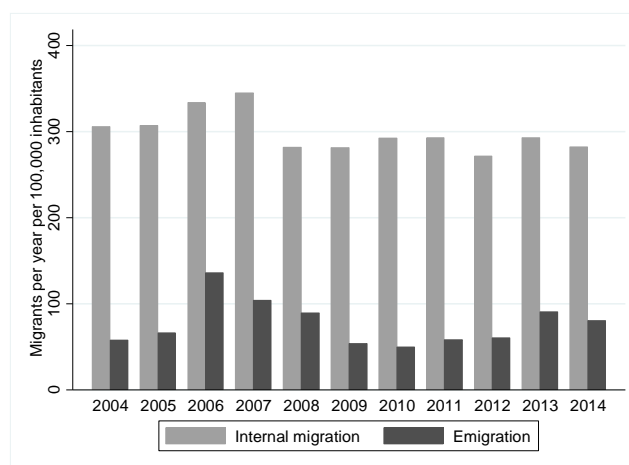


Figure 2: Internal and external out-migration rates in Poland, 2004-2014

Note: Internal out-migration rate is defined as the average (for all voivodships) annual outflow of migrants to the rest of Poland per 100,000 inhabitants. External out-migration (emigration) rate is the average (for all voivodships) annual outflow of migrants abroad per 100,000 inhabitants.

Source: Own calculations based on data from GUS (2017)

² Data on interregional migration flows are available online from the Territorial Cross-Section Local Data Bank (BDL) provided by the Polish Central Statistical Office (GUS, 2017). A more detailed description of this source is given in Section 5.

In order to put these data into comparison, I also computed average *emigration rates* (i.e. number of people from individual voivodships who permanently migrated abroad per 100,000 inhabitants per year). Fig. 2 shows that emigration rates are substantially smaller, but they follow the same time trend as the out-migration rates. The obvious difference is that the emigration rates reached their peak one year earlier (2006: 135.9 emigrants per 100,000 inhabitants per year).³

Fig. 3 presents the average annual out-migration rates over the whole period 2004-2014 for individual voivodships as origins of migration flows. The internal migration rates ranged from around 180 in voivodship MALOPOLSKIE (with Krakow) and MAZOWIECKIE (with Polish capital Warszawa) to almost 465 for voivodship WARMINSKO-MAZURSKIE in the North-Eastern Poland, pointing to substantial differences in regional mobility. With the exception of voivodship OPOLSKIE, where emigration of ethnic Germans is traditionally very strong, the internal out-migration was much higher than the emigration.

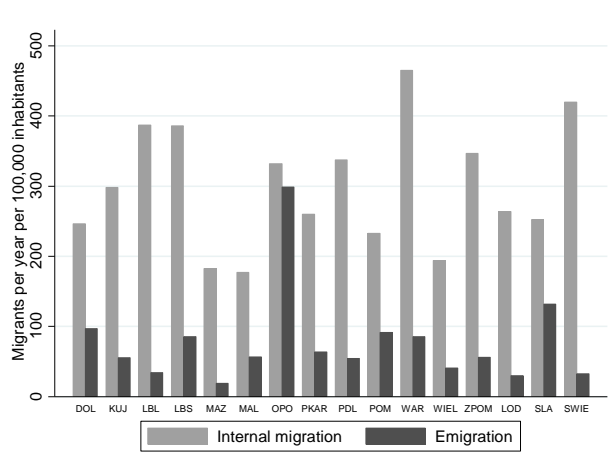


Figure 3: Internal and external migration rates by voivodships, 2004-2014

Note: Internal out-migration rate is defined as the average (over the entire period) annual outflow of migrants to the rest of Poland per 100,000 inhabitants. External out-migration (emigration) rate is the average (over the entire period) annual outflow of migrants abroad per 100,000 inhabitants.

Source: Own calculations based on data from GUS (2017)

The main directions of internal out-migration can be seen in Fig. 4 where arrows represent fifteen biggest bilateral out-migration rates in 2004 and 2014 respectively. With one exception, all voivodships that share a common border with MAZOWIECKIE have very high out-migration flows to this region. Important directions are also those to WIELKOPOLSKIE, to MALOPOLSKIE, and to POMORSKIE from their respective neighbors. These four were also

³ Kaczmarczyk (2014) reports that Polish emigration before 2008 was dominated by temporary or circular mobility which implies that the data presented above strongly underestimate total emigration outflows.

the only administrative regions in Poland which gained population through internal migration processes in each year from 2004 on as given by their *net outflow rates* (i.e. out-migration *minus* in-migration per 100,000 residents per year). In 2014, the spatial pattern of internal migration was almost the same as ten year before. The migration rates to the four main destinations slightly increased against the trend of lower average migration rate which points to the concentration of outflows mainly on voivodships in Eastern and North-Eastern Poland. Interestingly, voivodship DOLNOSLASKIE (with Wroclaw) became a net winner from interregional migration, as from 2006 on it constantly had a positive and growing surplus of in-migrants over out-migrants.

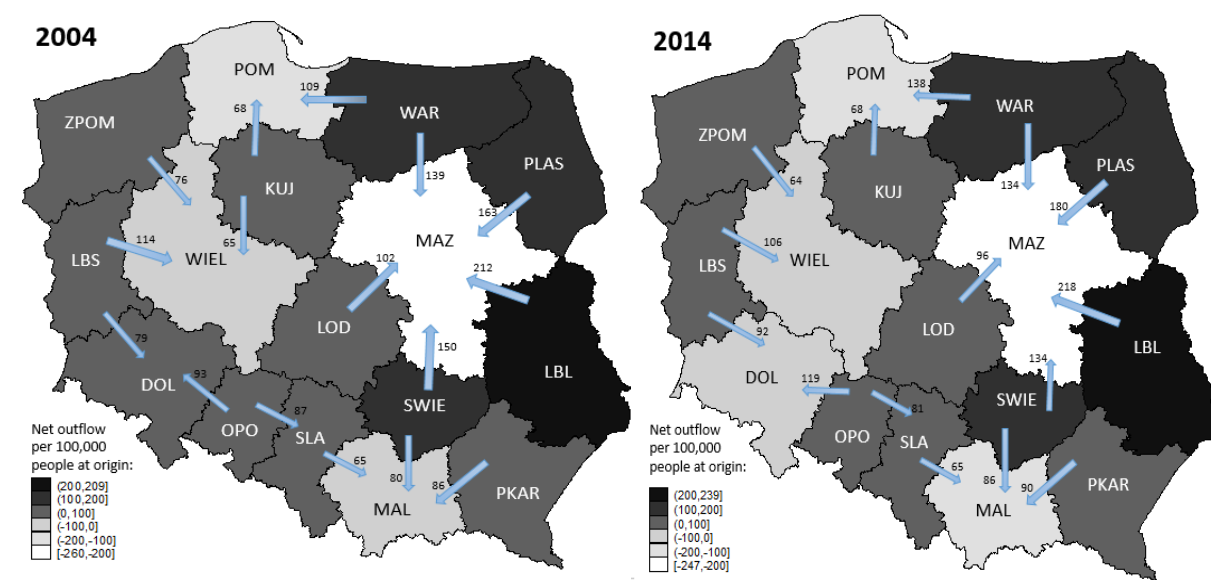


Figure 4: Main directions of bilateral interregional migration, 2004-2014

Note: Arrows symbolize fifteen biggest bilateral out-migration rates in 2004 and 2014 respectively. The attached numbers give the number of migrants per year from origin to destination per 100,000 residents at origin. Voivodships are shaded in proportion to the value of their net out-migration rate (= out-migration minus in-migration per 100,000 population). Lighter shades of grey are reserved for negative net outflows i.e. increase in population through interregional migration.

Source: Own calculations based on data from GUS (2017). The map is based on CODGIK (2017)

2.2 Spatial distribution of EU regional funds in Poland

With GDP per capita below the threshold of 75% of the EU average in purchasing power standards, all voivodships in Poland were eligible for EU regional support.⁴ However, the ex-post regional distribution in terms of total EU funds actually attracted is quite uneven.

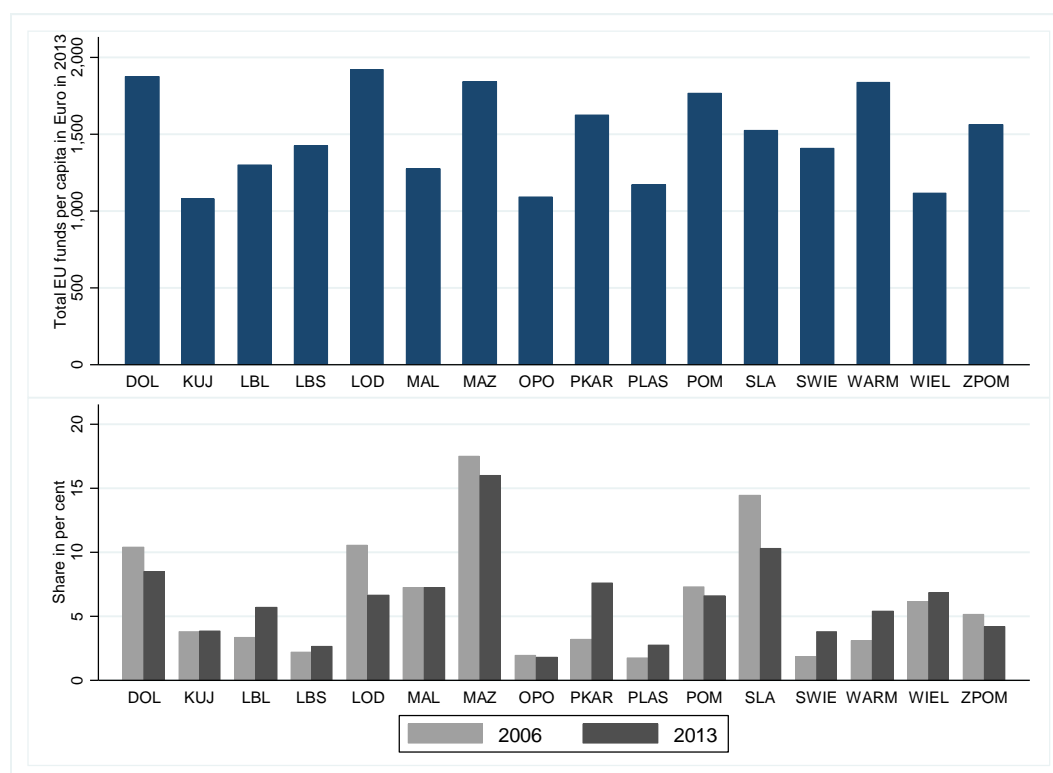


Figure 5: Spatial distribution of EU regional funds in Poland

Note: In the lower panel, bars show a share in % of an individual voivodship in the EU regional funds paid to Poland 2006 and 2013 respectively. In the upper panel, bars show the total (accumulated) amount of EU regional funds obtained (including pre-accession funds) in euro per inhabitant of the region at the end of 2013.

Source: Own calculations based on data provided by EC (2017c) and EC (2017d). For detailed description of the data please go to Section 5.

As shown in Fig. 5, MAZOWIECKIE as well as a small number of traditional industrial regions (DOLNOSLASKIE, SLASKIE, and LODZKIE) with a relatively high level of GDP per capita attracted a huge bulk of funds especially in the years to 2006. This comes as no surprise: All EU funds budgeted for a given member state are managed by this member state itself, where all projects are planned, implemented, administered and accounted. As shown in a number of empirical studies (Kauppi and Widgrén (2007), Dellmuth (2011), among others), the distribution of EU regional funds obtained by a member state is better explained by the

⁴ Each Polish voivodships has a status of a NUTS2 region in the NUTS classification (Nomenclature of territorial units for statistics) of the economic territory of the EU.

power of regional authorities in the process of political bargaining with the central government than by indicators of economic or social backwardness of a region. In Polish case, voivodships with profound experience from administering pre-accession EU funds and those with over-regional functions (notably MAZOWIECKIE), as well as those suffering from high structural unemployment due to lay-offs of industrial workers in the transition period, managed to capture the biggest portion of the funds especially in early years.⁵ Over time, however, EU funds became more equally spread over voivodships, so that even weaker regions in terms of GDP per capita and economic structure like WARMINSKO-MAZURSKIE and PODKARPACIE also gained substantial EU support. The only exception is OPOLSKIE – a region with a relatively high share of ethnic Germans and a high permanent emigration to Germany.

3 Theoretical foundation of the gravity model

3.1 The RUM model of migration

As demonstrated by Anderson (2011), a theoretical micro-foundation of the so-called “structural gravity equation of trade” developed in Anderson and van Wincoop (2004) can be successfully adopted to other bilateral flows. Following Beine et al. (2016), this section outlines a simple theoretical basis for the estimation of a structural gravity equation of migration, a random utility maximization model (RUM). A RUM model relies on the neoclassical assumption that individual decision on migration is based on maximization of expected economic well-being. Potential migrants choose between staying in region j or moving to destination k taking into account their individual characteristics (like education and age), characteristics of the regions j and k , as well as those of all other potential destinations l . Hence, an individual i living in region j may derive utility U from migration to region k in period t given as:

$$U_{ijkt} = w_{jkt} - c_{jkt} + \epsilon_{ijkt} \quad (1)$$

where w_{jkt} stands for deterministic component of utility (depending on regional provision of private and public goods), c_{jkt} denotes costs of moving from j to k at time t , and ϵ_{ijkt} is an individual-specific stochastic term.

5 Through the three main pre-accession instruments (PHARE, ISPA, and SAPARD) until the end of 2003 Poland attracted approximately 5.7 Bill € (Ministerstwo Rozwoju, 2010).

Assuming that ϵ_{ijkt} is independent and identically distributed and that the deterministic part of the utility from migration to k does not depend on the place the migrants come from, the expected migration flow from j to k in period t , $E(M_{jkt})$, can be expressed as:

$$E(M_{jkt}) = \varphi_{jkt} \frac{\gamma_{kt}}{\Omega_{jt}} s_{jt} \quad (2)$$

According to Eq. 2, bilateral out-migration flow from region j to k depends on:

- φ_{jkt} which is a measure of bilateral accessibility of destination k for potential migrants from origin j at time t . This term is negatively related to c_{jkt} in Eq. (1).
- γ_{kt} which measures the attractiveness of destination k . This is positively related to the utility w_{kt} derived from migration to k at time t .
- s_{jt} which is positively related to the ability of origin j to send migrants at period t .
- $\Omega_{jt} = \sum_l \varphi_{jlt} \gamma_{lt}$. The term Ω_{jt} stands for expected utility from the following choice situation: “stay in region j ” or “migrate”. This utility depends positively on accessibility of all regions l (not only destination k) and their attractiveness at time t .

Eq. 2 captures the idea that expected migration from j to k should decrease when attractiveness or accessibility of an alternative destination l would increase which was labelled *multilateral resistance to migration* by Bertoli and Fernández-Huertas Moraga (2013) following the terminology introduced by Anderson and van Wincoop (2004) for bilateral trade flows.

3.2 Research hypotheses about the impact of EU regional funds on interregional migration

From the RUM model, the expected bilateral out-migration flow depends on three general factors: a) ability of origin region to send migrants to destination region, b) relative attractiveness of destination region for migrants from origin region, and c) accessibility of destination region for potential migrants from the origin region. In order to understand how EU regional funds could affect migration decisions, the section starts by describing implementation of EU transfers in the member states.

The EU regional funds consist nowadays of the European Regional Development Fund (ERDF), the European Social Fund (ESF) and the Cohesion Fund (CF).⁶ The ERDF finances

6 European Agricultural Fund for Rural Development (EAFRD) and the European Maritime and Fisheries Fund (EMFF) belong to the European Structural and Investment (ESI) Funds, but are not regarded as instruments of the EU regional policy (EC, 2017b).

mainly direct aid to investment in companies to create jobs, modern infrastructure in the field of energy, communication, environment, and transport and other measures promoting regional competitiveness, employment growth, and regional cooperation. The ESF finances measures aiming at improving working and employment conditions as it focuses on problem-groups like unemployed or young job seekers. It also strengthens human capital building by financing reforms of the education system and acquisition of vocational qualifications. The ECF supports building and modernizing of trans-European transport networks, as well as other infrastructure projects improving the quality of the environment (EC, 2017e).

Through its supply-side effects, higher availability of the EU regional funds could be expected to improve economic prospects in a region for both stayers and potential in-migrants. This should result in lower out-migration and higher in-migration to regions which obtained substantial EU funding, and this is indeed what Thomas (2013) detected in Poland before 2009. Since the investment projects financed by the EU regional funds usually complement one another in terms of enhancing productivity and since they usually have a long life-time, their positive effect on attractiveness of destinations might even get stronger over time.

The positive effect of transfers on attractiveness of origin regions for stayers, however, might be overlapped by factors, which increase out-migration. In case EU regional transfers finance modern transport infrastructure, private migration costs would generally fall and the accessibility of other regions from a given voivodship would increase. In case of peripheral regions or those previously poorly connected, this could lead to higher out-migration, especially over time. In addition, EU spending on better education infrastructure in regions and on upgrade of qualifications of the regional labor force might increase availability of potential migrants with good job prospects elsewhere. Last but not least, it is empirically well confirmed that potential migrants might be credit-constrained, and that external financial support helps this condition become less binding (Clemens, 2014). Taking into account that EU regional funds were complemented by 33 billion euro through EU direct payments to Polish farmers and other support to rural regions financed by the EU Common Agricultural Policy (EC, 2014), it seems reasonable to expect that the EU transfers could have helped potential migrants bear the costs of migration.

Based on the considerations sketched above, I formulate four main hypotheses to be tested empirically in this paper:

Hypothesis 1:

Voivodships with higher EU regional funds absorbed had *ceteris paribus* (*c.p.*) higher out-migration.

Hypothesis 2:

The positive effect of higher EU regional funds on out-migration got stronger over time.

Hypothesis 3:

Voivodships with higher EU regional funds absorbed had *c.p.* higher in-migration.

Hypothesis 4:

The positive effect of higher EU regional funds on in-migration got stronger over time.

4 Econometric approach

4.1 Empirical model

In order to work empirically with Eq. 2, I normalize bilateral migration flows by relating them to the size of the population at origin obtaining bilateral out-migration rates m_{jkt} , and then expand Eq. 2 with a well-behaved error term η_{jkt} . This would give

$$m_{jkt} = \exp(\beta \mathbf{Z}_{jkt}) + \eta_{jkt} \quad (3)$$

\mathbf{Z}_{jkt} is a vector of all explanatory variables in the model. It consists of variables, which describe the (relative) attractiveness of migration to k from region j at time t , availability of migrants at j , and accessibility of region k . The key role of regional characteristics in migration decision justifies labeling those related to the origin as “*push*”, and those related to the destination “*pull*” determinants of migration respectively.

The most important characteristic positively related to the attractiveness of a region is its level of income per capita commonly measured through (real) GDP per capita (Beine et al., 2016). In addition, the current and future utility from migration w_{jkt} is related to the (relative) labor market conditions (proxied by regional unemployment rate).

Accessibility of destinations is usually captured by the inclusion of bilateral migration costs. These costs are partly time-invariant and decreasing with proximity (in physical terms or in terms of time) between the regions in question. In addition, common culture, history, and language usually lower these costs. Migration costs can also be time-varying, which is clearly seen in international context when national migration policy and growing ethnical as well as personal networks abroad can lower private costs for future migrants over time. Migration costs can also be region-specific (both time-invariant and time-varying) as it's the case for peripheral regions or those with initially poor, but growing transport infrastructure.

4.2 Coping with multilateral resistance to migration

Contrary to the long-standing empirical tradition of estimating gravity equations, an empirical analysis of the determinants of bilateral migration flows cannot rely exclusively on characteristics of the two regions involved, but has to incorporate properly the multilateral resistance to migration. When alternative destinations are disregarded, the estimates are biased since they capture both its own effect and the effect of alternative destinations (Beine et al. 2016).

There are various strategies, which have been employed to control for multilateral resistance in a pseudo-gravity approach. When the number of cross-sections (i.e. origin-destination pairs) and the time dimension are large enough, Common Correlated Effects (CCE) estimator proposed by Pesaran (2006) produces consistent and robust results even in the presence of serial and spatial correlation in residuals (Bertoli et al., 2013). In case this option is not feasible due to data limitations, Olivero and Yotov (2012) recommended including additional set of region-by-time dummies. Beine and Parsons (2015) show how origin-specific fixed effects and destination-year fixed effects control for multilateral resistance to international migration and for other unobservable factors.⁷

4.3 The PPML estimator

As shown by Santos Silva and Tenreyro (2006, 2011), estimation of the pseudo-gravity equation in a traditional way with OLS can lead to biased and inconsistent semi-elasticities. To obtain consistent estimates, they proposed the Poisson Pseudo-Maximum Likelihood (PPML) estimator, which accounts for heteroscedasticity, measurement errors and zero bilateral flows - all typical for trade and migration data.⁸ Indeed, Fally (2015) could prove that fixed effects in the PPML are generally consistent with the definition of multilateral resistance indexes and the equilibrium constraints that they need to satisfy in the structural gravity model as of Anderson and van Wincoop (2004). For the reasons presented above, Beine et al. (2016) recommend PPML for dealing with bilateral migration flows.⁹

7 The great bulk of empirical research incorporates a rich set of fixed effects always including the origin-by-time dummies (see Bertoli and Fernández-Huertas Moraga (2013), Bertoli et al. (2013), Orefice (2015), and Ortega and Peri (2013) among others).

8 The PPML does not require that data are distributed as Poisson and thus can be applied more generally to nonlinear models.

9 One obvious shortcoming of the PPML is that, being a nonlinear estimator, it over-weights large bilateral flows (Head and Mayer, 2014). Since in Polish context large bilateral migration flows appear only to one destination (MAZOWIECKIE), we capture them with a region-specific dummy.

4.4 Econometric model for estimation

Since the migration data in this study do not have time properties necessary to apply the CCE estimator due to short estimation periods, I rely on the PPML estimator and follow Royuela and Ordóñez (2016) by fitting empirically two models with different fixed effects structures:

Model 1: Panel model for the “push” determinants of interregional migration:

$$m_{jkt} = \exp(\beta \mathbf{X}_{jkt} + D_{kt} + D_{MAZ}) + \eta_{jkt} \quad (4)$$

where D_{kt} is a set of destination-by-year dummy variables and D_{MAZ} is a time-invariant dummy for MAZOWIECKIE as an origin region. The fixed effects of destination-by-year catch the multilateral resistance to migration derived from heterogeneity in the present and future attractiveness of destinations (Beine and Parsons, 2015). They also control for unobservable common trends to all regions, mainly related to the stance of the common business cycle. \mathbf{X}_{jkt} is the set of all covariates in the empirical model, which includes time-varying push factors of the origin regions shaping the migration decision. It also includes time-invariant origin-destination effects related to accessibility of a destination region k from a given origin region. Note however, that since PPML estimator requires the use of destination-time dummies, it is not able to deal with time-varying destination effects, such as income or labor market conditions at destination. From this model, estimated coefficients on variables describing origin regions tell us how out-migration rate to the same destination region changes due to changes in characteristics of origins. I use model 1 for testing hypotheses 1 and 2.

Model 2: Panel model for the “pull” determinants of interregional migration:

$$m_{jkt} = \exp(\beta \mathbf{X}_{jkt} + D_{jt} + D_{MAZ}) + \eta_{jkt} \quad (5)$$

where D_{jt} is a set of origin-by-year dummies and D_{MAZ} is a time-invariant dummy for MAZOWIECKIE as a destination region. The inclusion of origin-by-year dummies helps dealing with multilateral resistance to migration derived from heterogeneity in migration preferences by origin (Bertoli and Fernández-Huertas Moraga, 2015). Origin-time dummies also control for the size and other characteristics of population at origin, which determine the ability to generate migrants. \mathbf{X}_{jkt} is a matrix including time-varying pull characteristics of

destinations k shaping their attractiveness for potential migrants. It also includes time-invariant origin-destination effects related to accessibility of a destination region k from a given origin region j . Note again, that since PPML estimator requires the use of origin-time dummies, it is not able to deal with time-varying origin effects, such as income or labor market conditions at origin. This model compares two destinations and estimates the impact of variables referring to these destinations on out-migration rate from a given origin. I use model 2 for testing hypotheses 3 and 4.

Interpretation of the coefficients estimated with PPML resembles precisely the interpretation pattern as under OLS: The coefficients of any right-hand variable expressed in logs can be interpreted as simple elasticities, whereas coefficients of those variables that enter in levels are interpreted as semi-elasticities.

Baltagi et al. (2015) review the empirical research on trade and migration flows with various specifications of fixed effects: single (origin, destination, and time), double (origin-destination or origin-time) and triple (origin-destination-time). The inclusion of origin-destination terms generally could control for all observable and unobservable time-invariant costs and address the problem of endogeneity bias due to unobservable heterogeneity across pairs. The authors conclude that omitting pair effects would add upwards bias to any coefficient on time-invariant economic, geographical, or institutional variable. For feasibility reasons and because the main variable of interest is time-varying, I estimate Model 1 and 2 without origin-destination fixed effects, but with bilateral distance and contiguity as explanatory variables, having in mind that their estimates are likely upwards biased.¹⁰

5 Data sources and descriptive statistics

The empirical analysis in this paper is based on official data obtained – unless otherwise stated - from the Territorial Cross-Section Local Data Bank (BDL) provided by the Polish Central Statistical Office online (GUS, 2017). The compiled dataset includes bilateral annual migration flows between sixteen Polish administrative regions (voivodships) in the period 2004 to 2014. This forms a balanced panel with $16 \times 15 = 240$ origin-destination pairs observed over 11 years. There are no zero-migration flows in the sample.

The dependent variable in all empirical models is annual bilateral out-migration rate defined as the number of people per year who permanently moved from origin to destination voivodship

¹⁰ Larch et al. (2017) developed and made available in Stata an iterative PPML algorithm, which allows including all types of high dimensional fixed effects including pair fixed effect. However, this program does not allow including variables other than dummies into the empirical model.

per 100,000 people living in the origin voivodship at the end of the previous year. Obviously, since the data does not include temporary migration, it surely covers only a part of actual migration flows. Descriptive statistics of bilateral out-migration flows are given in Tab. A.1 in Appendix, showing a high level of variability across voivodships and years.

The main variable of interest is the accumulated size of the EU regional funds paid to beneficiaries in an individual voivodship before the end of each individual year. I use data compiled by the EU Commission on funds actually paid through European Structural Investment Funds from 2003 to 2014 (EC, 2017c).¹¹ However, as these payment data are on a national level only, I split them over regions and individual years by using the key derived from available information for individual years. More precisely, I assumed that the regional distribution of payments known for the year 2006 was the same in the years 2003 through 2005. I interpolate regional shares in total EU funds absorbed from 2007 to 2013 based on distribution known for 2006 and 2013 (EC, 2017d).¹²

Given the fact that the bulk of the EU funds was spent on public infrastructure, one could argue that what matters is the absolute size of all EU transfers obtained in the past. However, in my sample, the amount of total EU regional funds attracted into a voivodship is highly correlated with the regional real GDP per capita at the level of 0.84-0.87. For this reason, my EU variable gives totally attracted EU regional funds up to a given year per capita in an individual voivodship expressed in relation to the annual national average. The resulting correlation coefficients with regional GDP per capita are than acceptable at the level of between 0.20 and 0.36 depending on year. Alternatively, Egger et al. (2014) and Schmidt (2016) work with EU regional funds in relation to nominal GDP of the beneficiary. I use this alternative for the check of robustness in Section 6.3.

Since the EU variable is in focus of my investigation, I include only a limited number of key indicators, which according to the RUM model and existing empirical literature capture the main fundamentals that drive the observed pattern of migration. The proxy for attractiveness of various locations is the level of regional price-adjusted GDP per capita in a region in relation to national average.¹³ It is calculated from regional nominal GDP per capita and regional

11 These funds were paid through ERDF, ESF and ECF in the programming period 2007-2013, as well as ERDF, ESF, EAGGF and FIFG in the period 2000 till 2006.

12 Comparability of data from different sources (notably EU and national) is rather poor, due to a differing focus (funds committed vs. funds allocated vs. funds approved vs. funds paid), and the fact that funds from a previous programming period (say 2004-2006) are still flowing in the first two years of the next programming period (2007-2013).

13 In addition, regional price-adjusted average wages (available only for entities employing up to 9 persons) were also tested. Results are available from the author upon request.

inflation rates taken from GUS (2017) which I combine with regional price level for 2012 taken from Rokicki (2015). The labor market stance in a given year is measured by the difference between the regional unemployment rate and the average national unemployment rate.¹⁴ By relating all values of covariates to national averages, I am able to account for nation-wide common trends in income and unemployment.

Bilateral time-invariant migration costs are measured by two dyadic variables: physical distance in km which is taken from Google maps as a distance between voivodships' capital cities and a dummy variable that equals one in case of two regions, sharing a common border. The distance variable is taken in logs, which allows interpretation of the estimated coefficient as the value of elasticity of migration with respect to distance.

Finally yet importantly, two regional variables are included into the push model to control for the availability of potential migrants at origin. Based on data taken from Eurostat (2017), I calculate regional commuting rates as a number of people commuting to other regions in Poland per 100,000 labor force at origin per year. Commuters are defined as people with main place of residence in a voivodship other than the one they work in. I assume that potential migrants generally prefer to commute than to move away, and thus I hypothesize that higher commuting rates at origin decrease the out-migration to other regions. The second control variable is the regional external migration rate (emigration rate) calculated as the number of migrants abroad per 100,000 of population per year. The impact of emigration on internal migration might be negative when potential migrants substitute foreign for domestic destinations. The same effect occurs, when remittances from family members who previously moved abroad, allow better material life at home for the stayers without taking a personal risk of migration be it internal or international. Thus, in terms of the factors above, emigration – especially its surge between 2004 and 2006 - could have generally lowered relative attractiveness of interregional migration. White (2010) reports that Poles are less willingly to search for a better life at home when they can rely on pre-existing family-and-friends networks abroad. However, when potential migrants are heterogeneous with respect to their preferences and professional skills, internal and international mobility might be much less related to each other.¹⁵

14 The author worked both with rates based on registered unemployment and with those derived from labor market surveys (BAEL) which can be obtained from GUS (2017). The results are robust and can be obtained from the author upon request.

15 I also tested other demographic variables like age and education level assuming their impact on availability of migrants. As the estimates were not significantly different from zero, and the models were inferior judged by statistical criteria, I decided to omit them.

Since decisions on migration are worked out months in advance and are typically based on past experience and expectations formulated at that time, all explanatory variables with the exception of the emigration rate and the commuting rate are lagged by one year.¹⁶ This also helps address the problem of reversal causality related to income and migration variables (Orefice, 2015). Descriptive statistics on all variables used in our econometric models are given below.

Variables:	Obs.	Mean	Std. Dev.	Min	Max
Migrants from origin to destination per 100,000 inhabitants at origin per year	2640	19.921	28.854	0.664	238.363
EU regional funds per capita, total accumulated payments to the region, national average = 1	2640	0.944	0.263	0.545	1.566
EU regional funds, total accumulated payments to the region in relation to GDP, national average = 1	2640	1.046	0.256	0.647	1.720
Regional price-adjusted GDP per capita, national average =1	2640	0.911	0.184	0.711	1.519
Regional registered unemployment rate, in percentage points above national average	2640	0.508	1.825	-2.833	5.535
Emigrants from origin to the rest of the world per 100,000 inhabitants at origin per year	2640	77.015	72.383	6.012	458.852
Commuters to other voivodships in percent of the regional labor force per year	2640	1.293	0.717	0.240	3.430

Table 1: Descriptive statistics for the period 2004-2014

Source: Own calculations based on data sources specified in Section 5 above.

6 Results

6.1 The full period 2004-2014

Tab. 2 below reports the results of the “push” Model 1 (with destination-by-year dummies) and of the “pull” Model 2 (with origin-by-year dummies) for the whole period 2004-2014.

Each model is estimated in three specifications, which all include a measure of EU regional funds attracted, but have a growing set of explanatory variables from version (a) to version (c). All estimations are obtained through PPML. All specifications also include a fixed effect for MAZOWIECKIE accounting for a unique attractiveness of the Polish capital. The presented standard errors are robust to heteroscedasticity across origin-destination pairs.

All specifications confirm strongly that bilateral interregional migration flows in Poland are driven by economic factors in accordance with the RUM-based gravity model. The estimated push models 1(a) to 1(c) show that regions with lower than average real GDP per capita have *c.p.* significantly higher out-migration rates. Column 1(c) shows that, on average, a 1-percentage point lower real GDP per capita at origin leads to a higher migration outflow to a

¹⁶ The choice is based on the value of the Akaike’ Information Criterion and the (Pseudo) R² value.

specific destination by up to 2.21% per year and 100,000 inhabitants. Regions with higher unemployment rate tend to have *c.p.* higher out-migration rates. Longer distances discourage migrants. Models 1(b) and 1(c) confirm that bilateral out-migration rates are *c.p.* significantly higher for neighboring regions.

Model: Specification:	(1a)	Push (1b)	(1c)	(2a)	Pull (2b)	(2c)
Regressors:						
Ln bilateral distance:	-1.384*** (0.07)	-1.221*** (0.09)	-1.310*** (0.09)	-1.469*** (0.07)	-1.313*** (0.08)	-1.310*** (0.08)
Registered unemployment rate at origin, in percentage points above national average, once-lagged	0.048*** (0.02)	0.035* (0.02)	0.033* (0.02)			
Real GDP per capita at origin, national average =1, once-lagged	-1.698*** (0.35)	-1.842*** (0.37)	-2.209*** (0.34)			
Total EU regional funds per capita absorbed at origin, national average=1, once-lagged	0.041 (0.16)	0.111 (0.18)	0.174 (0.14)			
Common Border		0.299*** (0.11)	0.272*** (0.10)		0.310*** (0.10)	0.312*** (0.10)
Commuters, share in labor force at origin, in percent			-0.262*** (0.04)			
Emigrants from origin per 100,000 inhabitants			0.000 (0.00)			
Registered unemployment rate at destination, in percentage points above national average, once-lagged				-0.061** (0.02)	-0.062** (0.02)	-0.081*** (0.02)
Real GDP per capita at destination, national average=1, once-lagged				2.003*** (0.33)	1.846*** (0.32)	1.627*** (0.31)
Total EU regional funds per capita absorbed at destination, national average =1, once-lagged				0.553*** (0.16)	0.629*** (0.15)	0.641*** (0.16)
Emigrants from destination per 100,000 inhabitants						-0.002*** (0.00)
Origin-by-year fixed effects	No	No	No	Yes	Yes	Yes
Destination-by-year fixed effects	Yes	Yes	Yes	No	No	No
Other regional dummies included	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations (origin-destination pairs across years)	2880	2640	2640	2880	2640	2640
(Pseudo) R ²	0.821	0.813	0.842	0.845	0.851	0.856
Akaike's Information Criterium	22917.2	22152.7	19150.6	24126.3	23292.3	20979.3

Table 2: Determinants of bilateral interregional out-migration rates for 2004-2014

Note: Dependent variable is bilateral out-migration rate between origin *j* and destination *k* in year *t* defined as the number of people permanently moved from origin to destination region within a year per 100,000 people living in the origin voivodship at the end of the previous year. Standard errors reported in brackets are robust to heteroscedasticity across origin-destination pairs. *, **, *** denote significance at the 10%, 5% and 1% level respectively. Fixed effects are highly significant at least at 5% level, but not reported for the sake of brevity.

In all three specifications of the “push” Model 1, the effect of EU regional funds on out-migration rate is positive, but statistically not significant. Hence, so far the study could not find a clear-cut statistical evidence for our hypothesis 1. At the same time, the analysis could not

confirm the empirical results in Thomas (2013) about EU regional funds reducing out-migration. I will return to this issue in Section 6.3.

The level of EU regional funds plays a significant role for the choice of a destination as given by the “pull” models 2(a) through 2(c). Column 2(c) can be read in the following way: Comparing two destinations, the one with a 10-percentage points higher EU regional funds obtained (measured per capita in relation to national average) experienced on average 6.41% more migrants from the same origin region. Applied to the average bilateral migration rate of 19.921 per 100,000 and the average regional population of 2.39 million, the number corresponds to roughly 31 more migrants per year to this destination – a considerable increase.

All specifications of the “pull” Model 2 in Tab. 2 show that destinations with higher real GDP per capita, destinations with lower unemployment rate, as well as those being closer attract significantly more migrants from a given origin region. Unsurprisingly, there is significantly more out-migration to neighboring voivodships.

When it comes to other forms of spatial mobility, the level of migration abroad does not help explain the variation of out-migration rate across various origins. The coefficient on emigration variable in model 1(c) is not significantly different from zero, meaning that interregional migration and international migration are not significantly related to each other. However, estimates of the model 2(c) show that regions with higher emigration rates are significantly less attractive internal destinations. The “push” model 1(c) also delivers a strong evidence for commuting as a substitute for out-migration. On average, regions with a 1-percentage point higher share of commuters in labor force have *c.p.* lower out-migration rates by 26% per year and 100,000 residents.

6.2 The sub-periods

In this section, the full models 1(c) and 2(c) are estimated for three sub-periods 2004-2007, 2008-2010, and 2011-2014 separately. This is motivated by the observation that over these sub-periods external framework for migration decisions changed due to three factors: a) gradual opening of the EU-15 labor markets for Polish citizens,¹⁷ b) EU-wide economic slowdown after 2008, and c) extension of the size of the EU regional policy funds in the EU budget for 2007-2013. In addition, this split helps us test our hypotheses 2 and 4.

As shown in Tab. 3 below, the main push and pull factors of interregional migration namely income per capita together with the conditions at the destination’s labor market are the most

17 Initially, only the United Kingdom, Ireland, and Sweden granted workers from the CEE countries full access to their labor markets. After a seven-year transition period in May 2011, Germany and Austria as the last the old EU members lifted restrictions on labor mobility for citizens from the countries that joined the EU in 2004.

significant determinants over the entire ten-years post accession period. Out-migration was also higher to neighboring regions and the negative impact of distance on bilateral migration flows became significantly stronger over time. Although commuting significantly substituted for out-migration over the whole period, the elasticities fell over time. On average, there is no significant relation between the level of emigration from a voivodship and its level of interregional migration in any sub-period, supporting the idea of heterogeneity in terms of preferences and skills among migrants. In addition, the study detects that voivodships with higher unemployment rate had significantly higher out-migration only until 2010, but in times of generally improved labor market conditions afterwards unemployment did not significantly contribute to out-migration.

Model: Period:	2004-2007	Push 2008-2010	2011-2014	2004-2007	Pull 2008-2010	2011-2014
Regressors:						
Ln bilateral distance:	-1.271*** (0.08)	-1.313*** (0.08)	-1.374*** (0.09)	-1.266*** (0.08)	-1.305*** (0.07)	-1.369*** (0.08)
Registered unemployment rate at origin, in percentage points above national average, once-lagged	0.040*** (0.01)	0.045* (0.03)	-0.017 (0.03)			
Real GDP per capita at origin, national average =1, once-lagged	-2.601*** (0.36)	-2.179*** (0.40)	-2.609*** (0.47)			
Total EU regional funds per capita absorbed at origin, national average=1, once-lagged	0.201 (0.14)	0.244* (0.15)	0.366** (0.17)			
Common Border	0.276*** (0.10)	0.289*** (0.10)	0.261** (0.10)	0.326*** (0.10)	0.320*** (0.09)	0.298*** (0.10)
Commuters, share in labor force at origin, in percent	-0.424*** (0.06)	-0.267*** (0.04)	-0.235*** (0.04)			
Emigrants from origin per 100,000 inhabitants	0.000 (0.00)	0.001 (0.00)	-0.000 (0.00)			
Registered unemployment rate at destination, in percentage points above national average, once-lagged				-0.055** (0.02)	-0.135*** (0.03)	-0.128*** (0.05)
Real GDP per capita at destination, national average=1, once-lagged				1.691*** (0.35)	0.971** (0.38)	1.437*** (0.54)
Total EU regional funds per capita absorbed at destination, national average =1, once-lagged				0.560*** (0.15)	0.676*** (0.16)	0.878*** (0.25)
Emigrants from destination per 100,000 inhabitants				-0.001*** (0.00)	-0.002*** (0.00)	-0.002** (0.00)
Origin-by-year fixed effects	No	No	No	Yes	Yes	Yes
Destination-by-year fixed effects	Yes	Yes	Yes	No	No	No
Other regional dummies included	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations (origin-destination pairs across years)	960	720	960	960	720	960
(Pseudo) R ²	0.839	0.851	0.856	0.859	0.863	0.839
Akaike's Information Criterion	7359.0	4969.4	6634.6	7912.0	5399.4	7359.0

Table 3: Determinants of bilateral out-migration rates across sub-periods 2004-2007, 2008-2010, and 2011-2014

Note: Dependent variable is bilateral out-migration rate between origin j and destination k in year t defined as the number of people permanently moved from origin to destination region within a year per 100,000 people living in the origin voivodship at the end of the previous year. Standard errors reported in brackets are robust to heteroscedasticity across origin-destination pairs. *, **, *** denote significance at the 10%, 5% and 1% level respectively. Fixed effects are highly significant at least at 5% level, but not reported for the sake of brevity.

The “push” models in Tab. 3 show that regions with higher EU funding per capita have *c.p.* higher out-migration, which is consistent with Hypothesis 1. Moreover, this effect got stronger over time, which is given by a substantial rise in estimated semi-elasticities over time. Hence, Hypothesis 2 stating that EU funds increasingly stimulated out-migration cannot be rejected. Comparing two voivodships in the last sub-period 2011-2014, the one with EU funds per capita higher by 10 percentage points of national average had *c.p.* a higher out-migration by 3.66% per 100.000 inhabitants per year. Applying this estimate to the average bilateral out-migration rate of 19.921 per 100,000 and the average regional population of 2.39 million, the effect are roughly 17 more migrants per year from an average origin to an average destination.

The “pull” models in Tab. 3 confirm that EU funds absorbed by regions increased their attractiveness as destinations for potential migrants – the estimates of semi-elasticities are significant at 1% level and increase over time as the average level of EU funds in Polish regions rose. In the sub-period 2011-2014, a destination with 10 percentage points, more EU regional funds (in relation to national average) could attract *c.p.* roughly 42 more migrants from the same origin voivodship.

The results presented allow us to conclude that EU funds did not hamper migration in Poland, but rather fostered out-migration from relatively poorer regions to those richer, with stronger labor markets, and to those with higher absorption of EU regional funds. This is fully consistent with the tested hypotheses 1 through 4.

6.3 Robustness

I check the robustness and sensitivity of the obtained econometric results in two different ways. As recommended by Beine et al. (2016), the sample is split as a function of income at origin. This could help check the importance of credit constraint for the decision about out-migration. In an alternative specification, I work with the full sample, but employ an alternative measure of EU regional funds attracted by a single voivodship.

For the first robustness check, I look separately at migration flows from voivodships with real GDP per capita below the average value for Poland (called “poor” for simplicity). This group excludes MAZOWIECKIE, SLASKIE, WIELKOPOLSKIE, and DOLNOSLASKIE and consists of the same twelve Polish regions in every single year over the period 2004-2014. Except SLASKIE, all voivodships excluded constantly gained population thanks to higher in- than out-migration. Descriptive statistics on the “Poor” are given in Tab. A.2 in Appendix, while Tab. 4 below reports estimates of model 1(c) and 2(c) for this group in three observed sub-periods.

	Model: Period:	Push			Pull		
		2004-2007	2008-2010	2011-2014	2004-2007	2008-2010	2011-2014
Regressors:							
Ln bilateral distance:		-1.294*** (0.09)	-1.340*** (0.09)	-1.404*** (0.09)	-1.346*** (0.10)	-1.388*** (0.09)	-1.456*** (0.09)
Registered unemployment rate at origin, in percentage points above national average, once-lagged		0.039*** (0.01)	0.042 (0.03)	-0.038 (0.03)			
Real GDP per capita at origin, national average =1, once-lagged		-3.749*** (0.66)	-2.682*** (0.69)	-3.668*** (0.71)			
Total EU regional funds per capita absorbed at origin, national average=1, once-lagged		0.320** (0.16)	0.305* (0.18)	0.408** (0.18)			
Common Border		0.293** (0.12)	0.295*** (0.11)	0.283** (0.11)	0.366*** (0.11)	0.353*** (0.11)	0.330*** (0.12)
Commuters, share in labor force at origin, in percent		-0.427*** (0.07)	-0.260*** (0.05)	-0.214*** (0.04)			
Emigrants from origin per 100,000 inhabitants		0.000 (0.00)	0.001 (0.00)	-0.001 (0.00)			
Registered unemployment rate at destination, in percentage points above national average, once-lagged					-0.068** (0.03)	-0.161*** (0.04)	-0.154*** (0.06)
Real GDP per capita at destination, national average=1, once-lagged					1.584*** (0.43)	0.757 (0.46)	1.253* (0.68)
Total EU regional funds per capita absorbed at destination, national average =1, once-lagged					0.629*** (0.17)	0.747*** (0.18)	0.971*** (0.28)
Emigrants from destination per 100,000 inhabitants					-0.001* (0.00)	-0.002** (0.00)	-0.001 (0.00)
Origin-by-year fixed effects		No	No	No	Yes	Yes	Yes
Destination-by-year fixed effects		Yes	Yes	Yes	No	No	No
Other regional dummies included		Yes	Yes	Yes	Yes	Yes	Yes
Number of observations (origin-destination pairs across years)		720	540	720	720	540	720
(Pseudo) R ²		0.851	0.858	0.877	0.868	0.875	0.864
Akaike's Information Criterion		5754.6	3893.5	5122.2	6179.0	4186.2	5889.2

Table 4: Determinants of bilateral out-migration rates from “poor” voivodships across sub-periods 2004-2007, 2008-2010, and 2011-2014

Note: “Poor” voivodships are defined as those with real GDP per capita lower than the national average in a given year. Dependent variable is bilateral out-migration rate between origin *j* and destination *k* in year *t* defined as the number of people permanently moved from origin to destination region within a year per 100,000 people living in the origin voivodship at the end of the previous year. Standard errors reported in brackets are robust to heteroscedasticity across origin-destination pairs. *, **, *** denote significance at the 10%, 5% and 1% level respectively. Fixed effects are highly significant at least at 5% level, but not reported for the sake of brevity.

The results are very similar to those obtained for the full sample, but the estimated coefficients with respect to income are much higher. Regions with low GDP per capita had significantly higher out-migration. Especially after 2007, it holds independently on their labor market performance. This is consistent with migration dominated by outflow of people with professional skills seeking higher living standard nationwide.

In the group of “poor” voivodships, the estimated semi-elasticities on the EU regional funds variable are significant and positive in each sub-period. They are also significantly higher than those for the full sample, showing that EU funds had stronger impact on migration decisions in poorer regions. Moreover, since the estimates have the highest value for the years 2011-2014, the results fully support our hypotheses 1 through 4. Again, when applying this estimate to the

average bilateral out-migration rate of 21.700 per 100,000 and the average regional population of 1.84 million, the effect are 16 more migrants per year from an average poor voivodship to an average destination.

For the second robustness check, the EU-variable is constructed as the total accumulated amount of EU regional funds attracted until the end of the given year in relation to the regional nominal GDP of this year. I relate this number for each voivodship to the national average and use it in Model 1(c) and 2(c) lagged by one year. The estimates can be found in Tab. A.3 in Appendix.

Comparing estimates given in columns 1(c) and 2(c) in Tab. 2 with those in Tab. A.3, we conclude that the obtained results are highly robust with respect to the definition of the EU variable. On average, regions with higher EU regional funds in relation to their GDP not only attracted *c.p.* significantly more internal migrants, but also send *c.p.* more people to other voivodships than those with lower EU funds. The strength of this effect increased over time.

7 Conclusions

The EU regional transfers that Poland received in the first ten years of its EU membership have increased the level of internal migration flows and changed its spatial pattern. Although this result partly contradicts Thomas (2013), it is not fully surprising when we consider the well-documented empirical finding that international development aid granted to poorer countries fosters emigration from these countries (Clemens, 2014).

The detected positive effect of the EU transfers on the level of out-migration is significant for poorer voivodships with income per capita below national average. It also intensified over time. This can be explained by the observation that EU-financed infrastructure projects lower interregional mobility costs, selectively increase attractiveness of destinations, and enhance availability of potential migrants through investment in education and professional skills. In the period 2011-2014, on average, a higher size of EU regional funds per capita by ten percentage points in terms of national average led *c.p.* to a higher out-migration from a “poor” voivodship by roughly 4% per 100.000 inhabitants per year. This corresponds to 16 more migrants per year from an average “poor” voivodship.

By fostering out-migration from poorer regions and enhancing inflows to those relatively richer, EU transfers contributed to higher concentration of population and income across regions in Poland. Population losses in poorer regions lower in turn their future growth perspectives. This works, however, against the very objective of the EU regional policy, which is to promote the development of regions lagging behind and those with structural difficulties.

Thus, despite its contribution to modernization of public infrastructure in Poland, the EU regional policy in Poland through its migration effects might hamper regional convergence.

The question whether the above conclusions on the EU regional policy can be extended to other new EU member states calls for further comprehensive research. This requires more accurate data on internal mobility, which covers resettlement within regions and possibly includes individual characteristics of migrants (such as education and age). In addition, detailed statistical data on the actual distribution of the EU funds across regions and over time are necessary. In order to better understand the complex relation between the EU transfers and migration decisions, reliable information about regional beneficiaries of the EU support and the type of the EU funded projects is highly required.

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Appendix

Table A1: Statistical description of bilateral interregional migration rates, 2004-2014

By origin voivodship:		Observations	Mean	Std. Dev.	Min	Max
DOL		165	16.44	12.73	1.97	53.16
KUJ		165	19.89	23.49	1.33	77.32
LOD		165	17.60	24.11	1.67	121.68
LBL		165	25.81	51.05	2.46	238.36
LBS		165	25.72	32.86	1.66	135.45
MAL		165	11.81	15.24	1.46	71.31
MAZ		165	12.17	64.07	1.42	29.39
OPO		165	22.13	31.73	1.26	139.52
PKAR		165	17.33	22.75	1.67	92.25
PLAS		165	22.49	42.54	0.66	198.65
POM		165	15.52	14.99	0.96	61.47
SLA		165	16.82	15.41	2.45	71.53
SWIE		165	27.98	37.52	1.18	162.43
WARM		165	31.00	42.83	1.68	169.44
WIEL		165	12.94	10.80	1.21	39.32
ZPOM		165	23.10	21.89	2.38	90.62
By year:						
2004		240	20.37	28.26	0.75	212.21
2005		240	20.47	29.05	1.34	223.12
2006		240	22.25	32.41	0.92	238.36
2007		240	23.00	32.41	1.59	236.70
2008		240	18.78	25.90	1.46	185.12
2009		240	18.77	26.51	1.26	185.99
2010		240	19.50	28.11	0.66	207.92
2011		240	19.53	28.72	1.41	210.55
2012		240	18.12	26.94	1.33	211.52
2013		240	19.54	29.70	1.18	217.68
2014		240	18.82	28.83	0.84	218.28

Source: Own calculations based on GUS (2017)

Table A2: Descriptive statistics for estimations across “poor” voivodships, 2004-2014

Variables:	Obs.	Mean	Std. Dev.	Min	Max
Migrants from origin to destination per 100,000 inhabitants	1,980	21.700	32.403	0.664	238.363
EU regional funds per capita, total payments to the region, national average = 1	1,980	0.895	0.252	0.545	1.566
Regional price-adjusted GDP per capita, national average =1	1,980	0.823	0.070	0.711	0.933
Regional registered unemployment rate, in percentage points above national average	1,980	1.052	1.729	-2.833	5.535
Emigrants from origin to the EU per 100,000 inhabitants	1,980	78.613	77.756	8.318	458.852
Commuters to other voivodships, in percent of the regional labor force	1,980	1.466	0.738	0.408	3.430

Source: Own calculations based on data sources specified in Section 5.

Table A3: Determinants of bilateral out-migration rates across sub-periods 2004-2007, 2008-2010, and 2011-2014

Regressors:	Model: Period:	Push			Pull		
		2004-2007	2008-2010	2011-2014	2004-2007	2008-2010	2011-2014
Ln bilateral distance		-1.272*** (0.08)	-1.313*** (0.08)	-1.374*** (0.09)	-1.267*** (0.08)	-1.306*** (0.07)	-1.371*** (0.08)
Registered unemployment rate at origin, difference to national average in percentage points, once-lagged		0.040*** (0.01)	0.045* (0.03)	-0.014 (0.03)			
Real GDP per capita at origin, national average =1, once-lagged		-2.412*** (0.35)	-1.958*** (0.40)	-2.261*** (0.49)			
Total EU regional funds absorbed at origin in relation to regional GDP, national average=1, once-lagged		0.180 (0.14)	0.197 (0.14)	0.271* (0.15)			
Common Border		0.273*** (0.10)	0.286*** (0.10)	0.257** (0.10)	0.320*** (0.10)	0.314*** (0.09)	0.287*** (0.10)
Commuters, share in labor force at origin, in percent		-0.427*** (0.07)	-0.267*** (0.04)	-0.233*** (0.04)			
Emigrants from origin per 100,000 inhabitants		0.000 (0.00)	0.001 (0.00)	-0.000 (0.00)			
Registered unemployment rate at destination, difference to national average in percentage points, once-lagged					-0.054** (0.02)	-0.134*** (0.03)	-0.122** (0.05)
Real GDP per capita at destination, national average=1, once-lagged					2.162*** (0.32)	1.526*** (0.40)	2.298*** (0.53)
Total EU regional funds absorbed at destination in relation to GDP, national average =1, once-lagged					0.524*** (0.15)	0.612*** (0.16)	0.768*** (0.24)
Emigrants from destination per 100,000 inhabitants					-0.001*** (0.00)	-0.002*** (0.00)	-0.001* (0.00)
Origin-by-year fixed effects		No	No	No	Yes	Yes	Yes
Destination-by-year fixed effects		Yes	Yes	Yes	No	No	No
Other regional dummies included		Yes	Yes	Yes	Yes	Yes	Yes
Number of observations (origin-destination pairs across years)		960	720	960	960	720	960
(Pseudo) R ²		0.839	0.851	0.857	0.856	0.860	0.850
Akaike's Information Criterium		7368.7	4978.3	6655.6	7973.6	5441.9	7593.9

Note: Dependent variable is bilateral out-migration rate between origin j and destination k in year t defined as the number of people permanently moved from origin to destination region within a year per 100,000 people living in the origin voivodship at the end of the previous year. Standard errors reported in brackets are robust to heteroscedasticity across origin-destination pairs. *, **, *** denote significance at the 10%, 5% and 1% level respectively. Fixed effects are highly significant at least at 5% level, but not reported for the sake of brevity.

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