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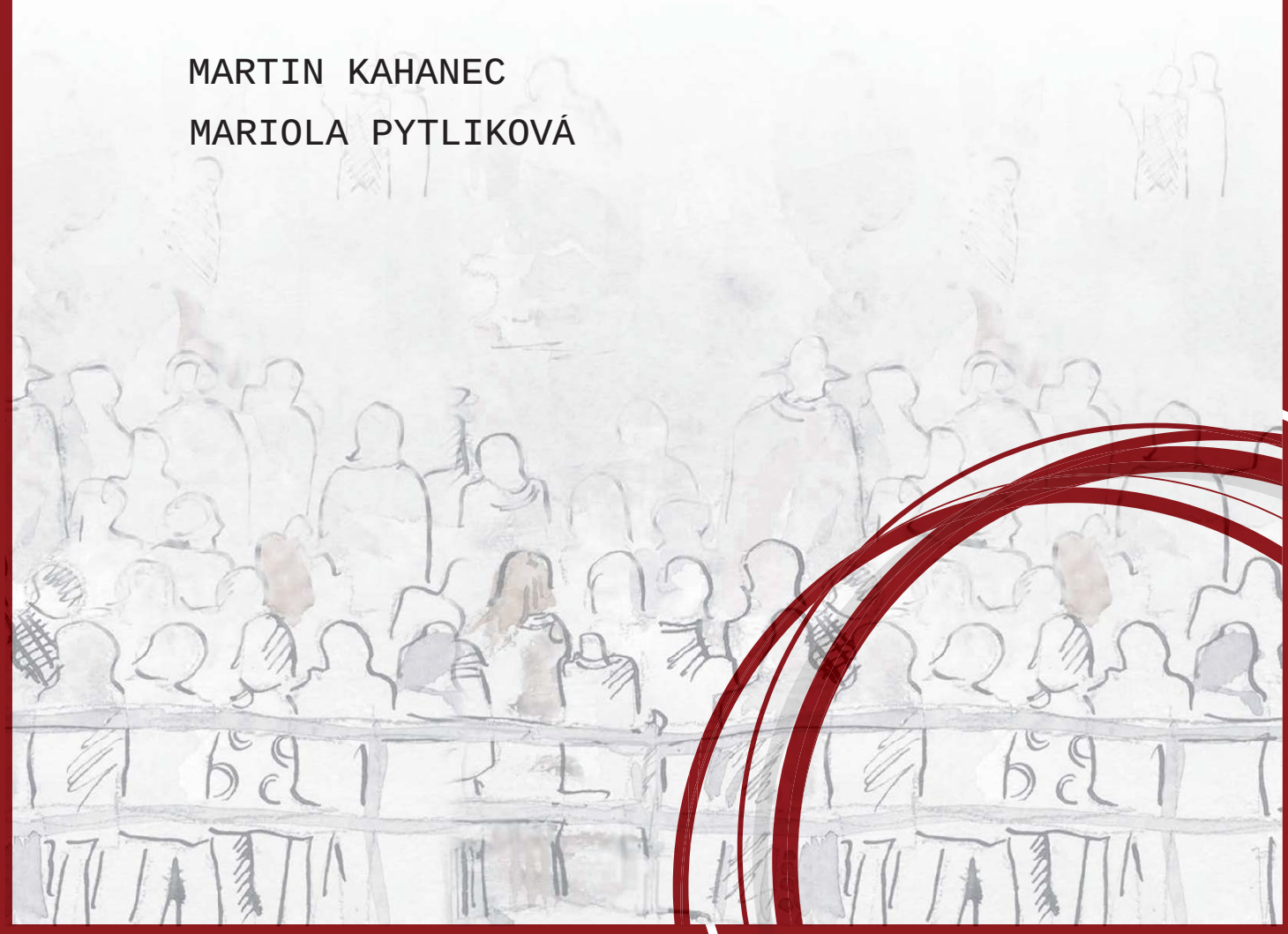

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ABSTRACT

The Economic Impact of East-West Migration on the European Union

This study contributes to the literature on destination-country consequences of international migration with investigations on the effects of immigration from new EU member states and Eastern Partnership countries on the economies of old EU member states over the years 1995-2010. Using a rich international migration dataset and an empirical model accounting for the endogeneity of migration flows we find positive and significant effects of post-enlargement migration flows from new EU member states on old member states' GDP, GDP per capita, and employment rate and a negative effect on output per worker. We also find small, but statistically significant negative effects of migration from Eastern Partnership countries on receiving countries' GDP, GDP per capita, employment rate, and capital stock, but a positive significant effect on capital-to-labor ratio. These results mark an economic success of the EU enlargements and EU's free movement of workers.

Keywords: EU enlargement, free mobility of workers, migration impacts, European Single Market, east-west migration, Eastern Partnership

JEL Classification: J15, J61, J68

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1. Introduction

Europe has always been a hub of international migration. In 2010, almost seven out of a hundred residents in the EU were born outside the EU, and additional three were born in a different member state than the current state of residence.[1] The 2004 and 2007 enlargements of the European Union and the extension of EU's internal market, including the freedom of movement of workers[2], to the new member states from Central and Eastern Europe changed the migration landscape in Europe tremendously. These enlargements abolished the barriers that precluded East-West migration flows during the Cold War, and created an internal labor market for the total population of about half a billion people, cross-cutting boundaries of member states with disparate level of economic development, wages, unemployment rates, and labor market institutions.[3] Unsurprisingly, these differences lead to significant migration flows mainly (but not exclusively) in the east-west direction. These new migrant flows have not been unanimously welcome in the receiving countries, and immigration from Central and Eastern Europe was one of the pivotal arguments in the debate about UK's leaving the European Union, commonly known as "Brexit".

The scale of these flows was indeed remarkable, with about five and half million citizens of the new member states (EU12) living in the pre-enlargement member states (EU15[4]) in 2010, which constitutes an increase by three and half million, or the factor of 2.5, over just six years.[5] As this large-scale policy experiment can certainly provide a number of interesting insights into the labor market effects of migration, quite naturally a significant body of literature studying the repercussions of such migration flows mainly for the receiving but also the sending labor markets has emerged.[6] This literature has mainly looked at the effects on wages, employment and unemployment, and welfare take up in individual member states separately. Generally speaking, besides some local effects, the available evidence is that the receiving labor

[1] Own calculations based on the data collected and described in the data section below.

[2] All nationals of EU member states as well as their family members enjoy the right of free movement in the EU as stipulated by the Treaty on the European Union, Directive 2004/38/EC, and the Case Law of the European Court of Justice if they do not pose an undue burden for the host member state's public funds and they possess comprehensive health insurance.

[3] This inevitably lead to some anxieties which resulted in transitional arrangements allowing member states to open their labor markets gradually and within up to 7 years after the accession of new member states. See Kahanec, Zaiceva and Zimmermann (2010) and Palmer and Pytlikova (2015).

[4] EU15 refers to the fifteen pre-2004 member states: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden and United Kingdom. Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia (referred to as EU10) joined the EU in 2004, Bulgaria and Romania (denoted EU2) joined in 2007, and Croatia was the most recent addition to the EU in 2013. EU8 refers to EU10 minus Cyprus and Malta. EU27 includes EU15, EU10 and EU2.

[5] Calculations based on the own data collection efforts, the data is described in the section below. For other sources of estimates for earlier years see also Kahanec, 2013, and Kahanec and Zimmermann, 2016.

[6] See e.g. Kahanec and Zimmermann, 2010, 2016; Kahanec, 2013; Galgoczi, Leschke and Watt, 2009 and 2012;Holland et al., 2011;Kaminska and Kahancová, 2011; Kureková, 2011; Wadsworth, 2014; Gerdes and Wadensjö, 2010.

markets absorbed post-enlargement immigrants rather seamlessly with statistically or economically insignificant effects on labor market indicators.

This evidence may however mask broader consequences of post-enlargement mobility. Migration in general facilitates cross-border social and economic ties, leading to an increased mobility of ideas and technologies, capital, and goods and services and thus a better allocation of production factors and improved total factor productivity, as well as gains from trade.[7] Although inherently difficult to detect, such effects may significantly affect EU member states, and thus their measurement is important for the debate about EU's migration policy.

The aim of this study is to analyze the effects of recent east-west mobility on economic outcomes across the EU and in the EU as a whole. Using an empirical model accounting for the problem of endogeneity of migration flows, we look at a range of indicators, in particular at GDP per capita, employment rates, capital stock and total factor productivity (TFP). The analysis is based on a rich dataset on immigration flows and stocks of foreigners, which has been collected by writing to selected national statistical offices, for 42 destination countries from virtually all source countries from around the globe for the years 1980–2010.[8] We comparatively evaluate the effects of post-enlargement intra-EU mobility (after the 2004 and 2007 enlargements) and immigration from the Eastern Partnership (EaP) countries on a subsample consisting of EU destination countries.[9]

The main contribution of this study is twofold. First, the massive post-enlargement migration flows over a relatively short period of time offer a unique framework that is worth exploring to inform the academic debate about the broader economic effects of migration and migration policy. Second, a comparative analysis of the costs and benefits of mobility under various migration regimes is much needed in view of the heated policy debates surrounding migration policy in the EU. This agenda has become ever more urgent in view of EU's plans to upgrade mobility frameworks within its Eastern Partnership program and an increased migration potential in some of the key source countries as a consequence of the recent events in EU's neighborhood including the Arab Spring events, the Syrian civil war of the 2010s, and the Ukrainian crisis that started in 2014.

The rest of the paper is organized as follows. Section 2 presents the theoretical and empirical literature relevant to our study. Section 3 describes shortly the novel international migration database and other

[7] Chiswick, 2011; Hunt and Gauthier-Loiselle (2010); Peri and Requena (2010); Javorcik et al. (2011); Kerr and Kerr (2011); Parrotta, Pozzoli and Pytlikova (2014a and 2014b); Nathan (2011, 2014); Bansak, Simpson and Zavodny (2015); Peri, Shih and Sparber (2015).
[8] See Adsera and Pytlikova (2015) and Cai et al.(2016)
[9] EaP includes Armenia, Azerbaijan, Belarus, Georgia, Moldova, and Ukraine

variables important for our analyses and provides some descriptive statistics. Section 4 presents an empirical model on the impact of immigration on destination country economy, on which we base our analysis, and our identification strategy. We discuss results of econometric analyses in in Section 5. Finally, Section 6 concludes and provides a discussion of future steps in our research.

2. Literature review

The effects of immigration on receiving countries has been a much debated issue in economics for a long time. Early theoretical models on the effects of labor mobility considered immigration in an extended version of the traditional Solow-Swan model, where immigrants are assumed to increase country's unskilled population, which ceteris paribus leads to a lower per capita income because of a reduction in capital. Benhabib (1996) relaxes the assumption of the Solow-Swan model that immigrants do not provide any capital, which leads to some economic gain from immigration in terms of per capita GDP. Borjas (1995) argues that immigrants increase labor endowment in receiving countries and the new internal equilibrium is then characterized by lower national wage and higher employment and national income. The difference with respect to the initial equilibrium is the so called "immigrants surplus" (Borjas, 1995). A study by Hanson (2008) analyzes welfare consequences of immigration by assuming heterogeneity of workers in terms of skills, and perfect substitutability between native and foreign-born workers. The author shows that when low-skilled workers are allowed to freely move between countries, there will be migration from low-wage countries to high-wage countries until the wages will equalize. In the receiving country home-born unskilled workers lose while the native high- skilled workers win in terms of surplus. Thus, so far the theory says that the effect of migration depends on the type and selectivity of immigrants. Besides substitutability or complementarity of immigrant and native labor, capital endowments play an important role: if the physical capital endowment provided by immigrants is lower than the average native capital endowment the effect of immigration will be negative in terms of per capita GDP. From the empirical point of view the question of immigration's economic impacts is thus still open.

Most of the existing empirical papers examine the impact of immigration by focusing only on labor market implications and on one or only a few receiving countries (e.g. Aydemir and Borjas, 2007; Borjas, 2003; Ottaviano and Peri, 2008; Manacorda et al., 2012). Angrist and Kugler (2003) use a panel of European countries and analyze the labor market effects of immigration. Related to this paper, Peri (2008) and Gonzalez and Ortega (2011) analyze the effects of immigration on employment, capital accumulation and productivity, respectively, across US states and Spanish regions. The literature on the aggregate effects of migration using cross-country panel analysis is very scant. From earlier contributions, Dolado, Goria and

Ichino (1994) found a negative effect of immigration on per capita income growth, so they argued that this was due to the fact that immigrants in OECD countries have lower human capital than natives. Recently, the aggregate effects of immigration have been discussed by a number of studies of Giovanni Peri. For instance, Peri (2012) analyzes the effects of immigration on each input of production function and on total factor productivity (TFP) for U.S. states' economies. The author also discusses the potential endogeneity problem, which he solves by using the instrumental variable (IV) technique, with past settlement patterns of immigrants driven by proximity to the border as an instrument for gross migration rates. In particular he shows that an increasing immigration leads to: (i) no crowding out of employment of natives, (ii) an increasing TFP growth. Felbermayr, Hiller and Sala (2010) investigate the effect of immigrants (by using the stock of immigrants in destination country) on per capita GDP in the host countries. Using an IV cross-section approach and controlling for institutional quality and trade and financial openness, they find a positive effect of immigration on per capita GDP: a 10% increase in the migrants stock leads to a 2.2% increase in per capita GDP. Similarly Bellini, Ottaviano, Pinelli and Prarolo (2013) find that the share of foreigners in total population has a positive effect of per capita GDP in EU destination regions.

Further, Peri (2007) argues that immigrants' and natives' skills are not perfectly substitutable[10], which creates the incentive for natives to specialize in more skilled jobs (e.g. more intensive in communication and language tasks[11]) and let the immigrants to do the manual tasks (Peri and Sparber, 2009). This finding is consistent with other immigration studies that show immigration does not crowd out natives, but in fact it has a positive effect on employment and investment (Ortega and Peri, 2009; Kahanec and Zimmermann, 2010), while total factor productivity is increased by optimizing the task specialization and by encouraging the adoption of unskilled-efficient technologies (Peri 2012).

In an earlier paper, Peri (2006) argues that although immigration increases employment for the natives with complementary skills, it has a negative effect on those with substitutable skills. Previous research also shows that immigrants are substitutes for work performed by migrants that came in earlier migration waves. In particular, using data from different countries and different econometric methods, they find that immigration increases the overall wages for natives in the host country, but reduces the wages of previous immigrants (Ottaviano and Peri, 2012; D'Armuri et al., 2010, Docquier et al., 2013, Longhi et al., 2010). A recent study by Foged and Peri (2016), however, shows that even if immigrants may be imperfect substitutes to low-skilled workers, they still improve their labor market position. The reason is that, as a reaction to the migrant inflow, low-skilled native workers moved to complementary job market areas and

[10] In line with the theoretical framework presented in e.g. Borjas (1999), the effect of immigration depends very much on whether the immigrants are substitutes or complements with respect to natives.
[11] or other soft skills, see an overview by Balcar (2014).

started to specialize in non-manual skills. This leads to an increase in their wages and employment opportunities (Foged and Peri, 2016). However, in contrast to the hypothesis of imperfect substitutability of immigrants and natives, Docquier et al (2013) find that immigration increases wages, on average, it has a negative effect for highly educated workers (except for US) and a positive effect for the wages of low-skilled workers.

From other outcome variables, it is worth mentioning that immigration appears to have a positive effect on trade creation, by reducing the fixed costs of trade, through the network effects and stimulates the trade of differentiated products (Peri and Requena, 2010) and on foreign direct investment (Javorcik et al. 2011; Gormsen and Pytlikova, 2012). The effect on services is also positive, in the sense that it decreases the prices for low-skilled services (e.g. gardening, house-cleaning), which benefits the natives (Longhi et al, 2010). Regarding the effects of immigration on education, some previous studies suggest that the increase in the number of foreign students has a negative effect on the education of natives, while it increases the knowledge creation for universities (Hanson, 2008; Kato and Sparber, 2013). Using a panel of EU member states, industries and skill-groups, Guzi, Kahanec, and Mýtna-Kureková (2015), document that immigrants are more responsive to labor and skill shortages than the natives, contributing to economic effiiency in the receiving countries. Kahanec and Zimmermann (2014) argue that immigration tends to reduce income inequality.

When it comes to the effects of post-enlargement migration on receiving countries, the consensus in the literature appears to be that of very limited if any effects on wages or unemployment rates (see Kahanec and Zimmermann, 2010, 2016; Gilpin et al., 2006; Blanchflower, Saleheen, and Shadforth, 2007; Lemos and Portes, 2008). Doyle, Hughes, and Wadensjö (2006), Hughes (2007) and Barrett (2010) report that even in Ireland, with the highest relative inflows from the new member states, effects on aggregate unemployment rate could not be detected, although some substitution might have occurred. Brenke, Yuksel, and Zimmermann (2010) point at competition for low-skilled jobs between EU8 migrants and immigrants from outside of Europe. Similarly, Blanchflower and Lawton (2010) report some substitution in low skilled sectors. Blanchflower and Shadforth (2009) and Blanchflower, Saleheen, and Shadforth (2007) argue that it was the fear of unemployment that resulted in some wage moderation in the UK prior to the 2004 enlargement. Several authors, including Kahanec and Zimmermann (2010, 2016), Kahanec et al. (2013), Giulietti et al. (2013), or Barrett (2010) have proposed positive macroeconomic effects of post-enlargement mobility within the EU. The latter study for example argues that increased immigration from the new member states fueled the Irish economy and boosted its GNP growth during the boom preceding the Great Recession. However, empirical analyses using more general multi-country data to investigate this

hypothesis are missing. Even less is known about the possible effects of immigration from EaP countries. This paper contributes to the literature by providing empirical estimates of the effects of immigration on total GDP and GDP per capita, aggregate employment, capital stock, productivity and, consequently, income per capita at the country level by focusing on the recent large immigration flows from Central and Eastern Europe to the EU15.

3. Data description

The dataset on international migration used for the analyses has been collected by Mariola Pytlikova and encompasses information on bilateral flows and stocks of immigrants from all world source countries in 42 destination countries over the period 1980–2010.[12] The dataset has been collected by requesting detailed information on migration inflows and foreign population stocks by source country from selected national statistical offices in 27 countries. For six OECD countries – Chile, Israel, Korea, Mexico, Russian Federation and Turkey - the data comes from the OECD International Migration Database. For nine other destinations – Bulgaria, Croatia, Cyprus, Estonia, Latvia, Lithuania, Malta, Romania and Slovenia – the data is collected from Eurostat. For purposes of our analysis we focus on EU15 and EU27 as destination countries and the EU12 and EaP as sending countries, for a time period ranging from 1995 to 2010.[13]

The data covers annually both migration flows and foreign population stocks[14] and is more comprehensive with respect to destinations, origins and time due to our own effort with data gathering from particular statistical offices. For an overview of comprehensiveness of observations of flows and stocks across all EU27 destination countries over time, see the Appendix Table A1 and Table A2, respectively. It is apparent that the data becomes more comprehensive over time and thus missing observations become less of a problem for more recent years.

In our dataset, as in the other existing datasets, different countries use different definitions of an "immigrant" and draw their migration statistics from different sources. For instance, countries as Poland and Slovak Republic define an ''immigrant'' by country of origin or country of birth, while countries as

[12] The original OECD migration dataset by Pedersen, Pytlikova and Smith (2008) covered 22 OECD destination and 129 source countries over the period of years 1989-2000 (see Pedersen, Pytlikova and Smith, 2008, for a description of the dataset). For the study by Adsera and Pytlikova (2015), we extended the number of destinations to 30 OECD countries and the number of source countries to all world countries, and we extended the time period so that it covers years 1980-2010. This current dataset covering 42 destinations and years 1980-2010 has been used in Cai et al (2016) and it is thereafter referred as Pytlikova (2011).

[13] We chose the period from 1995 in order to avoid problems related to different country break-ups, such as countries of Former Yugoslavia and Former USSR.

[14] Migration flow is the inflow of immigrants to a destination from a given origin in a given year. The definition usually covers immigrants coming for a period of half year or longer. Foreign population stock is a number of foreigners from a given country of origin living in a destination in a given year. The foreign population stock data is dated ultimo.

Austria, the Czech Republic, Denmark, Finland, Greece, Iceland, Italy, Norway and Sweden accounts an immigrant by citizenship and some countries as Belgium, France, Hungary, Germany, Luxembourg, Portugal, Spain, Switzerland and the United Kingdom accounts an immigrant by self-reported nationality. Different definitions are in place also for immigrant stocks. While some countries report the first generation of immigrants, including the ones that have received citizenship (country of birth definition preferred in our data), other countries include in the immigrant population the second and third generation, excluding the naturalized ones (definition by citizenship or country of origin), see Pedersen et al. (2008), Adsera and Pytlikova (2015) and Cai et al.(2016) for a more detailed discussion on the restrictions given by migration flows and migration stocks using the dataset. Appendix Tables A3 and A4 provide a detailed overview of definitions and sources of the data on migration inflows and immigrant stocks, respectively. The information on other economic and social factors for these countries has been collected from various sources, such as the World Bank, OECD, ILO, or IMF.

Descriptive statistics

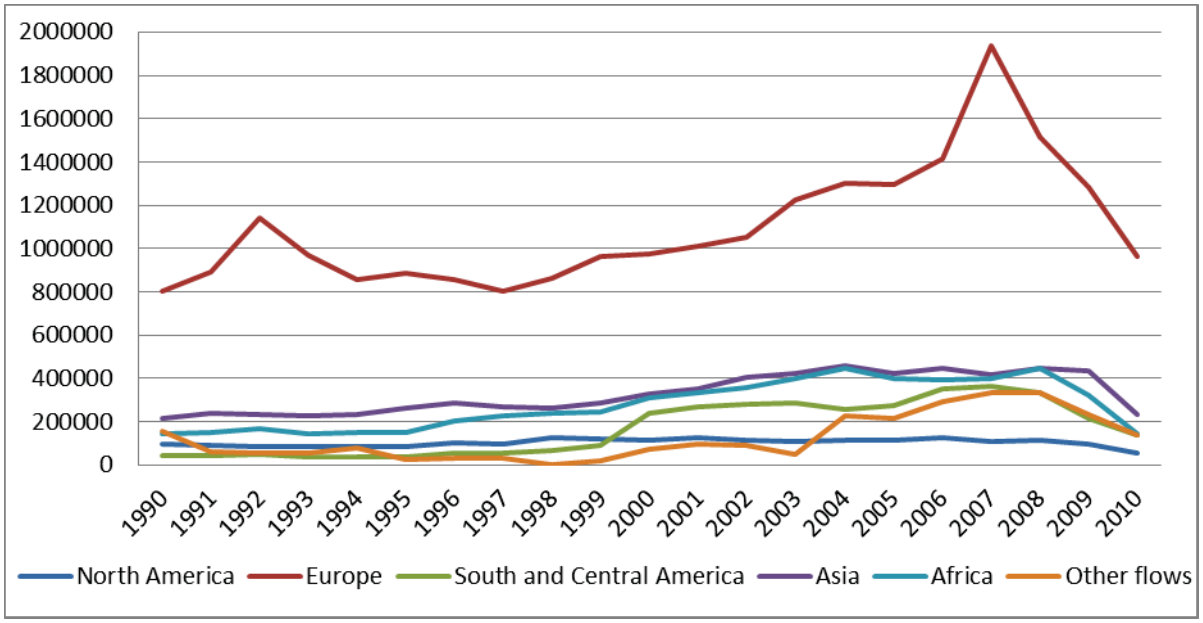
Compared to other advanced economies labor mobility is relatively low in the European Union. Gill and Rasier (2012) report that the annual interstate mobility of working-age population in the EU15 was about 1% before the 2004 enlargement. The corresponding rate for the US was 3%, Australia and Canada 2%, and even the Russian Federation exhibited 1.7%. In southern Europe mobility rates are even lower at about 0.5% annually, whereas countries like France, Ireland, Netherlands or the UK report mobility rates around 2% (Bonin et al, 2008).

Most migration in Europe happens among EU member states; inflows from Eastern Partnership countries to the EU had been increasing before the onset of the Great Recession, but remain much below those from other source regions. Figure 1 describes migration flows into EU countries, by continent of source countries. As it can be seen, the biggest migration flows come from Europe, followed by Asia and Africa. Figure 2 allows for a closer look at the migration flows from Europe. We divide the source countries of foreigners into the “old” EEA/EFTA18 countries, EaP countries and EU 2004 and EU 2007 entrants to the EU. Figure 2 shows that the highest numbers of immigrants come from the “old” EU/EEA/EFTA18 source countries and the inflows are relatively stable over time, whereas the lowest immigration into EU27 destinations stems from the EaP source countries.

Figure 2 also shows the evolution of European history. The 1992 peak of migration from “Other European source countries” region corresponds to the development in migration surrounding the fall of the USSR. Also, one can observe a gradual but considerable increase in migration flows for the new EU 2004 entrants

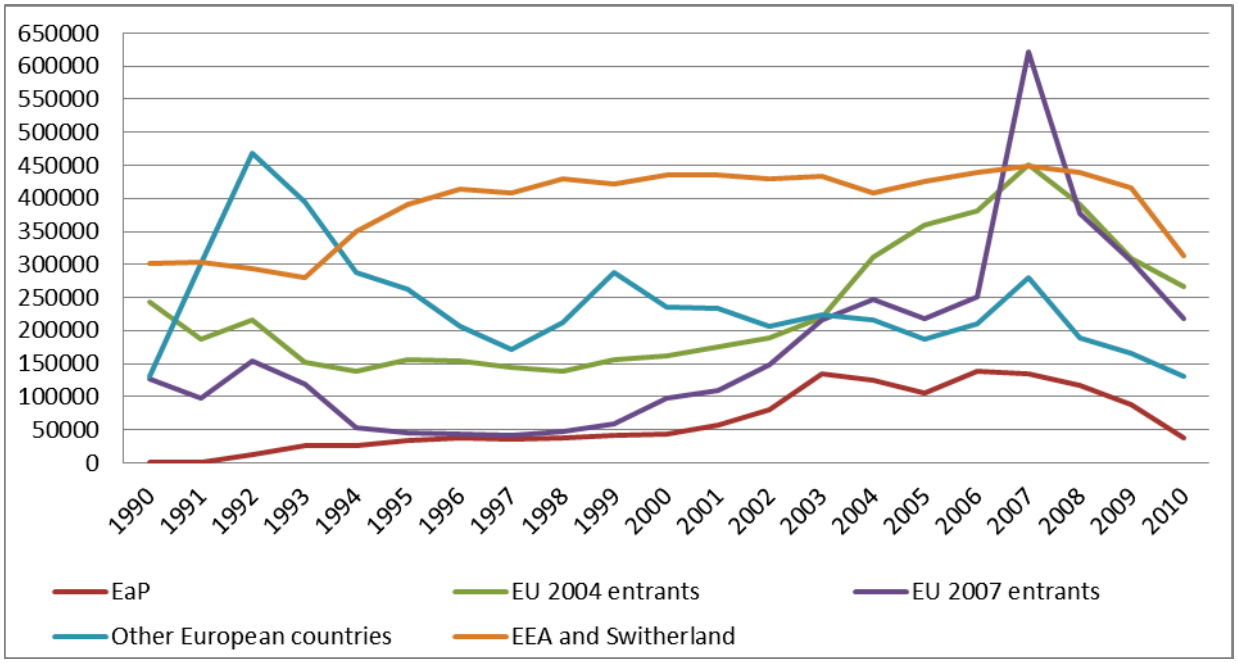
after the first wave of EU's eastern enlargement in 2004. Similarly, migration from Bulgaria and Romania was increasing sharply after the 2007 EU enlargement. The decline after 2008 for all countries most likely corresponds to the financial crisis, which started to affect Europe in that year.

Figure 1: Migration flows to EU27 destination countries by regions of origin, 1990-2010.



Source: Gross inflows. Own calculations using collected migration flows and stock database by Pytlikova (2011)

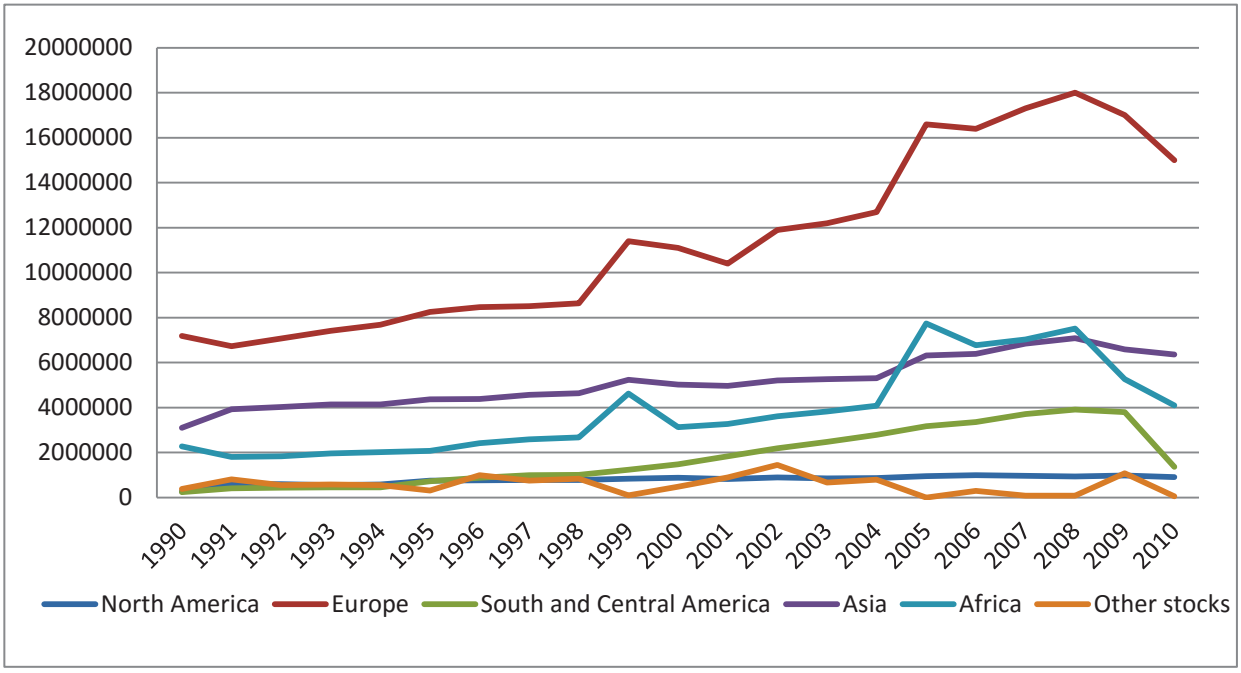
Figure 2: Migration flows to EU27 destination countries from Europe, by European regions of origin, 1990-2010.



Source: Gross inflows. Own calculations using collected migration flows and stock database by Pytlikova (2011)

Looking at the evolution of migration stocks by continents of origin, we may observe that migration trends follow closely the development in the migration flows. European countries provide the highest number of migrants, followed by Asia and Africa, see Figure 3.

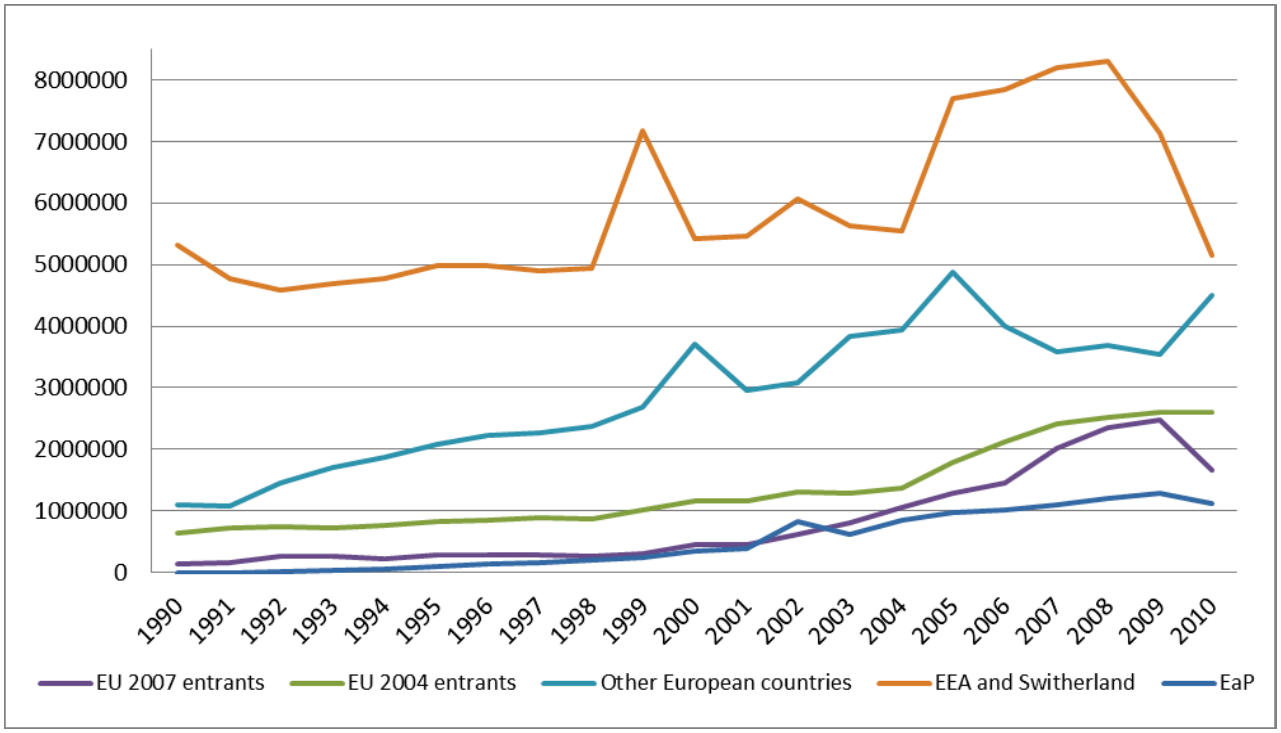
Figure 3: Foreign population stocks living in EU27 destination countries by regions of origin, 1990-2010.



Source: own calculations using collected migration flows and stock database by Pytlikova (2011)

Similarly as in the case of immigrant flows, we divide the foreign population stocks stemming from Europe into more detailed regions of origin, see Figure 4. We can observe that the highest number of migrants living in EU27 countries come originally from the "old" EU15 countries, and Norway, Iceland and Switzerland ("old" EEA/EFTA18), whereas foreigners stemming from the EaP countries have the lowest numbers. Still, it can be seen an upward trend, suggesting future increases in the stock of migrants from EaP countries.

Figure 4: Foreign population stocks living in the EU27 destination countries from Europe, by European regions of origin, 1990-2010.



Source: own calculations using collected migration flows and stock database by Pytlikova (2011).

Transitional arrangements applied differently across the EU towards citizens of new member states and other factors such as linguistic proximity or labor market performance resulted in significant variation in terms of the intensity of migration flows across destination countries and in resulting stocks of foreign population. Whereas as of 2010 the main target countries for EU8 citizens were the UK and Germany, relatively few of them live in Malta, Bulgaria or Slovenia, see Table 1. Italy and Spain dominated as the most attractive destinations for the EU2 migrants, while at the other end of the range were mainly the EU8 countries. Migrants from EaP countries predominantly live in Italy, Germany, but also Poland and the Czech Republic. Countries such as Malta, Finland, Slovenia and the Netherlands are least popular destinations among the EaP migrants (see Table 1). We may observe that there was only a slight increase in the share of immigrants from the EaP countries in the EU destination, from 3.36 % to 3.58% immigrants from the EaP in total immigration in 1995 and 2010, respectively.

Table 1: Stocks of migrants from EU8, EU2 and EaP countries of origin in European destinations in 1995 and 2010.

ORIGINS:	**EU8**		**EU2**		**EaP**		**Total world**	
DESTINATIONS:	**1995**	**2010**	**1995**	**2010**	**1995**	**2010**	**1995**	**2010**
Austria	165478	185535	46083	79990	5144	16571	1003399	1315512
Belgium	6972	58131	2909	39554	867	12853	909769	1057666
Bulgaria	1165	1093	195	183	4966	4502	25634	23838
Cyprus	1105	x	5816	x	2293	x	88640	150678
Czech Rep	75744	91830	6331	11483	49018	141475	159207	426423
Denmark	13010	42570	1803	11099	483	7969	249885	428904

Estonia	7029	x	63	x	40946	x	262826	217890
Finland	7941	31870	850	2769	68	1457	106303	248135
France	125377	120006	30164	64626	13239	46182	4308527	5342288
Germany	423263	680314	148103	201405	50718	192815	7173866	6753621
Greece	6772	2165	10373	55463	1177	47524	155453	621023
Hungary	8539	11249	70151	73930	4902	18021	139953	197819
Ireland	419	152452	738	12705	0	5906	251624	612169
Italy	29031	143759	27792	1019710	2092	346163	737793	4570317
Latvia	31333	27722	110	924	128575	110619	401974	343271
Lithuania	13499	15624	60	180	80110	81707	246609	222447
Luxembourg	1096	7118	468	2249	259	x	162285	221364
Malta	176	468	232	1012	138	474	9751	15460
Netherlands	22771	91271	4067	27099	86	2544	1284106	1735217
Poland	91519	20276	5047	4176	415330	167302	1358799	883480
Portugal	368	3280	411	45004	66	67230	168316	443055
Romania	7126	7757	19928	19036	53454	57648	133983	161597
Slovakia	8127	18957	1784	1641	2792	6226	21907	62584
Slovenia	1129	1791	189	758	301	1799	212458	253786
Spain	8567	135433	4616	948384	1242	124840	1173767	6604181
Sweden	76655	117131	14227	26393	694	11874	936022	1384929
UK	179143	978792	6892	149780	660	18092	3828790	7317000
Total all destinations	1313354	2946594	409402	2799553	858240	1491793	25509794	41614654

Notes: Instead of year 1995, year: 1996 for Ireland and Hungary, 1997 for Italy and Spain, 1998 for Belgium and Slovenia, 1999 for France, 2000 for Austria, Estonia and Luxembourg, 2001 for Bulgaria, Lithuania and Malta, 2002 for Cyprus, Poland and Romania, 2003 for Latvia. Instead of year 2010, year: 2009 for Belgium, Bulgaria, Romania and Spain, 2008 for France, Lithuania and Malta, and year 2006 for Greece.

The effects of immigrant inflows importantly depend on the skill composition of immigrant inflows. Although the data do not generally permit a detailed account of the variation in skill composition across destination countries, previous literature using micro-data indicates that migrants from the new EU member states appear to have been predominantly medium skilled, but with rather high proportions of high skilled individuals (Kahanec and Zimmermann, 2010; Brücker and Damelang, 2009). Brücker and Damelang (2009) report that the share of high skilled individuals was 27 percent among EU15 natives, 22 percent among EU8 immigrants, and 18 percent among EU2 immigrants. The corresponding figures for low-skilled migrants were 27, 17, and 29 percent. Although especially EU8 migrants appear to be relatively skilled, we should note that many of them worked in occupations below their level of formal education, which probably affected their impact on the labor market (Kahanec and Zimmermann, 2010). As for the cross-country variation, Holland et al. (2011) report that Luxembourg, Demark, Sweden, and Ireland exhibit the highest shares of high-skilled workers from the new member states, whereas Portugal, Spain, Belgium, Netherlands, and Finland disproportionally attracted their low-skilled colleagues. According to Kahanec

(2012) migrants from the EaP countries appear to have been the least educated of the three immigrant groups considered in this study, and have been similarly exposed to downskilling into lower skilled jobs.

4. Methodology

To determine the effects of immigration from new EU member states and from Eastern Partnership Countries on the receiving EU economies, we follow an aggregate production function framework, in part as in Peri (2012), Ottaviano and Peri (2012) and Docquier et al (2013). The starting point of our analyses is the Cobb-Douglas production function:

$$Y_{jt} = A_{jt} K_{jt}^{\alpha} L_{jt}^{1-\alpha} \quad (1)$$

Where *Y* represents the total output, *K* represents the physical capital input, *L* represents the labor input and *A* represents the total factor productivity. Parameter α represents the capital income share.[15] Subscripts *j* and *t* indicate destination country and year, respectively. We use a logarithmic transformation of derivatives over time, and the linear form of equation (1) can be then written as:

$$\ln Y_{jt} = \ln A_{jt} + \alpha \ln K_{jt} + (1-\alpha) L_{jt} \quad (2)$$

Borrowing elements of growth theory, this model suggests that the growth rate of total output depends on the growth rate of the physical capital, the growth rate of the labor input and also the growth rate of the total factor productivity.

Using equation (1) the average wage in country *c,* at time *t* can be calculated as the marginal product of labor as follows:

$$w_{jt} = \frac{dY_{jt}}{dL_{jt}} = A_{jt} \left(\frac{K_{jt}}{L_{jt}}\right)^{\alpha} (L_{jt})^{\alpha} \quad (3)$$

Using the same transformation as in the case of equation (2), it follows that the percentage change in average wages depends on total factor productivity, but also on the capital-labor ratio and the labor growth rates:

$$\ln w_{jt} = \ln y_{jt} = \ln A_{jt} + \alpha(\ln k_{jt} - \ln L_{jt}) \quad (4)$$

where $k_{jt} = \frac{K_{jt}}{L_{jt}}$, the capital to labor ratio and y_{jt} represents GDP per worker. Therefore, determining the effects that immigration has on wages and economic growth rate implies determining the effects it has on

[15] As a standard in the literature, we assume α = 0.33.

total employment, physical capital, total factor productivity and the capital to labor ratio. In other words, it implies estimating the following set of models:

$$\ln X_{jt} = D_t + \gamma \ln s_{jt} + \upsilon_j + \theta_t + \delta_r \theta_t + \varepsilon_{jt} \quad (5)$$

where *X* represents one of the following: *employment rate and labour force participation* (to account for the labor input), *capital services* and *capital to labor ratio* (to account for the capital input), *total factor productivity* (calculated as the Solow residual), *output per worker* (to account for the average wage) and *output per capita*. To capture other factors determining the economic outcomes of our interest that cannot be attributed to the changes in stock of foreigners per population, we account for country-specific time-invariant characteristics, represented by the term υ_j, time fixed effects θ_t, as well as time fixed effects interacted with region dummies[16] in our main specifications, $\delta_r \theta_t$. Finally, ε_{jt} represents the robust error term clustered by country. The explanatory variable of our interest is foreign population stock *S* from particular regions of origin relative to the total population *P* in destination country *j*, $s_{jt} = \frac{S_{jt}}{P_{jt}}$. Thus, the effects of immigration on the destination country economies are captured by coefficient γ.

We hypothesize that foreign population can affect the aggregate production of the receiving country. In particular we expect that, first, immigrants increase the total labor supply and may at the same time either crowd-out some natives or attract them into employment (especially if they provide jobs complementary to those of natives and stimulate productivity and specialization, or enable natives to enter the labor market by providing household services). We therefore estimate immigration's total effect on employment, which combines their direct contribution and the effect on native employment. Second, we expect immigration to affect investment, as marginal product of capital may be increased due to the increase in labour supply. In addition, depending on skill composition of immigrants, the effect on capital accumulation and capital intensity can be positive, as highly educated immigrants may work in more capital-intensive sectors, or may use capital-complementary techniques. On the other hand low–skilled immigrants can have a negative effect on capital, or leave it unaffected. Thus, the impact on capital accumulation and capital intensity in the short and long run depends on the composition of immigrants. Finally, immigrants may either give rise to crowding out effects given fixed factors of production (acting as substitutes) and/or they

[16] The region dummies are defined in the following matter: Western European country group contains Austria, Belgium, Germany, Luxembourg, the Netherlands, UK and Ireland; Southern European country group contains Italy, France, Spain, Portugal, Greece, Cyprus and Malta; Central and Eastern European country group contains the new EU 2004 and 2007 member countries excluding Malta and Cyprus; Nordic country group covers Denmark, Finland, Norway, Sweden and Iceland.

may add to the varieties of ideas and products in the receiving economy (acting as complements); depending on which effect prevails, this may result in higher or lower total factor productivity.

Identification

A methodological problem that arises for the models described above is the problem of simultaneity or reverse causality. It may well be the case that immigration rates are influenced by the dependent variables (low employment, low GDP may trigger migration flows), and not the other way around. To deal with the potential endogeneity problems, we apply the instrumental variable (IV) technique in our analyses, in which identification of causal effects rests on the instrumental variable. To qualify for a good instrument, a variable has to meet two conditions. First, it must be uncorrelated with the error term of the structural model and, second, it must be correlated with the endogenous variable.

As an instrument we use the predicted *foreign population rates*, using a model of determinants of bilateral migration in order to obtain predicted stocks of migrants. In our two-stage strategy, the first-stage model of migration determinants has the following form:

$$\ln s_{ijt} = \gamma_0 + \delta_{ij} + \lambda_i \theta_t + \varepsilon_{ijt}, \qquad (6)$$

where s_{ijt} stands for the share of foreign population originating from country *i* and living in country *j* at time *t.* On the right hand side we include an interaction of origin country fixed effects and time dummies, $\lambda_i \theta_t$, to account for any economic, demographic or social changes in origin countries in each year and a set of bilateral country-pair specific effects, δ_{ij}. Based on the model we predict foreign population stocks, which are then summed by each destination country and adjusted for the population size of each particular destination country. The resulting variable is used as an instrument for the structural equation in the second stage. Hence, for our identification strategy we assume that development in home countries represented by the interaction of the origin country dummies and time is uncorrelated with economic conditions in destination countries (with our dependent variables we use in the second step), and at the same time those push factors represent strong predictors of international migration (Adsera and Pytlikova, 2015; Palmer and Pytlikova, 2015).

5. Results

The results of our analyses of the effect of immigration on the EU15 and EU27 destination countries are presented in Tables 1 and 2, respectively. We report each model estimated by the OLS method with

country fixed effects and by the IV technique, which accounts for possible endogeneity of migration flows. The rows correspond to models with the *employment rate* and *labour force participation* (to account for the labor input), *capital services* and *capital to labor ratio* (to account for the capital input), *total factor productivity* (calculated as the Solow residual), *output per worker* (to account for the average wage) and *output per capita* as dependent variables. To account for possible differences across immigrant categories, as defined by their origins, we distinguish the results for foreigners stemming from the 2004 EU entrants, 2007 EU entrants, and EaP countries.

A number of notable results emerge. Whereas fixed-effects models generally produce insignificant results, relatively small, but negative and statistically significant, effects on GDP, GDP per capita, capital-to-labor ratio, and output per worker emerge for immigration from the EaP countries. Due to possible endogeneity of migration flows, our preferred specification is the IV model. In IV regressions, we observe statistically significant positive effect of immigration from the new EU countries on GDP and GDP per capita in the EU15 destination countries, whereas the coefficient to the immigrants coming from EaP is negative. The estimated effect on GDP per capita is quite large as the coefficients imply that 10 percent increase in the number of immigrants coming from the 2004 and 2007 EU member countries per destinations population increases the destinations GDP per capita by 0.3 and 0.55 percent, respectively. In contrast, 10 percent increase in share if immigrants coming from the EaP lowers GDP per capita in the EU15 countries by 0.13 percent. Whereas in the FE regressions there is some evidence that an increase in the shares of foreigners from new EU members states increases labor force participation (at 10% level of significance), in the 2SLS regressions the coefficients are no longer significant. The positive effect of immigration from new member states on the employment rates is documented in the 2SLS regressions; however, a small, but negative and statistically significant, coefficient emerges for immigrants from EaP countries.

No statistically significant results emerge in the IV models for the effects on total factor productivity. The same applies to the impacts on capital stock and capital-to-labor ratio for immigration from the new EU member states; however, for immigrants from the EaP countries a small negative effect on capital stock and a positive impact on capital-to-labor ratio emerge as statistically significant. Interestingly, the latter result contradicts the one found in the FE model, indicating that countries with increasing capital-to-labor ratio might be substituting capital for immigrant labor from the EaP countries. Finally, negative effects on output per worker are found for immigrants from new EU member states, but the corresponding results for those from EaP countries are insignificant.

In the next step, we run similar analyses using immigration to EU27 countries. It turns out that the results are generally very similar to those estimated for the EU15 countries, except that the coefficients are, as a

rule, estimated less precisely. This indicates that the results we observe are primarily driven by the EU15 countries. This is not surprising, given that immigration to the EU15 is considerably larger and has a longer history than migration flows to the rest of the EU

Table 1: Consequences of foreign population on production factors, productivity and factors per worker in the EU15 economies: yearly changes, FE and IV estimates. Period of analyses: 1995-2010.

To EU15	Effects of immigration from 2004 EU entrants					Effects of immigration from 2007 EU entrants					Effects of immigration from EaP countries				
Dep. Var.	FE		2SLS – FE			FE		2SLS – FE			FE		2SLS – FE		
		No of Obs		No of Obs	F-test		No of Obs		No of Obs	F-test		No of Obs		No of Obs	F-test
Log(GDP per Capita)	-0.001 (0.002)	225	0.03** (0.01)	183	7.88	-0.0021 (0.001)	225	0.055* (0.03)	183	11.08	-0.00486*** (0.00135)	225	-0.01302*** (0.00501)	161	11.39
Log(Total GDP)	-0.00073 (0.00343)	225	0.05290*** (0.01657)	183	7.88	-0.00108 (0.00181)	225	0.09195** (0.04367)	183	11.08	-0.00589*** (0.00173)	225	-0.01444** (0.00620)	161	11.39
Log(Labor force participation)	0.0005* (0.0003)	225	0.0005 (0.002)	183	7.88	0.0005* (0.0003)	225	0.0009 (0.003)	183	11.08	0.00049* (0.00027)	225	-0.00134 (0.00154)	161	11.39
Log (Employment rate)	-0.0004 (0.00105)	225	0.02*** (0.003)	183	7.88	-0.0002 (0.0006)	225	0.03*** (0.01)	183	11.08	-0.00061 (0.00056)	225	-0.00993*** (0.00348)	161	11.39
Log (Capital stock)	-0.00006 (0.0002)	225	-0.0001 (0.0006)	183	7.88	-0.00007 (0.00009)	225	-0.0003 (0.001)	183	11.08	-0.00002 (0.00009)	225	-0.00196*** (0.00063)	161	11.39
Log(Total factor productivity)	0.00004 (0.0004)	225	-0.004 (0.002)	183	7.88	0.00007 (0.0005)	225	-0.007 (0.006)	183	11.08	-0.00015 (0.00031)	225	-0.00247* (0.00143)	161	11.39
Log(Capital to labor ratio)	0.001 (0.003)	225	-0.017 (0.01)	183	7.88	0.001 (0.0016)	225	-0.018 (0.02)	183	11.08	-0.00389** (0.00153)	225	0.03296*** (0.01038)	161	11.39
Log(Output per worker)	-0.001 (0.002)	225	-0.03** (0.01)	183	7.88	-0.0022* (0.0012)	225	-0.06*** (0.02)	183	11.08	-0.00452*** (0.00113)	225	0.00544 (0.00574)	161	11.39

Notes: Each cell shows the coefficient from a different regression with the dependent variable described in the first cell of the row and the explanatory variable equal to the total flow of immigrants as a share of the initial population of the receiving country. All regressions includes year, country fixed effects and interaction of region dummy and time. Robust standard errors clustered by country are in parentheses. The 2SLS estimation method uses the predicted flow of immigrants from the gravity push factors as instruments, in particular we use (xi: xtreg lnflowstocks i.from*i.year, fe)model: ln(sijt)=a+b(country FE*year)+v(country FE); the predicted share of foreign population per destination population are then summed on the destination country level and used as an IV. ***,**,* imply significance at the 1, 5 and 10% level.

Table 2: Consequences of foreign population on production factors, productivity and factors per worker in the EU27 economies: yearly changes, FE and IV estimates. Period of analyses: 1995-2010.

To EU27	Effects of immigration from 2004 EU entrants					Effects of immigration from 2007 EU entrants					Effects of immigration from EaP group				
Dep. Var.	OLS-FE		2SLS – FE			OLS-FE		2SLS – FE			OLS-FE		2SLS – FE		
		No of Obs		No of Obs	F-test		No of Obs		No of Obs	F-test		No of Obs		No of Obs	F-test
Log(GDP per Capita)	0.002 (0.00261)	405	0.008 (0.02)	258	7.92	0.00007 (0.00202)	405	0.01 (0.04)	258	13.18	0.00055 (0.00248)	405	-0.01386*** (0.00512)	236	11.42
Log(Total GDP)	0.00181 (0.00264)	405	0.02920 (0.02474)	258	7.92	-0.00014 (0.00238)	405	0.04478 (0.04570)	258	13.18	-0.00079 (0.00250)	405	-0.01492** (0.00627)	236	11.46
Log(Labor force participation)	0.00009 (0.0003)	392	-0.0004 (0.003)	258	7.92	0.00012 (0.00026)	392	-0.0007 (0.00401)	258	13.18	0.00005 (0.00025)	392	-0.00092 (0.00159)	236	11.46
Log (Employment rate)	-0.0009 (0.00116)	405	0.009 (0.007)	258	7.92	-0.00120 (0.00151)	405	0.014 (0.01250)	258	13.18	-0.00098 (0.00120)	405	-0.01022*** (0.00353)	236	11.46
Log (Capital stock)	-0.00001 (0.0002)	399	-0.0005 (0.001)	254	8.13	-0.00006 (0.00016)	399	-0.0008 (0.001)	254	12.87	0.00004 (0.00020)	399	-0.00189*** (0.00062)	232	11.42
Log(Total factor productivity)	-0.0001 (0.0005)	383	-0.004 (0.005)	253	7.88	0.0001 (0.0005)	383	-0.007 (0.007)	253	13.27	-0.00022 (0.00046)	383	-0.00189 (0.00147)	231	11.42
Log(Capital to labor ratio)	0.006 (0.004)	399	-0.026 (0.02)	254	8.13	0.005 (0.003)	390	-0.04076 (0.02920)	254	12.87	0.00349 (0.00408)	390	0.03263*** (0.01046)	232	11.42
Log(Output per worker)	0.003 (0.002)	395	-0.04** (0.02)	258	7.92	0.0014 (0.003)	395	-0.06*** (0.02)	258	13.18	0.00153 (0.00252)	395	0.00515 (0.00580)	236	11.46

Notes: Each cell shows the coefficient from a separate regression with the dependent variable described in the first cell of the row and the explanatory variable equal to the total flow of immigrants as a share of the initial population of the receiving country. All regressions includes year, country fixed effects and interaction of region dummy and time. Robust standard errors clustered by country are in parentheses. The 2SLS estimation method uses the predicted flow of immigrants from the gravity push factors as instruments, in particular we use (xi: xtreg lnstocksperpop i.from*i.year, fe)model: ln(sijt)=a+b(country FE*year)+v(country FE); the predicted share of foreign population per destination population are then summed on the destination country level and used as an IV. ***,**,* imply significance at the 1, 5 and 10% level.

6. Conclusions

In this study we contribute to the literature on destination-country consequences of international migration. In particular we look at the effects of immigration from the new EU member states and Eastern Partnership countries on the EU – separately for old EU member states (EU15) and on the EU as a whole (EU27) – over the years 1995-2010. Taking into account possible reverse causality from economic indicators to migration flows, our results show positive and significant effects of post-enlargement migration flows from the new EU member states on GDP, GDP per capita, and employment rate and negative effect on output per worker. Regarding immigration from EaP countries, we find small but statistically significant negative effects on GDP, GDP per capita, employment rate, and capital stock, but a positive significant effect on capital-to-labor ratio, in EU countries.

Our results for intra-EU mobility are in line with the previous literature; complementing it by showing that the generally neutral-to-positive positive effects found at the micro level, or at various levels of aggregation, also show up at the macro, EU-wide, level, and for a number of, but not all, economic indicators. On the other hand, small negative effects are found for immigration from EaP origins. Further research is needed to better understand why EaP immigration differs from mobility from new EU member states. Besides the possibility that this difference emerges due to different composition of immigrant inflows from the two clusters of origins, an alternative hypothesis is that it is an artifact of different legal status of immigrants from new EU member states and those from EaP countries. One plausible explanation is that free labor mobility contributes to the positive effects of intra-EU migration on the receiving countries by enabling immigrants to allocate and integrate more efficiently. As a corollary, it may well be that legal barriers to immigration from the EaP and their integration hamper positive economic effects of their immigration.

These findings underscore the positive economic effects of intra-EU mobility as a pillar of economic efficiency of the single market in the EU, and provide an economic argument for eliminating, or at least reducing, barriers to labor mobility and immigrant integration. They also highlight the unfortunate gap between what hard data show about labor market impacts of migration on the one hand and public perceptions and beliefs about free mobility in the EU on the other hand, as also demonstrated by the public debates surrounding Brexit.

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Appendix

A.1 Data

Table A1: Country-Year Coverage migration flows

Columns: Destination Countries; Rows: Year

Cell: numbers of source countries, for which we have some observations of number of migrants for particular year

Dest	AUT	BEL	BGR	CYP	CZE	DEU	DNK	ESP	EST	FIN	FRA	GBR	GRC	HUN	IRL	ITA	LTU	LUX	LVA	MLT	NLD	POL	PRT	ROM	SVK	SVN	SE
Year																											
2010	190				135	193	203	113	212	183				144	208		204	141			194	124	148		212	209	194
2009	190	184			141	193	203	113	209	183		26		139	209	188	205	141	209		198	123	150		212	208	192
2008	190	182	207	209	143	194	203	113	208	183	120	21		142	208	187	204	146	207		195	205	143	75	212	207	192
2007	190	93	190	190	147	193	203	113	190	183	124	19	191	128	2	181	190	142	190	190	197	205	126		211	190	192
2006	190	96		190	142	193	202	108	190	183	120	34	190	133	2	182	190	139	191		193	205	128		208	190	192
2005	190	85		189	142	191	203	66	190	183	107	114		121	2	185	189	137	189		187	205	124		208	190	192
2004	190	71		189	146	191	203	57	190	183	107	109		108	2	183	189	135	189		193	205	118		208	190	192
2003	189	70		189	142	191	203	57		183	127	107		121	2	180	189	127	189		191	205	114		208	190	192
2002	189	70		187	141	191	203	57		183	128	99		110	2	182	188	123	187		198	205	126		208	188	192
2001	189	70		131	115	84	203	57		183	130	106		117	2	181	195	116	195	187	197	205	114		208	196	192
2000	189	70		195	110	83	203	59		183	129	111		118	2	182	195	124	195	131	197	205	113		208	196	192
1999	189	70			108	193	203	58	188	183	118	110		114	2	181	195	123	195	131	191	205	114		208	196	159
1998	189	70		131	122	193	203	59	188	183	117	116	188	114	2	182	195	120	188	131	191	16	144		208	196	166
1997	189	55			111	193	203	39		183	118	48	183	114	2	179		110			194	14	144		208	24	164
1996	189	55			114	193	203	58		183	118	52	205	116	2	178		108			191	14	144		208	24	167
1995		55			117	193	203	39		183	118	54	203	117	2	48		110			187	13	144				165
1994		55			106	193	203	39		183	118	27	205	119	2	32		103			186	13	144				164
1993		48			97	193	203	39		183		39	205	106	2	32		99			185	11	143				168
1992		48				189	203	45		183		45	205	111	2	32		105			174	11	143				157
1991		48				172	203	42		183		49	206	104	2	32		95			160	11					148
1990		48				44	203	42		183		38	200	102	2	32		100			163	10					144
	AUT	BEL	BGR	CYP	CZE	DEU	DNK	ESP	EST	FIN	FRA	GBR	GRC	HUN	IRL	ITA	LTU	LUX	LVA	MLT	NLD	POL	PRT	ROM	SVK	SVN	SE

Table A2: Country-Year Coverage foreign population stocks

Columns: Destination Countries; Rows: Year

Cell: numbers of source countries, for which we have some observations of number of migrants for particular year

Dest	AUT	BEL	BGR	CYP	CZE	DEU	DNK	ESP	EST	FIN	FRA	GBR	GRC	HUN	IRL	ITA	LTU	LUX	LVA	MLT	NLD	POL	PRT	ROM	SVK	SVN	SE
Year																											
2010	209				171	192	201			193		179		173	209	192		26	208		209	209	176		150	209	199
2009	209	185	208		172	190	201	112		191		171		180	208	190		26	207		207	209	177	196	145	208	199
2008	209	187	190		171	192	201	112		191	127	177		178		192	205	26	204	190	209		176	198	144	205	199
2007	209	178			168	193	200	112		191	128	174		174		188	205	26	205		207		179	196	142	204	199
2006	209	184			168	193	200	112		193	193	148	189	173	43	189	204	23	203		207		174		143	205	199
2005	209	182			166	139	201	112		193	204	97	191	165		189	204	23	203		208		173	195	138	205	199
2004	209	181			165	139	201	112		193		101	189	162		188	201	23	200		208		171	195	137	200	199
2003	209	181			163	138	201	112		193		100	190	156		188		23	203		207		167		149	200	199
2002	209	181		136	161	138	201	99		193		100		158	177	186		23			207	201	167	37	148	204	199
2001	207	181	189		163	138	201	99		193		97		154		187	201	12		190	206		166		142	205	199
2000	191	176			161	138	201	99	136	193		102	207	163		184		137			206		163		140	205	199
1999		174			164	138	201	99		193	162	87		163		185		12			204		157		136	205	111
1998		174			158	138	201	99		193		104		161		38		12			204		154		144	136	111
1997		55			152	138	201	99		193		100	189	159		189		12			204		151		144		111
1996		55			153	138	201	63		193		90	205	157	36	50		12			204		150		139		111
1995		55			150	138	201	58		193		85	205	146		50		12			200		150		140		111
1994		55			145	137	201	58		193		87	205			50		12			9		146				107
1993		48				137	201	58		193		87	205			50		12			9		139				104
1992		48				132	201	58		193		82	205			185		12			9		129				101
1991		48				117	201	58		193		70	205		2	184		12			9		125				98
1990	70	48				118	201	57		193	76		205					82			9		120				100
	AUT	BEL	BGR	CYP	CZE	DEU	DNK	ESP	EST	FIN	FRA	GBR	GRC	HUN	IRL	ITA	LTU	LUX	LVA	MLT	NLD	POL	PRT	ROM	SVK	SVN	SE

Table A3: Inflows of Foreign Population: Definitions and Sources

Migration flows to:	*Definition of "foreigner" based on*	*Source*
Austria	Citizenship	Population register, Statistik Austria (1997 to 2002), Wanderungsstatistik 1996-2001, Vienna
Belgium	Citizenship	Population register. Institut National de Statistique.
Bulgaria	Citizenship	Eurostat.
Cyprus	Citizenship	Eurostat.
Czech Rep.	Citizenship	Permanent residence permit and long-term visa, Population register, Czech Statistical Office
Denmark	Citizenship	Population register. Danmarks Statistics
Estonia	Citizenship	Eurostat
Finland	Citizenship	Population register. Finish central statistical office
France	Citizenship	Statistics on long-term migration produced by the 'Institut national d'études démographiques (INED)' on the base on residence permit data (validity at least 1 year) transmitted by the Ministry of Interior.
Germany	Citizenship	Population register. Statistisches Bundesamt
Greece	Citizenship	Labour force survey. National Statistical Service of Greece 2006-2007 Eurostat
Hungary	Citizenship	Residence permits, National Hungary statistical office.
Ireland	Country of Birth	Labour Force Survey. Central Statistical Office. Very aggregate, only very few individual origins.
Italy	Citizenship	Residence Permits. ISTAT
Latvia	Citizenship	Eurostat
Lithuania	Citizenship	Eurostat
Luxembourg	Citizenship	Population register, Statistical Office Luxembourg
Malta	Citizenship	Eurostat.
Netherlands	Country of Birth	Population register, CBS
Poland	Country of Origin	Administrative systems (PESEL, POBYT), statistical surveys (LFS, EU-SILC, Population censuses). Central Statistical Office of Poland
Portugal	Citizenship	Residence Permit, Ministry of Interior.
Romania	Citizenship	Eurostat.
Slovak rep.	Country of Origin	Permanent residence permit and long-term visa, Slovak Statistical Office
Slovenia	Citizenship	Data for 1996-1997 taken from UN migration data. 1998 – 2009 Eurostat.
Spain	Country of Origin	Residence Permit, Ministry of Interior
Sweden	Citizenship	Population register, Statistics Sweden
United Kingdom	Citizenship	Residence permits for at least 12 months. IPS - office for national statistics, and EUROSTAT

Table A4: Stocks of Foreign Population: Definitions and Sources

Foreign population stock in:	Definition of "foreigner" based on	Source
Austria	Country of birth	Statistics Austria, Population Census 2001 and Population Register 2001 to 2009. For census year 1981 and 1991 definition by citizenship
Belgium	Citizenship	Population register. Institut National de Statistique
Bulgaria	Citizenship	Eurostat.
Cyprus	Country of birth	Eurostat.
Czech Rep.	Citizenship	Permanent residence permit and long-term visa, Population register, Czech Statistical Office and Directorate of Alien and Border Police
Denmark	Country of origin	Population register. Danmarks Statistics
Estonia	Country of birth	Eurostat
Finland	Country of birth	Population register. Finish central statistical office
France	Country of birth	Census. Residence permit. Office des migrations internationals.
Germany	Citizenship	Population register. Statistisches Bundesamt
Greece	Citizenship	Labour force survey. National Statistical Service of Greece.
Hungary	Citizenship	National Hungary statistical office
Ireland	Country of birth	Censuses, Statistical office, Ireland
Italy	Citizenship	Residence Permits. ISTAT
Latvia	Country of birth	Eurostat
Lithuania	Country of birth	Eurostat
Luxembourg	Citizenship	Population register, Statistical office Luxembourg
Malta	Citizenship	Eurostat.
Netherlands	Citizenship	Population register, CBS
Poland	Country of birth	2002 Census, rest permits, Statistics Poland
Portugal	Citizenship	Residence Permit, Ministry of Interior, www.ine.pt
Romania	Country of birth	Eurostat.
Slovak Republic	Country of Origin	Permanent residence permit and long-term visa, Slovak Statistical Office
Slovenia	Country of birth	Eurostat.
Spain	1985-1995 Citizenship 1996-2009 Country of birth	Residence Permit, Ministry of Interior
Sweden	Country of Birth	Population register, Statistics Sweden
United Kingdom	Country of Birth	LFS, UK statistical office

Appendix A2: Descriptive statistics, variable definitions and sources

Table A5: Descriptive statistics, definitions and sources

Indicator	Definition	Source	Obs	Mean	Std. Dev.	Min	Max
Foreign population stocks from the new EU2004 member states	Foreign population stocks from the new 2004 EU source country group living in a particular destination country	Own calculation on the data collected, see Adsera and Pytlikova, 2015	340	78908	152546	191	1074037
Foreign population stocks from the new EU2007 member states	Foreign population stocks from the new 2007 EU source country group living in a particular destination country	Own calculation on the data collected, see Adsera and Pytlikova, 2015	336	35142	72359	65	553288
Foreign population stocks from EaP countries	Foreign population stocks from EaP source country group living in a particular destination country	Own calculation on the data collected, see Adsera and Pytlikova, 2015	294	35806	73251	2	447868
Population	Total population is based on the de facto definition of population, which counts all residents regardless of legal status or citizenship—except for refugees not permanently settled in the country of asylum, who are generally considered part of the population of their country of origin.(in thousands)	WDI, World Bank	540	17900000	22100000	360000	82500000
GDP per capita	GDP per capita (constant 1995 international $), PPP: GDP per capita is gross domestic product divided by midyear population. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data are in constant international dollars.	WDI, World Bank	540	22525.2	11076.8	5867.6	74421.6
Unemployment rate	The share of the labor force that is without work but available for and seeking employment.	WDI, World Bank	493	8.53352	4.1763	.6	23.88304
Labor force participation	Labor force participation rate is the proportion of population ages 15 and older that is economically active: all people that supply labor for the production of goods and services during a specified period.	WDI, World Bank	540	57.66444	5.280597	46.6	69.2
Capital services	Capital services represent the flow of productive services from the cumulative stock of past investments (Schreyer P et al, 2003)	Own calculations based on data from WDI, World Bank	487	73397.17	44262.25	5588.37	265967

Online Appendix A3: Construction of the variables needed for the analyses (not intended for publication)

Total employment

As standard in previous literature, we calculate total employment as:

$$total\ employment = (1 - unemployment) * \ labor\ force \quad (1)$$

Where *unemployment* is defined as a percentage of total labor force. Data on unemployment and labor force have been both collected from the WDI, World Bank.

Capital stock and the perpetual inventory method

It has been argued in the literature that gross capital stocks are an intermediate step towards the calculation of productive capital stocks, which is a good proxy for the capital services (see e.g. Schreyer et al, 2003). Capital services are often used in production and productivity estimations. The capital stock calculated using the perpetual inventory method can be considered a special case of productive stocks, where the efficiency depreciation of the assets is considered constant during its life cycle.

Capital services represent "*the flow of productive services from the cumulative stock of past investments*" (Schreyer et al 2003). This concept can be applied for any type of asset and it must be thought of as a quantitative measure. In practice, it is very hard to compute the capital services offered by the assets owned by a company or other entities because these services are not directly observed. The gross capital stock offers information on the stock owned by an entity and it can be assumed (similarly as e.g. Dettori et al, 2008; Ortega and Peri, 2009; Young, 1995) that the capital stock is proportional to the capital services of the assets, after it has been transformed in 'productive' units, creating the *productive stock of capital.* Therefore, the productive services are considered to be proportional with the productive stocks. The difficulty in calculating the productive services and productive stock is strictly related with the difficulty of calculating elements such as: depreciation and the decay (efficiency decline), age-price and age-efficiency patterns and of course, the retirement pattern of the assets. This information is different from firm to firm and from country to country, and firms are not required to record it in their accounting, therefore, even if managers and suppliers usually joggle with these values every day, they are not specifically quantified. Information on the age-price and age-efficiency (they can sometimes coincide) is very hard to find and can be deducted from special surveys or can be estimated econometrically. There are, of course, attempts to do so but the results are to be used with caution because age-efficiency and age-price profiles can be computed only for products that have a second hand market (Schreyer et al, 2003). Another way of calculating them is by attributing them random variable's distributions. The most commonly used are the

hyperbolic distribution, the linear distribution or the geometrical pattern. The latter is the one used in the perpetual inventory method, which we use to calculate capital stocks for our analyses. Here, the capital stock can be considered a special case of productive stocks, where the efficiency of the assets is considered constant during the whole life span. For this paper, the capital stock has been calculated from the aggregated capital, at country level.

The perpetual inventory method

In this paper we use the perpetual inventory method to calculate the capital stocks. In its simplest form, it uses information on gross fixed capital formation and depreciation rates as follows:

$$K_t = K_{t-1} \cdot (1 - \delta) + I_t \qquad \text{(A1)}$$

Where *K* represents the capital stock, *t* indicates time, δ denotes the depreciation rate and *I* represents the investment (gross fixed capital formation).

The only part missing from equation (A1) is the initial capital stock. The initial capital stock is calculated using the formula (Young, 1995):

$$K_0 = \frac{I_0}{(gr_{rate} + \delta)} \qquad \text{(A2)}$$

Where, I_0 represents the initial investment, gr_{rate} represents the growth rate of the investment and δ denotes the depreciation rate. In an ideal case, the initial investment rate would be extracted from national accounts or calculated using specialized surveys. For this paper, the initial investment has been calculated as the gross fixed capital formation in 1975 (five years before the start year of the dataset) or the first year available for the countries where there was no data available in 1980, similarly as in Young, (1995) and Dettori et al. (2008). The growth rate has been calculated as the average growth rate of gross fixed capital formation from the initial five years of the available data or as the average growth rate from 1980-1984.

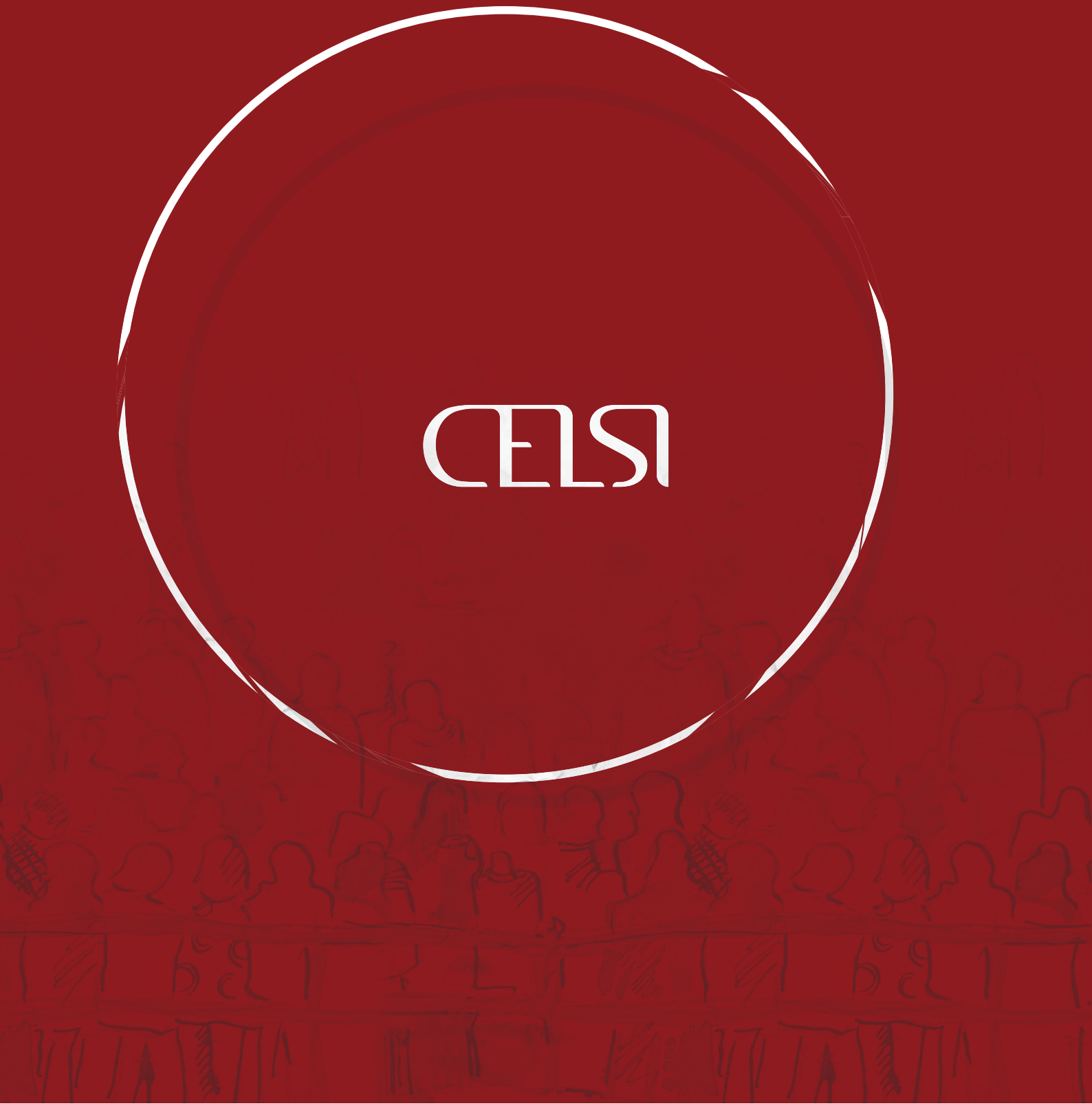
As mentioned earlier, depreciation rates are hard to estimate because each company and each country has its own measures. There is no country-average depreciation rate available for aggregated capital rates. Following others, we use a constant geometrical depreciation rate of 10% and we assume that an aggregated capital stock depreciation rate of 10% would be very close to the average depreciation rate used by statistical institutes.

Total factor productivity

We calculated the total factor productivity (TFP) using the Solow model given the aggregate nature of our data. Starting from a Cobb-Douglas production function and assuming constant returns to scale, the TFP is extracted from the following equation:

$$y_{\mathrm{jt}} = \varphi_{\mathrm{j}} + \beta_1 \cdot (1 - \delta) \cdot k_{\mathrm{jt}} + \beta_2 \cdot \delta \cdot l_{\mathrm{jt}} \qquad \text{(A3)}$$

where y_{jt} represents the output in year *t* for country *j*, and *k* and *l* represent the inputs of the Cobb-Douglas function, capital stock (as capital input) and the labor force (as labor input), respectively. The term of interest in this case is φ_{j}, which represents the total factor productivity. All variables are in natural logarithms. δ represents the share of labor input and has been considered similarly as in other studies to be 0.66. Similarly to Young (1995), we apply first differences of the model. First differentiating the logarithmic form is similar to using growth rates of the variables and accounts for the causes of growth for the total output. By using this method, the residual incorporates any productivity increase of the input factors because in growth accounting, the input contribution to growth is considered constant.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