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Labour mobility and labour market adjustment in the EU*

Alfonso Arpaia, Aron Kiss, Balazs Palvolgyi, Alessandro Turrini**

Abstract

This paper assesses the role of labour mobility in the EU as an adjustment mechanism. It presents stylised facts on mobility and migration at national and sub-national level, analyses the determinants of mobility flows by means of gravity equations, and studies the dynamic response of mobility to asymmetric demand shocks by means of vector auto regression (VAR) analysis in the vein of Blanchard and Katz (1992). It is found that EU membership increases mobility significantly. Membership in the euro area, while not raising the magnitude of mobility flows per se, is associated with a stronger reaction of labour mobility to unemployment differences across countries. The dynamics of labour mobility in response to asymmetric demand shocks is analysed on country-level data on a panel of EU countries. Results indicate that mobility absorbs about a quarter of the shock within 1 year and about 60 per cent after 10 years. The analysis also shows that the response of migration to shocks has been growing over time, becoming almost twice as important after EMU completion. A version of the VAR model allowing for the analysis of the response of wages indicates that the response of real wages to asymmetric demand shocks has also increased after EMU.

JEL Classification: J61; J64.

Keywords: Labour mobility; geographic mobility; migration; gravity; adjustment; asymmetric shocks; optimal currency areas.

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1. INTRODUCTION

This paper aims at assessing the role of labour mobility in macroeconomic adjustment in the EU in light of the experience of the crisis.

Labour mobility received attention in the early debate on the Economic and Monetary Union (EMU). It was stressed that the reduced room for absorbing asymmetric shocks via macroeconomic policy tools in a monetary union required a sufficient degree of labour mobility as an alternative adjustment channel. Empirical analysis revealed that, as compared with other monetary unions, notably the US, EU countries participating in EMU did not exhibit a comparable degree of mobility, and mobility played a minor role in the process of adjustment (Blanchard and Katz, 1992; Decressin and Fatás, 1995). Several years has passed since the outburst of the financial crisis, and there is growing attention to the potential contribution of labour mobility to counteract the divergence in growth and unemployment among EU countries and particularly within the euro area.

The financial crisis and the ensuing current account and debt crises in the euro area acted as persistent macroeconomic shocks with asymmetric effects, radically changing the landscape of the euro area. The convergence in income per capita observed during the first decade of EMU was to a large extent reversed. Countries in the euro-area periphery witnessed capital flights, a protracted contraction in domestic demand amid deleveraging, and a marked deterioration in public finances. The rebalancing process involving an adjustment in relative costs and prices between net debtor and net creditor members of the euro area is a necessary condition for a durable reduction of external macroeconomic imbalances and the narrowing of unemployment divergences. Such a process, however, can be long-lasting and marked by considerable distress in the countries enduring competitive internal devaluation and high and protracted unemployment.

Against this background, having conditions in place that do not restrict labour mobility would help easing adjustment: it would permit a more moderate reaction of activity rates and part of the divergence in unemployment rates would be absorbed by mobility rather than real wages.

The paper starts out by assessing main stylised facts and trends regarding mobility in EU countries. Cross-country mobility flows in the EU appear to remain considerably lower as compared with those recorded in other highly integrated areas, most notably the United States, and well below mobility within countries. Moreover, the stock of migrants from outside the EU is well above that from other EU countries in most EU Member States. Nevertheless, cross-EU mobility is on an upward trend, and not only in light of the enlargement of the EU to Eastern European countries with high outward migration rates.

The analysis then focuses on the determinants of mobility flows by means of 'gravity equations', which link gross mobility flows to the characteristics of origin and destination countries, their distance, and other variables capturing mobility costs. Previous analyses of migration by means of gravity equations mostly focused on long-term economic determinants of migration flows (e.g., Lewer and Van den Berg, 2008; Mayda, 2010; Ortega and Peri, 2013).. As compared with existing analyses, a step forward is made in this study to assess the role played by EU governance and its interaction with labour market developments in driving mobility flows. Additionally, the estimation of gravity equations allows the assessment of whether actual mobility trends deviate from what would be predicted on the basis of fundamentals. It is found that mutual EU membership raises mobility significantly. In contrast, while mutual membership in the euro area does not affect the magnitude of mobility flows by itself, it increases the response of mobility to relative unemployment rates. This suggests that, within the euro area, labour mobility performs the role of an adjustment channel to asymmetric shocks to a greater extent.

The next step in the analysis consists of assessing the dynamic response of labour mobility to asymmetric labour demand shocks. To that purpose, a Vector Auto Regressive (VAR) model in the spirit of Blanchard and Katz (1992) is estimated for a panel of EU countries. The aim is that of assessing simultaneously the co-movement of relative unemployment, inactivity rates and labour mobility in response to shocks to relative labour demand. As compared with recent analyses (e.g., Dao et al., 2014; Beyer and Smets, 2014) the focus is on mobility across countries rather than

across regions, to keep the analysis close to the type of adjustment that matters in response to shocks that are largely country-specific, and to permit the analysis to explore also the behaviour of relative real wages in response to shocks, as this is a key variable to allow the adjustment of relative unemployment rates. Results indicate that labour mobility absorbs about 25 per cent of asymmetric shocks after one year and more than 60 per cent at peak, i.e., after about 10 years. It is shown also that the response of mobility, as well as that of real wages, has increased after monetary unification. At peak, the response of mobility for the post EMU sample is about twice as large as that for the pre-EMU sample.

The focus of the paper is on labour mobility within the EU. However, depending on the context of the analysis, disentangling whether mobility takes place fully within the EU or the euro area or also with third countries could be problematic in terms of data availability. Such a distinction, although relevant from the perspective of the smooth working of the monetary union, it is seldom pursued in analogous analysis, partly because of the lack of sufficiently long and complete time series, partly because what is relevant from the viewpoint of the adjustment for the single country is the response of labour mobility to shocks, irrespective whether mobility flows take place with another member of the monetary union. In the rest of the paper, the terms "mobility" and "migration" will be used interchangeably, although in the EU policy context, the former term refers to cross-country mobility within the EU and the latter to mobility between EU and non-EU countries.

The remainder of the paper is organised as follows. In the next section the case for labour mobility as an adjustment channel is presented. The third section presents a number of stylised facts regarding labour mobility in the EU. Section 4 analyses the determinants of mobility flows by means of gravity equations. Section 5 is devoted to the analysis of the dynamic response of labour mobility to country-specific shocks. Section 6 concludes.

2. LABOUR MOBILITY AS AN ADJUSTMENT CHANNEL

Since the onset of the monetary union, labour mobility within the EU attracted attention in the academic and policy debate. In particular, in the early debate on EMU it was stressed that the relatively low degree of labour mobility among EU countries would be a weakness of the forthcoming monetary union. The loss of exchange rate flexibility and an independent monetary policy would require alternative channels of adjustment in the presence of asymmetric shocks. Countries hit by persistent negative idiosyncratic shocks would face high unemployment for protracted periods. Avoiding the economic and social costs linked to persistently diverging unemployment would require a sufficient degree of flexibility in wages or a sufficiently mobile labour force. These were seen among the conditions for the EMU countries to be part of an "optimal currency area".

The low degree of labour mobility across EU countries as compared with US States can be linked to language and cultural differences, largely heterogeneous policy contexts, notably concerning the labour market, fiscal and social welfare policies. Some reasons underlying reduced labour mobility within Europe were considered to be linked to persisting legal and administrative barriers to the Single Market ensuing notably from limited portability of welfare rights, recognition of qualifications, access to regulated professions. Despite being a relevant adjustment channel, there are limits to what labour mobility can achieve in terms of shock absorption and there are costs that need not be neglected.

The strongest case in favour of adjustment taking place via labour mobility is one with persistent asymmetric labour demand shocks and persistent unemployment, notably linked to real wage rigidity. In such a context, asymmetric shocks translate into diverging unemployment rates for a prolonged period, and labour mobility is likely to result in a win-win situation with reduced overall unemployment and a relatively limited impact on the economic situation of the rest of the population in both the source and the destination country. It is well-known instead, that under fully flexible wages migration is likely to bring aggregate gains, but with redistribution in favour of source country workers and against destination country workers,

which see their earnings reduced in light of an increased supply of labour (e.g., Borjas, 1999). Moreover, migration in case of short-lived, temporary shocks may not be justified, as national automatic stabilisers and safety nets could be sufficient to deal with temporary unemployment.

It should also be added that the effects of labour mobility go beyond those considered in standard, simplified, static models of international economics. In particular, from the viewpoint of the source country, the migration of skilled labour and the consequent phenomenon of "brain drain" may imply reduced TFP and income growth rates over time (Commander et al., 2004). Moreover, in presence of large differences in tax and welfare policies across countries, migration could entail additional redistribution effects via the public budget, and the implications of government debt for future generations could be exacerbated by large-scale outward migration.

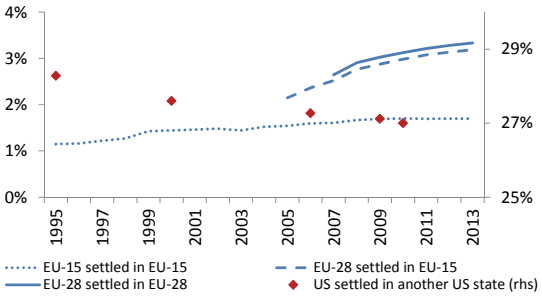
Finally, there is ample evidence showing that individual perceptions and attitudes towards migration tend to be more negative than justified on the basis of economic outcomes only, which constitutes an additional limit to what labour mobility can achieve by itself as a channel of adjustment to asymmetric shocks (e.g., Mayda, 2006).

3. LABOUR MOBILITY IN THE EU: STYLISED FACTS

3.1. Trends in cross-country mobility after EMU and enlargement

Mobility across the EU has been increasing over the past two decades, as measured by the share of EU population born in a different EU country (Graph 1). The increase is particularly evident when looking at data for the post-enlargement EU (available for relatively recent years only). Mobility rates are higher across the enlarged EU, and have been on an upward trend since the mid-2000s. This is mostly the result of large and growing flows from countries of new accession, notably Eastern European countries. However, growing mobility is not only from the East to the West.

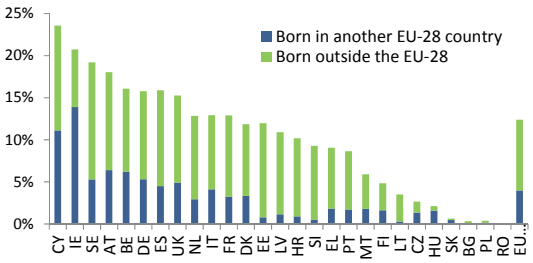
Graph 1: **Share of EU working age population born in other EU countries, and share of US population born in a different US state**



(1) All three EU series are expressed as a percentage of EU-28 working age population.
(2) Data for the EU series excludes Germany, since no time series is available about the breakdown of foreigners living in Germany by origin country.
Source: Eurostat population statistics and Eurostat special extraction from the Eurostat Labour Force Survey; US Census Bureau, Census and American Community Survey.

Mobility among the countries that were Members of the EU before the 2004 enlargement also exhibit a positive, albeit moderate, trend over the past two decades. Conversely, over the same period, mobility within the US appears to be on a downward trend from a much higher level. ([1])

Graph 2: **Share of working-age population born in other countries, 2013**

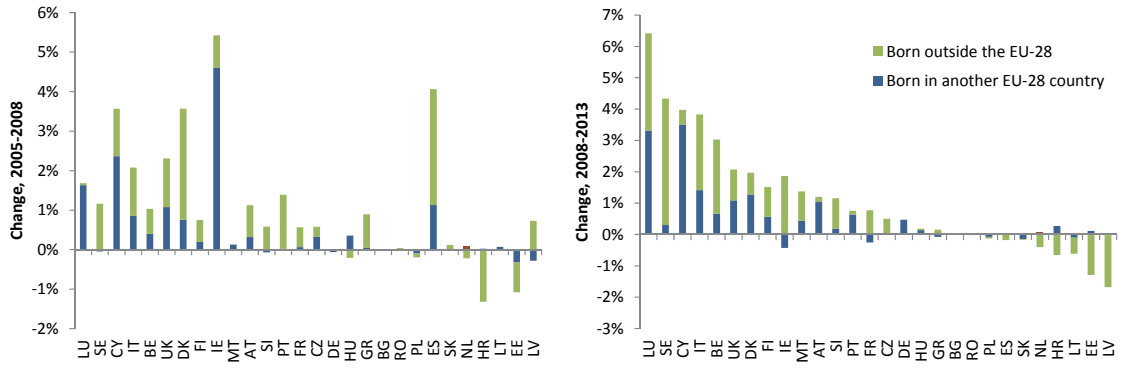


(1) Luxembourg was omitted to improve visibility. In Luxembourg, 38% of the population was born in another EU-28 country, and 9% was born outside the EU-28.
Source: Eurostat for DE and EU-28, for others calculations based on a Eurostat special extraction from the European Labour Force Survey.

Despite this rising trend, mobility across EU Member States remains lower as compared to other world regions, most notably the US (OECD, 2012). In 2013, about 4% of working-age EU citizens lived in a different EU country than where

([1]) Recent surveys of EU mobility trends include European Commission (2014a, pp. 282-286; 2014b) and Barslund and Busse (2014).

Graph 3: **Change in the share of working-age population born abroad, before and during the crisis**



(1) For BG, DE and IE, 2006 instead of 2005. For DE, the value is for all foreigners, no breakdown available. Countries are ranked according to change 2008-2013.
Source: Own calculations based on a Eurostat special extraction from LFS.

they were born (Graph 2). In the US, as a comparison, about 30% of the working age population lives in a state different from their state of birth. ([2]) Intra-EU mobility is relatively low also when compared to migration from outside the EU. ([3])

The share of intra-EU migrants in the working-age population is about half of the share of migrants born outside the EU (8.4%). ([4]) Within-EU labour mobility appears somewhat higher if cross-border workers are taken into account: there are about 1.1 million EU citizens who work in another EU country but do not reside there. In addition, there are about 1.2 million posted workers, who were working for their home companies in another Member State for a limited period of time.

There are considerable differences in the size and composition of the foreign born population across EU Member States, with however some regularities that are worth noticing (Graph 2). First, the share of foreign-born population is in general lower in New Member States. In 2013, this share exceeded 12% in 12 out of the 15 "old" Member States, while it remained below 12% in 12 out of the 13 New Member States. Second, in most countries the share of population born outside the EU exceeds the share of population born in other EU countries.

Recent developments in the share of foreign-born population also show great differences across countries (Graph 3). ([5]) It appears that in general the weight of intra-EU mobility is higher in recent migration flows as compared to stock data (compare with Graph 2). Inward migration flows were generally stronger in "old" Member States both before and after the crisis, but some changes took place with the crisis. The countries where the stock of migrants grew most before the crisis included countries on the euro area periphery like Ireland and Spain. In light of the crisis, in these same countries inflows adjusted downward to a large extent, while the stock of foreign-born population fell substantially in the Baltic countries.

Absolute (as opposed to relative) net migration flows are shown in Graph 4. Not surprisingly, the biggest flows in absolute terms are observed most populous Member States. The graph also confirms that net migration flows varied greatly through time in a number of Member States. In a number of EU countries such as the UK, Italy, Spain, net inward flows grew since the nineties, peaked at mid-2000s and fell after the crisis. Net migration

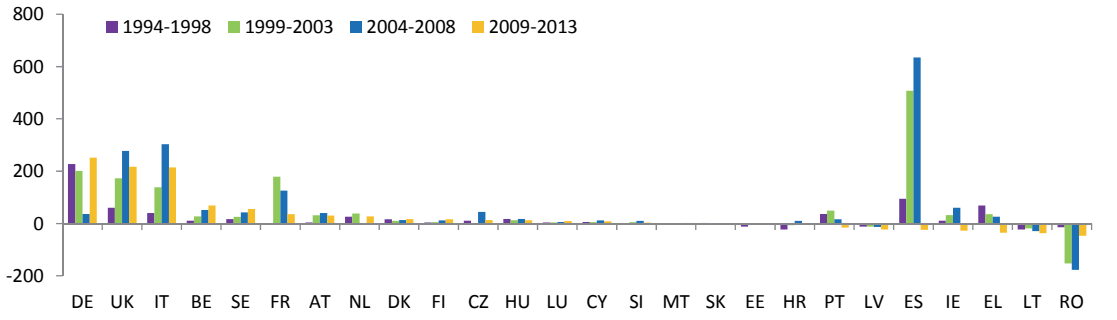
([2]) Own calculations based on 2010 data of the U.S. Census Bureau (2011). Comparable recent figures and historical data for the U.S. have been published by Molloy et al. (2011).

([3]) Survey evidence also indicates that the actual number of mobile Europeans is only a tiny fraction of those who would consider working abroad (e.g. in European Commission, 2013).

([4]) In the US, the population share of working age people born outside the US is 16%, or about half the share of people who moved from one state to another (own calculations based on Pew Research Center's (2012) tabulation of the 2010 U.S. Census).

([5]) Data, based on the EU Labour Force Survey, that allows a differentiation between EU and non-EU migrants, go back to 2005 (see also Box 1 on data sources).

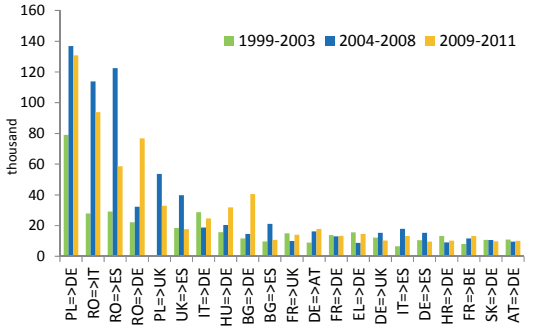
Graph 4: **Average annual net migration flows (thousand)**



(1) Bulgaria and Poland have been omitted as the size of reported flows were consistently below what is suggested by other data sources.
(2) Countries are ordered according to net migration in the latest period 2009-2013.
Source: Eurostat population statistics, own calculations.

flows turned from positive to negative after the financial crisis in countries severely hit by current account and debt crises, such as Spain, Greece, Ireland and Portugal. In a number of Eastern EU countries, notably Romania and the Baltics, net migration flows were generally negative since mid-1990s.

Graph 5: **Average gross bilateral flows exceeding 10,000 over the period 1999-2011, within EU-28**



(1) The results may be affected by data availability and differing data collection methodologies applied by different countries.
(2) Bilateral relations are ordered according to the overall period average.
Source: OECD International Migration Database, own calculations.

Data on gross bilateral migration flows allow a more disaggregated look at the patterns of European mobility. ([6]) Graph 5 shows the largest absolute bilateral mobility flows observed in the data: all bilateral flows that average above ten thousand individuals over the observed period. A number of observations are in order:

- Most of the large absolute bilateral flows involve large countries. Germany is the most frequent destination country in the list, but it also features as the origin country in three bilateral relationships.

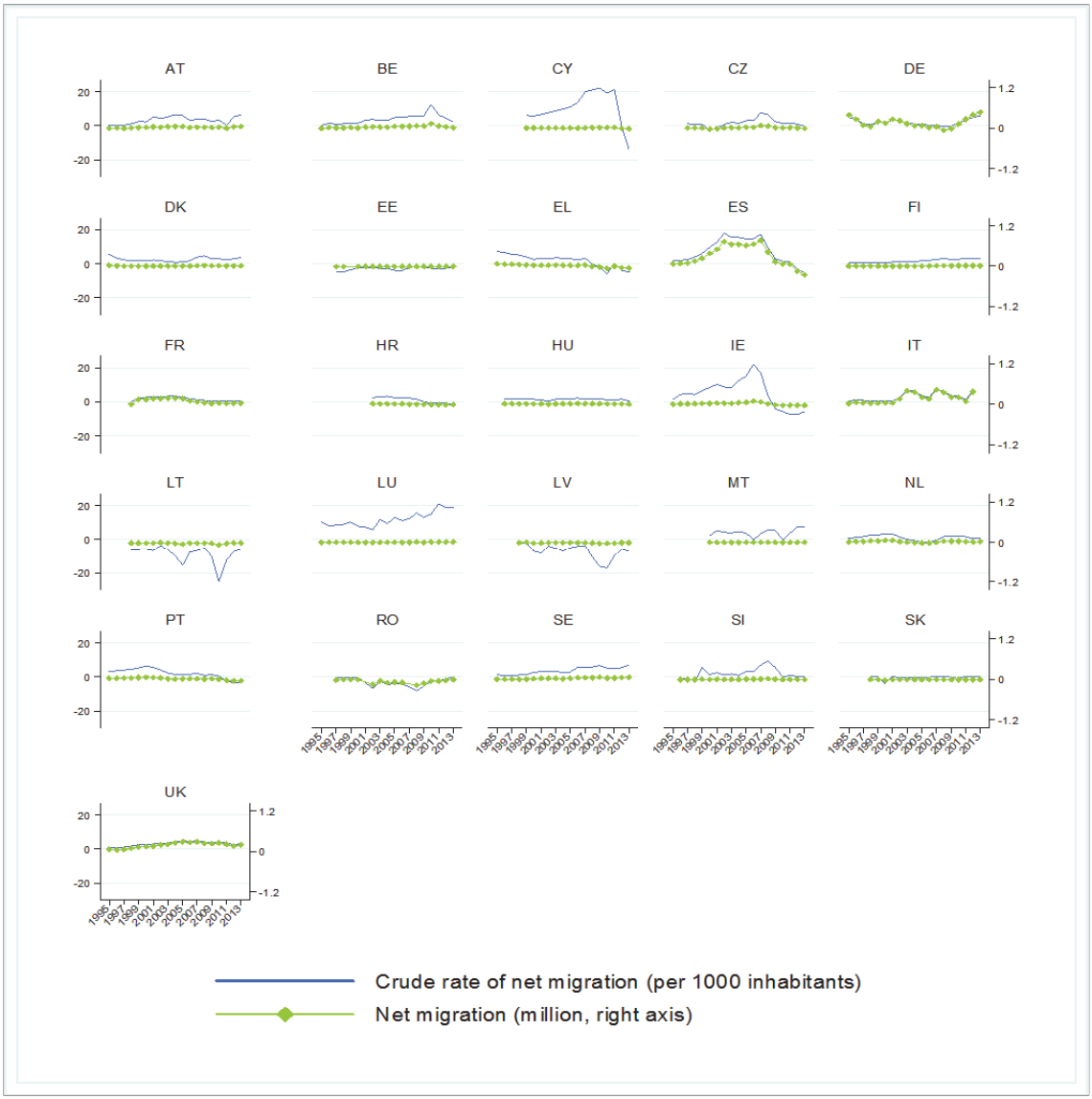
- About half of the largest absolute gross bilateral flows, and notably the five largest ones, concerned pair of countries including a new Member State.

- The other half of the largest absolute gross bilateral migration flows are among two old Member States. These include flows from the "South" to the "North" (from Italy and Greece to Germany), from the "North" to the "South" (from the UK and Germany to Spain), within the "South" (from Italy to Spain) and six bilateral relationships within the "North" (from France to Belgium, Germany and the UK, from Germany to Austria and the UK, and from Austria to Germany).

- The aggregate time pattern of migration flows to different countries is reflected also in bilateral relationships: in particular, large bilateral flows to Spain peaked in the pre-crisis period, while large bilateral flows to Germany increased in the post-crisis period.

([6]) Gross bilateral migration flows are taken from OECD's International Migration Dataset (see Box 1 on data sources). The results shown in the following graphs may depend on data availability, as data availability is uneven across bilateral relationships.

Graph 6: **Relative and absolute net migration, 1995-2013.**



(1) Statistics on net migration include statistical adjustment by national statistical offices. The results may be affected by differing data collection methodologies applied by different countries.
(2) Bulgaria and Poland have been omitted as the size of reported flows was consistently below what is suggested by other data sources. Outliers in the data for Estonia, Italy and Romania have been removed.
Source: Eurostat population statistics.

Graph 6 provides a detailed time profile of absolute and relative annual net migration by destination country. The graph confirms that countries that were greatly affected by current account reversals and the debt crisis saw a rapid reduction in net migration. It is also visible that this did not happen in a parallel fashion in all affected countries: the decrease occurred more rapidly in Ireland than in Spain, and it occurred in Cyprus only after 2011, reflecting broader economic developments.

Net migration was negative before the crisis In Latvia and Lithuania; it fell further and considerably in the first years of the crisis and bounced back in the latest years.

Box 1: Data sources on migration

A number of data sources on migration statistics are available for EU countries, with different sources providing insights on different aspects of migration. Below a description is provided of the main features of the statistical sources used in the present analysis.

Eurostat population statistics

Eurostat data on net migration plus statistical adjustment give a snapshot of migration balances. Net migration flows are constructed as the difference between the total population change and the estimated 'natural population change' (i.e., the change due to natality and mortality). Such flows, expressed as shares of population are named crude rate of net migration. The advantage of these net migration flows is that they are available for most countries in long time series. The statistic is available also at regional (including NUTS2) level. The main shortcoming is that these flows are affected by inaccuracies in the estimation of population change, as underlying administrative registers are not always up-to-date. Statistical adjustments, including census-related population revisions, lead to outliers and breaks in the series in some instances. Since this indicator is calculated on a residual basis, it does not allow the identification of actual inflows and outflows, or their composition.

Comprehensive statistics on population by citizenship and country of birth are made available by Eurostat since 2008. The data sources are administrative records or national surveys. The advantage of these statistics is that they capture migration directly, rather than on a residual basis. Such statistics also allow for a breakdown by sex, age. However, shortcomings may be related to imperfect comparability of administrative data and lack of compliance of migrants to register or deregister as residents.

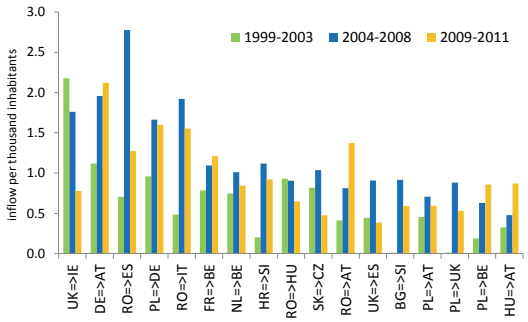
Eurostat Labour Force Survey

The Eurostat Labour Force Survey (LFS) is a standardised survey primarily aiming at assessing employment and unemployment in the EU. Harmonised data, allowing assessment of EU27 mobility, are available in general starting 2005. As the survey asks questions about recent changes of residence, the data provides an estimate of recent sub-national and international migration movements. It also allows researchers to analyse the age profile and labour market status of migrants. Its shortcomings are those of surveys in general: migrants, among other vulnerable groups, may be underrepresented in the sample partly due to a higher non-response rate. As a result, mobility flows implied by LFS are usually lower than those implied by Eurostat population statistics. Also, not all statistical breakdowns are available for all countries. A somewhat more detailed discussion of European data sources and, in particular, of the EU LFS is provided by European Commission (2012, p. 282-283).

OECD International Migration Database

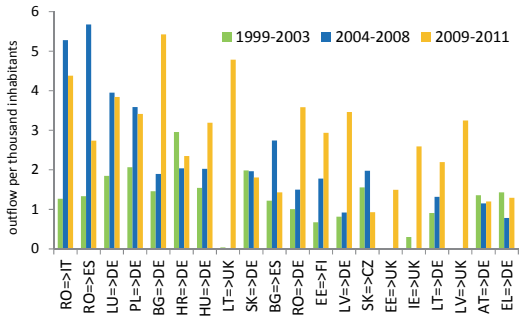
The OECD International Migration Database cover migration flows into most OECD Member countries as well as the Baltic States, Bulgaria and Romania from more than 200 origin countries. The period covered is 1990-2011, and coverage is higher for more recent time periods. The data are based on submissions by national correspondents and reflect existing national statistics, so that methodologies and definitions are not always harmonised (OECD, 2013, Statistical annex, pp. 311-315).

Graph 7: **Average gross bilateral flows exceeding 0.5 per 1000 of destination country population over the period 1999-2011, within EU-28**



(1) The results may be affected by data availability and differing data collection methodologies applied by different countries.
(2) Migration flows to Luxembourg have been omitted for better visibility. The highest flows per 1000 inhabitants into Luxembourg over the period were from PT (7.5), FR (5.2), BE (2.4), DE (1.8), IT (1.3), UK (0.9), PL (0.5).
Source: OECD International Migration Database, own calculations.

Graph 8: **Average gross bilateral flows exceeding 1 per 1000 of source country population over the period 1999-2011, within EU-28**



(1) The results may be affected by data availability and differing data collection methodologies applied by different countries.
(2) Data on migration inflows to the UK are missing for various years depending on the source country. There is only 1 year available on migration from EE, 3 years (LV), 5 years (LT) and 6 years (IE).
Source: OECD International Migration Database, own calculations.

Graph 7 and Graph 8 show the largest gross bilateral migration flows relative to the population of the destination and origin countries, respectively. Some of the largest absolute flows appear among the largest relative flows as well, but a number of additional insights can be gained:

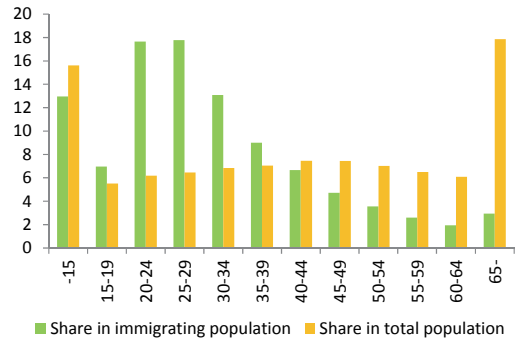
- Some bilateral migration flows are large in relative terms in both directions. Relative to the smaller country's population, flows in both directions between Austria and Germany, Ireland and the UK, appear among the largest.

- A number of bilateral flows that are large relative to the population of the destination country are between neighbouring countries (e.g., from France and the Netherlands to Belgium, from Croatia to Slovenia, Romania to Hungary, Slovakia to the Czech Republic, Hungary to Austria).

- Most of the bilateral flows that are large relative to the population of the origin country are from new Member States to large old Member States.

Migrants differ from the rest of the population for a number of characteristics. Graph 9 shows the age composition of the total population and that of the population of individuals migrating to EU countries in 2012. The graph shows that the majority of migrants is between 20 and 40 years, an age bracket typical of individuals in tertiary education or prime working age.

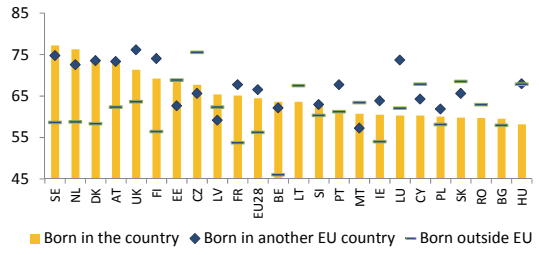
Graph 9: **Share of different age groups among the total population and among the flow of migrants in 2012**



Source: Eurostat population statistics, own calculations.

Finally, Graph 10 compares the employment rate of the population born in EU countries to that of migrants born in other EU Member States and outside the EU. On average, the employment rate of migrants from other EU countries is about 2 percentage points higher than that of the population born in a given country, while the employment rate of migrants from outside the EU is about 8 percentage points lower. This evidence is largely driven by the fact that relatively few migrants are not in working age, and that migrants coming from outside the EU have in general a lower education background and have to face higher legal and administrative obstacles.

Graph 10: **Employment rate by country of birth, 2013**



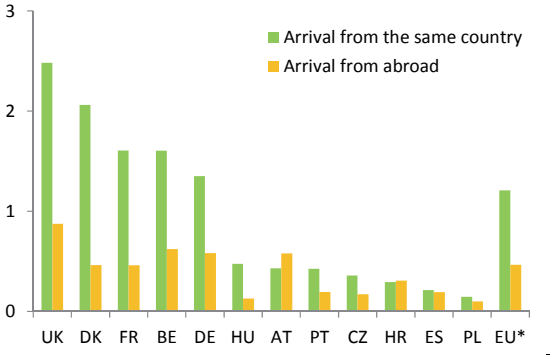
(1) DE is omitted because the employment rate for EU and non-EU migrants is not available for this country.
(2) For BG, LT and RO the of the employment rate of people born in another EU country is not available.
Source: Eurostat Labour Force Survey.

3.2. Sub-national mobility

Economic shocks in a monetary union can have a differential effect not only on different Member States but also on different regions of the same Member State. Thus, sub-national mobility continues to play a role in the adjustment to asymmetric shocks after monetary unification.

Graph 11 summarises information on annual sub-national and cross-country mobility rates in a number of EU countries. The graph shows that, in the countries where data is available, about 1.2% of the population was mobile between NUTS2 regions of the same country, while about 0.5% of the population has migrated from another country (about the half of which from another EU Member State). This means that in 2013 about five times as many people moved to another region in the same EU Member State than moved between two EU Member States. This ratio is comparable to that found by Gáková and Dijkstra (2008) on data for 2005 and 2006 (their result was however somewhat higher, in the order of 6 to 1). This is an indication that between-country mobility may have increased in the EU relative to subnational mobility.

Graph 11: **Annual rates of sub-national and international inward mobility, 2013, % of total population**

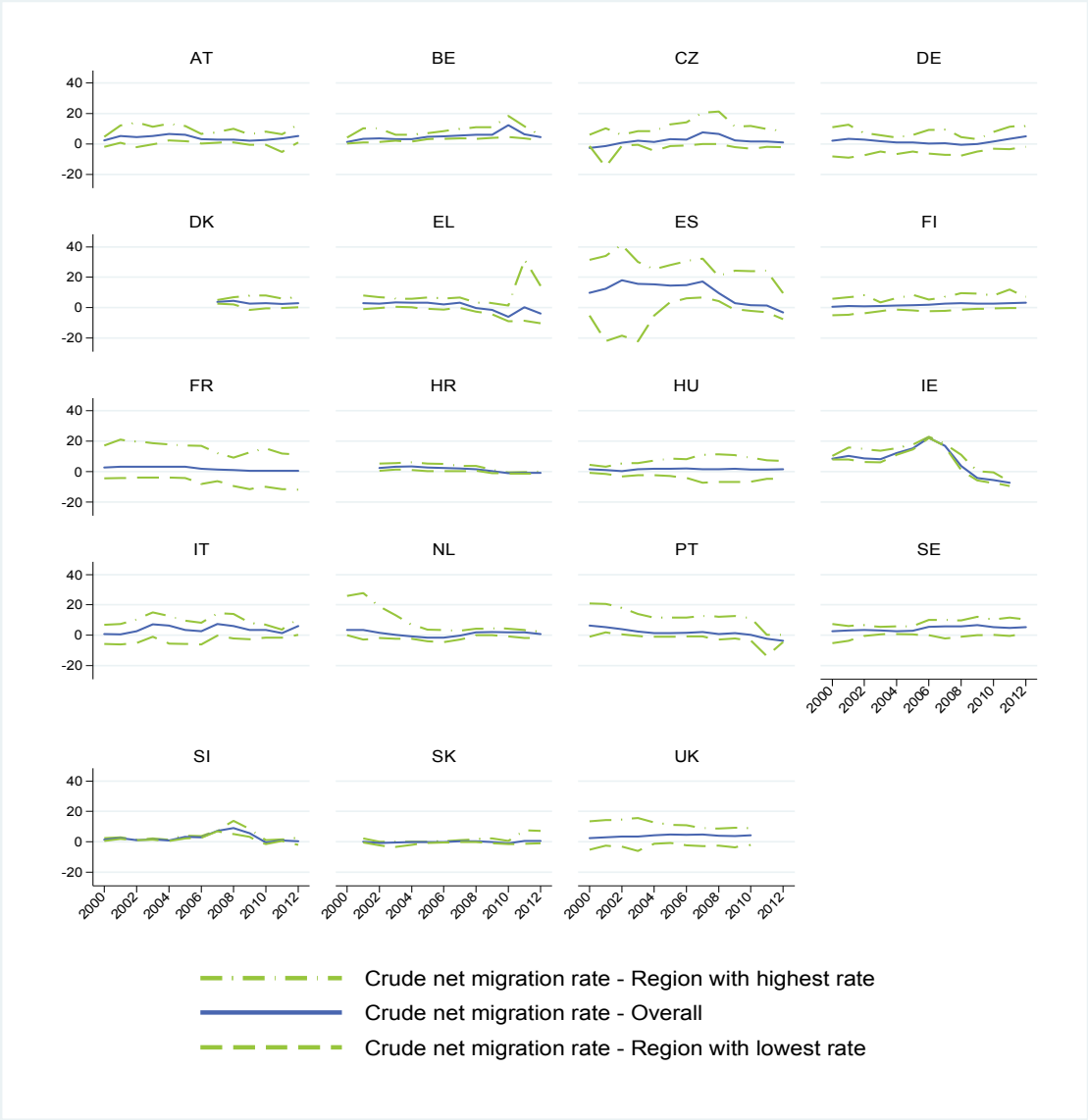


(1) 'Arrival from the same country' refers to working-age individuals who were residents of another NUTS2 region of the same country 1 year before the interview.
(2) The EU average is a weighted average that covers the countries shown, representing 70% of the EU's working age population.
(3) Data was not available for BG and IE. Countries for which the quality of data was questionable for internal mobility (IT, RO, SI, SK) or external mobility (EL, FI, NL, SE) have been excluded.
Source: Eurostat special extraction from the European Labour Force Survey.

Graph 11 also shows that there are considerable differences across countries concerning the relative importance of sub-national (regional) and international mobility. Countries with high regional mobility rates include large member States (France, Germany and the UK), which can be explained by the fact that the number of regions in a country has a mechanical (and positive) effect on the sub-national mobility rate. At the same time, countries in which the regional mobility rate exceeded 1% in 2013 included smaller countries like Belgium and Denmark, while larger countries like Poland and Spain recorded a regional mobility rate below one-quarter of a percent.

The mobility rates shown in Graph 11 allow a comparison with the U.S., where estimates of the annual inter-state mobility rate range between 1.5% and 3% depending on the methodology (Molloy et al., 2011). This is larger than the migration rate across EU Member States by an

Graph 12: **Crude rate of net migration and the country level, and region with the highest and lowest value**



(1) Only countries with more than one NUTS2 level region are shown. Bulgaria, Poland and Romania have been omitted because of data concerns.
Source: Eurostat population statistics, own calculations.

order of magnitude. ([7]) While US migration rates have been on a falling trend in the last three decades (Molloy et al. 2011; 2014), migration between EU Member States has increased somewhat (see next Section).

Regional and cross-country migration interact also because international migration flows may affect regions of the same country differently. Graphs 12 and 13 compare regional and country-level net migration rates in a way that summarises the effect of both subnational and international migration.

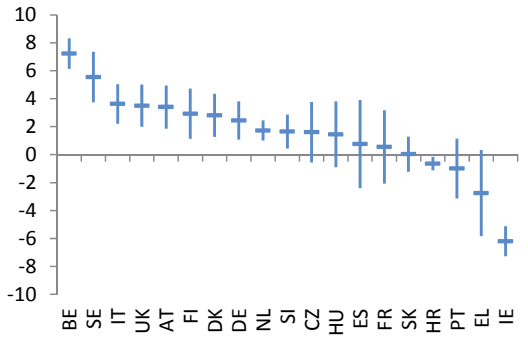
([7]) Molloy et al. (2011) compare US interstate mobility with mobility across NUTS2 regions in the EU, arguing that the size of NUTS2 regions (the population ranging between 0.8 and 3 million) is comparable to many U.S. states. If the comparison is made this way, the mobility in the EU could be about 80% of the US level if the lower end of the US estimates is accepted. It appears more natural to compare migration across political units (like across US states and EU Member States), but comparability is imperfect because of the different size and geography of such units.

Graph 12 depicts country-level net migration rates and, for every country, the same statistic for the region with the highest and lowest net migration rate. The graph permits to assess whether migration developments have been relatively homogenous in the various Member States or, to the contrary, whether country-level developments were accompanied by very disparate processes on the sub-national level.

Graph 12 shows that, among large Member States, large regional differences appear especially in Spain and France, while in Germany, Italy and the UK regional deviations from country-level trends appear to be somewhat smaller.

Among smaller Member States, it is notable that large swings of the overall net migration rate in Ireland were reflected in almost parallel developments of both Irish regions. In contrast, relatively large and sustained regional disparities are observed in the Czech Republic, Hungary and Portugal. A high degree of dispersion of mobility rates across regions is also found in Greece at the end of the sample period and in the Netherlands at the beginning.

Graph 13: **Crude rate of net migration, country-level and one standard deviation range, average, 2009-2012**



(1) Crude rate of net migration and statistical adjustment.
(2) The standard deviation is calculated as the average of annual standard deviations.
(3) Note on sample composition.
Source: Eurostat population statistics, own calculations.

Graph 13 focuses on a different measure of disparity across regions: it shows, besides the average country-level net migration rate for the post-crisis period, the standard deviation of regional net migration rates is greatest, in the post-crisis period, in Spain and France among the large countries, and the Czech Republic, Greece, Hungary and Portugal among the medium-sized countries.

4. EXPLAINING MOBILITY FLOWS

This section investigates determinants of bilateral migration flows between countries. Besides estimating the main drivers of migration flows globally, the section intends to answer the following questions. Does mutual membership in the European Union and the euro area increase migration flows between countries? How do cyclical economic conditions affect bilateral migration? Does the EMU affect migration patterns in Europe?

4.1. The approach

Estimation of a 'gravity equation' of migration flows is an appropriate method to analyse the determinants of bilateral migration flows. The term 'gravity equation' or 'gravity model' refers to a type of empirical regularity in economic interactions between countries. As a prominent application of the gravity model, it has been long noted that a country's trade with other countries is positively related with the trading partners' economic size but negatively related with the distance between both. ([8])

While the gravity model has been applied to migration before, recent improvements in the quantity and quality of available data on bilateral migration have spurred a new literature on the determinants of migration making use of the gravity model. ([9]) The literature has found consistent evidence for a number of intuitive relationships: bilateral migration is positively related with the population of countries and negatively with the distance between them; furthermore, common language and past migration

([8]) The gravity equation has been first used by Tinbergen (1962) to explain trade flows. Anderson (2010) and Head and Mayer (2013) provide surveys of the literature. The term 'gravity equation' is motivated by the analogy with the mass and distance of celestial bodies.

([9]) See, e.g., reviews of the literature by Greenwood (2005), Anderson (2010) and Beine et al. (2014).

Box 2: **Specifying the gravity equation for migration**

The gravity equation migration estimated in this report is specified as follows:

$$\ln MIG_{ijt} = \beta_0 + \beta_1 \ln(POP_{it} \cdot POP_{jt}) + \beta_2 \ln(DIST_{ij}) + \beta_3 \ln\left(\frac{PCGDP_{jt}}{PCGDP_{it}}\right) + \beta_4 \ln\left(\frac{UR_{jt}}{UR_{it}}\right) + \beta_5 \ln(STOCK_{ij\,0}) + \beta_6(LANG_{ij}) + \beta_8(LINK_{ij}) + \beta_9(EU_{ij}) + \beta_{10}(EA_{ij}) + a_t + a_i + a_j + u_{ijt}$$

The dependent variable (defined in logarithm as all variables except for the dummies) is gross migration flow (MIG) from origin country i to destination country j in year t. Explanatory variables include standard 'gravity' controls like the product of both countries' populations (POP) and geographical distance ($DIST$). Some variables are included to control for factors that influence the expected individual gain from migration: the ratio of per-capita incomes ($PCGDP$) and unemployment rates (UR) of both countries. The relative unemployment rate is included in first lag to avoid potential endogeneity. Further variables control for the cost of migration, such as dummies for common language ($LANG$), and past colonial links ($LINK$) between both countries, as well as the stock of immigrants ($STOCK$) in destination country j from origin country i prior to the period of study. The effect of mutual membership of country pairs in the EU and the euro area (EA) is controlled for by suitably generated dummy variables. Time dummies (a_t) control for global trends and cycles.

Many unobserved factors may influence the propensity of a country's inhabitants to choose emigration and the relative attractiveness of destination countries. These factors are sometimes called 'multilateral resistance terms' in the literature. Origin and destination country dummies (a_i and a_j) are included to control for such time-invariant factors. Origin and destination country dummies also allow control for the possible problem of differing statistical methodologies used by different countries in the sample.

The log-log specification allows the estimated parameters to be interpreted as elasticities. While weaknesses and alternatives to the logarithmic specification have been discussed in the literature (see, e.g., Head and Mayer, 2013; Beine et al., 2013), it remains a standard way to estimate the gravity equation.

between pairs of countries increase migration flows. ([10])

Some recent studies have chosen a more structural approach, motivating the estimated gravity equations with a theoretical model of migration choice. ([11]) Only a few studies, however, have investigated the effect of business-cycle fluctuations on migration flows: Beine et al. (2013) show that business cycle indicators have a statistically significant effect on migration flows. They also find that mutual euro area membership increases migration flows, although their specification does not control for mutual EU membership. ([12]) The approach taken here differs from that of Beine et al. (2013) in that it places more emphasis of how the EMU and the crisis affected the magnitude and direction of migration flows, with a view to investigate whether the importance of mobility as an adjustment channel is increasing in recent years.

([10]) See, e.g., Lewer and Van den Berg, 2008; Mayda, 2010; Pedersen et al., 2008. Studies with a focus on North America include Clark et al. (2007) and Karemera et al. (2000).

([11]) The more structural approaches include the study by Ortega and Peri (2013) which, besides confirming qualitatively findings of previous studies, estimates the effects of immigration policies of destination countries on migration flows.

([12]) The controls the authors employ only include mutual membership in the Schengen agreement.

4.2. Data

Gross bilateral migration flows are taken from the OECD's International Migration Database. ([13]) The database includes information of annual gross migration flows from about 200 origin countries to 38 destination countries. Data for the years 1992-2011 are used. Data are scarce for earlier years and are incomplete for the year 2012 at the time of the analysis.

Control variables were collected from the World Bank's World Development Indicators. 'Dyadic' control variables describing the geographic distance between country pairs as well as information about common language and colonial history were collected from the publicly available database of CEPII as documented by Mayer and Zignago (2011). Past bilateral migration stock, used as a control variable, is from the World Bank. For a description of these data, see Ozden (2011).

4.3. Estimation results

Determinants of bilateral gross migration flows are estimated in a gravity model. The dependent variable is gross migration flow from a given origin country to a given destination country. Explanatory variables include standard gravity controls, such as the product of populations of and distance between the origin and destination country, controls for the expected gain from migration (per-capita GDP and unemployment rate in the destination country, relative to that in the origin country) as well as for the cost of migration (common language, colonial history, as well as the magnitude of past migration between both countries, measured as the stock of migrants in 1990).

In addition, a series of dummy variables is included with the aim to capture the interplay between the evolution of European integration and the economic context. First, dummy variables control for mutual membership in the EU and the euro area. Further, appropriate interaction terms allow testing whether the importance of relative unemployment rates has increased since the inception of the EMU or during the crisis. More detail on the specifications is presented in Box 2.

([13]) Information about the database is provided by the statistical annex of OECD (2013, pp. 311-315). See also Box 1 on data sources.

In the following, two sets of regression results are presented. The first set of results is from regressions run on the full sample: after the introduction of control variables, the full sample includes 163 origin countries and 38 destination countries. The specifications run on the full sample are able to simultaneously analyse the determinants of migration among EU countries, among countries not belonging to the EU and between pairs of countries of which only one is a member of the EU. They therefore allow the analysis of whether accession to the EU increases migration flows to and from other EU Member States. The second set of results is from regressions run on a sample restricted to EU15 countries. This specification allows a focus on the determinants of migration among 'old' Member States.

Table 1 presents results obtained from the first set of specifications run on the full sample. The table proceeds from a 'bare-bones' specification in column (1), through one including origin and destination country effects in column (2), to the full specification including interaction terms in column (3). A number of observations can be made.

- The product of both countries' populations and their relative level of GDP per capita have a strongly significant effect on migration flows when country effects are excluded. The estimation suggests that if either the origin or the destination country's population increases by 1 percent, gross bilateral migration increases by about half a percent. In a similar vein, if per-capita GDP in the destination country increases by 1% relative to the origin country, this increases the gross bilateral migration flow by about 0.06%. When the gravity equation is estimated with country effects, relative per-capita GDP and population lose explanatory power. This means that country dummy variables sufficiently control for the effect of country size and relative level of development on global migration flows.

- Other traditional control variables (distance, common language, past colonial relationship, initial bilateral migrant stock) have a strongly significant effect on bilateral migration in the

expected direction. These effects are robust to the inclusion of country effects.

Table 1: **Determinants of gross bilateral migration flows: Gravity equations on the global sample**

Dependent variable: Log gross migration flow	(1) No country effects	(2) Country effects	(3) Full specifi-cation
Log product of populations	0.491***	0.274*	0.244
	(0.005)	(0.164)	(0.163)
Log weighted distance	-0.514***	-0.669***	-0.668***
	(0.010)	(0.014)	(0.014)
Log relative GDP per capita in the destination country	0.061***	-0.002	-0.003
	(0.006)	(0.068)	(0.069)
Log relative unemployment rate in the destination country (lag)	-0.099***	-0.137***	-0.138***
	(0.011)	(0.022)	(0.022)
Log bilateral migrant stock in the destination country, 1990	0.358***	0.301***	0.302***
	(0.004)	(0.005)	(0.005)
Common language	0.779***	1.028***	1.027***
	(0.024)	(0.026)	(0.026)
Past colonial relationship	0.556***	0.615***	0.613***
	(0.041)	(0.041)	(0.041)
Both countries are EU members in given year	0.179***	0.248***	0.249***
	(0.035)	(0.034)	(0.034)
Both countries are EA members in given year	0.160***	0.020	-0.024
	(0.041)	(0.039)	(0.040)
Interaction term: Relative Unemp. * Post-2008 crisis			0.040*
			(0.024)
Interaction term: EMU * Post-2008 crisis			0.081
			(0.061)
Interaction term: EMU * Relative Unemp.			-0.179***
			(0.039)
Double interaction: EMU * Rel. Unemp. * Crisis			-0.115
			(0.080)
Constant	-15.950***	-9.472**	-8.673*
	(0.173)	(4.492)	(4.480)
Source country effects	no	yes	yes
Destination country effects	no	yes	yes
Year effects	yes	yes	yes
Observations	27,924	27,924	27,924
R-squared	0.721	0.823	0.823

(1) All equations estimated with OLS.
(2) The sample period encompasses the years 1992-2011. After the introduction of control variables, the sample includes 163 origin countries and 38 destination countries. For a more detailed documentation of the time and country coverage of the sample, see the Appendix.
(3) Asterisks indicate estimated coefficients that are statistically significant at the 1% (***), 5% (**), or 10% (*) level.
Source: Own calculations based on data from the OECD International Migration Database.

- The relative unemployment rate is estimated to affect migration significantly. If the unemployment rate of the destination country increases by one percent relative to the origin country, the bilateral migration flow to this country is estimated to decrease by about 0.14 percent in the specifications with country effects.

- Mutual EU membership is estimated to increase bilateral migration flows by about 25%, everything else being equal, in the specification with country effects.

- Finally, mutual euro area membership does not appear to affect migration by itself, but the estimated interaction terms indicate that it does influence migration flows (column 3). Mutual euro area membership intensifies migration toward countries with a relatively low unemployment rate, as suggested by the negative and significant estimated coefficient of the interaction term between the EMU dummy and the relative unemployment rate. This effect appears to have strengthened further in the crisis, as well as migration in all directions in the euro area during the same period, although the corresponding coefficients do not reach statistical significance. This supports the view that, in the euro area, migration flows serve the adjustment to asymmetric shocks more than between other countries.

Table 2 presents gravity equations of gross migration flows among the "old" Member States (EU15). Rather than using interaction terms, this exercise analyses the development of migration patterns by estimating the same relationship on three different subperiods: column (1) reports results for the full period (1992-2011); column (2) reports results from the period after monetary unification (1999-2011), while column (3) presents results from the post-crisis years (2008-2011). All specifications include origin and destination country effects as well as year effects. ([14]) A number of observations can be made.

- Over the full sample period, population and relative per-capita GDP affect migration flows significantly among EU15 countries even in the presence of country effects. This indicates that there is a premium to "big-to-big" and "relatively-poor-to-rich" country migration among the "old" Member States.

- The effect of other control variables (distance, past migration and common language) is strongly significant, goes in the expected direction, and is robust to the period chosen.

([14]) In the estimations for this restricted sample, variables controlling for past colonial relations and mutual euro area membership had to be dropped for lack of variability.

- The relative unemployment rate is a significant determinant of migration flows among the EU15. Over the full sample period, the magnitude of the estimated coefficient is similar to the one estimated on the global sample.

- In the post-EMU period, the effect of the relative unemployment rate is higher than over the full sample period. This indicates that post-EMU, the role of migration as a cyclical adjustment channel between Old Member States has increased.

- Post-crisis, the effect of the relative unemployment rate is similarly elevated as over the post-EMU period but the coefficient is not estimated precisely enough to reach statistical significance (potentially because of the relatively low number of observations). The effect of relative per-capita GDP is estimated to be higher than over the longer sample periods, which may be related to the fact that the crisis affected the euro area 'periphery' more than the 'core'. Finally, the "big-to-big" country premium is estimated to have disappeared after 2008, while the effect of other control variables is similar to the magnitudes estimated over the whole sample period.

Table 2: **Determinants of gross bilateral migration flows: Gravity equations of intra-EU15 mobility**

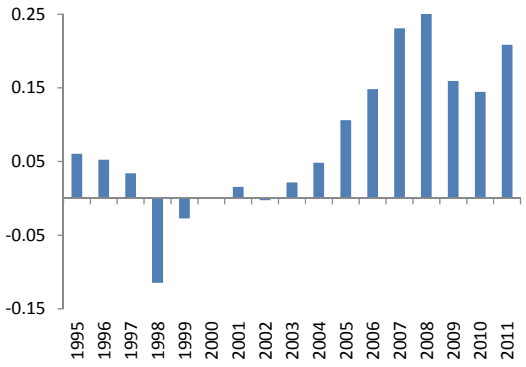
Dependent variable: Log gross migration flow	(1) Full sample (1992-2011)	(2) EMU period (1999-2011)	(3) Crisis period (2008-2011)
Log product of populations	1.350***	1.504***	-0.268
	(0.475)	(0.552)	(2.922)
Log weighted distance	-0.258***	-0.308***	-0.331***
	(0.042)	(0.045)	(0.068)
Log relative GDP per capita in the destination country	1.704***	1.308***	2.050**
	(0.260)	(0.387)	(1.035)
Log relative unemployment rate in the destination country (lag)	-0.143***	-0.209***	-0.197
	(0.040)	(0.048)	(0.124)
Log bilateral migrant stock in the destination country, 1990	0.407***	0.386***	0.350***
	(0.017)	(0.019)	(0.030)
Common language	0.511***	0.507***	0.604***
	(0.054)	(0.063)	(0.102)
Constant	-42.047***	-49.792***	8.303
	(13.927)	(16.874)	(103.897)
Source country effects	yes	yes	yes
Destination country effects	yes	yes	yes
Year effects	yes	yes	yes
Observations	2,217	1,751	550
R-squared	0.913	0.922	0.935

(1) All equations estimated with OLS.
(2) Asterisks indicate estimated coefficients that are statistically significant at the 1% (***), 5% (**), or 10% (*) level.
Source: Own calculations based on data from the OECD International Migration Database.

4.4. The time profile of migration among old EU member states

Synthetic information on the time profile of mobility among EU15 countries is summarised by the year effects estimated in the specification on the restricted sample. Year effects pick up changes in the mobility that are observed across the board and are not explained by other factors controlled for (e.g., convergence in GDP per capita; changing disparities in unemployment rates; changing country composition of the sample). Graph 14 presents the estimated year effects starting with 1995. The magnitude of the estimated year effects can be interpreted as a general increase or decrease of gross bilateral migration flows as compared to the baseline of 1992. A value of 0.15 in 2006 means, for example, that migration flows in that year were approximately 15% higher in general than in 1992 (after controlling for all factors included in the equation).

Graph 14: **Time profile of intra-EU15 mobility: Estimated year effects**



(1) The graph depicts the estimated year effects from regression (1) of Table II.1.2. The level zero is set by mobility flows in 1992.
Source: Own calculations based on data from the OECD International Migration Database.

Graph 14 shows that mobility among EU15 countries increased rapidly starting from 2003, and peaked in 2008 about 25% above the levels of the early 1990s. After a drop in 2009 and 2010, mobility picked up in 2011. Despite these decreases, mobility in the EU15 remained overall at historically high levels throughout the crisis years.

4.5. Country-specific time profiles

The previous subsection has established that (i) migration flows are affected by the unemployment differential between countries; (ii) that this effect is stronger in the euro area; and (iii) may have further increased in the euro area during the crisis.

This subsection presents a visual analysis of the unexplained component of inward and outward migration flows of EU countries. The unexplained component of inward or outward migration is the weighted average of the residuals from the regressions explaining mobility flows. The unexplained part of migration flows synthesises information about time-variant factors affecting the willingness of a country's citizens to choose migration and the attractiveness of different destination countries that are not fully captured by structural and cyclical control variables.

It should be noted that looking at the unexplained component of migration flows does not allow conclusions to be drawn about global time trends in migration. These are part of the explained component because the underlying regressions include year dummies. Also, the unexplained component of migration flows cannot be used to compare countries in terms of the absolute magnitude of migration flows. Overall differences across countries are part of the explained component because the underlying regressions include origin and destination country dummies.

The unexplained component of migration flows is calculated both by destination countries and by origin countries. It is calculated as a weighted average of the residuals from the regression on the global sample as presented in column (3) of Table 1. ([15]) Since the gravity equation is specified in log-log terms, the unexplained component can be interpreted as deviation in (approximately) percentage terms. Thus, a value of (1.0) can be interpreted as implying that the actual migration flow was about double the prediction, while a value of (-1.0) can be interpreted as implying that the actual migration flow was about half the prediction.

Graph 15 shows the unexplained component of mobility flows by destination country. Movements in the unexplained component of mobility inflows are largest in the Czech Republic, Lithuania, Portugal and Spain. In Spain, the unexplained component moves together with the cycle, providing support to the notion that migration to this country was more procyclical than in other countries. In the other three countries, the unexplained component appears to be largely procyclical as well, but there appear to be idiosyncratic factors. Migration flows to the Czech Republic and Portugal were generally lower than predicted at the beginning of the sample period. Migration flows to Lithuania were higher than predicted in the first years observed in the early 2000s.

Also, there is a perceptible increase in 2010-2011 in the unexplained component of migration inflows into countries of the euro area core, i.e., Austria, France, Germany, Luxembourg and the Netherlands, while this is less clear in Belgium and Finland.

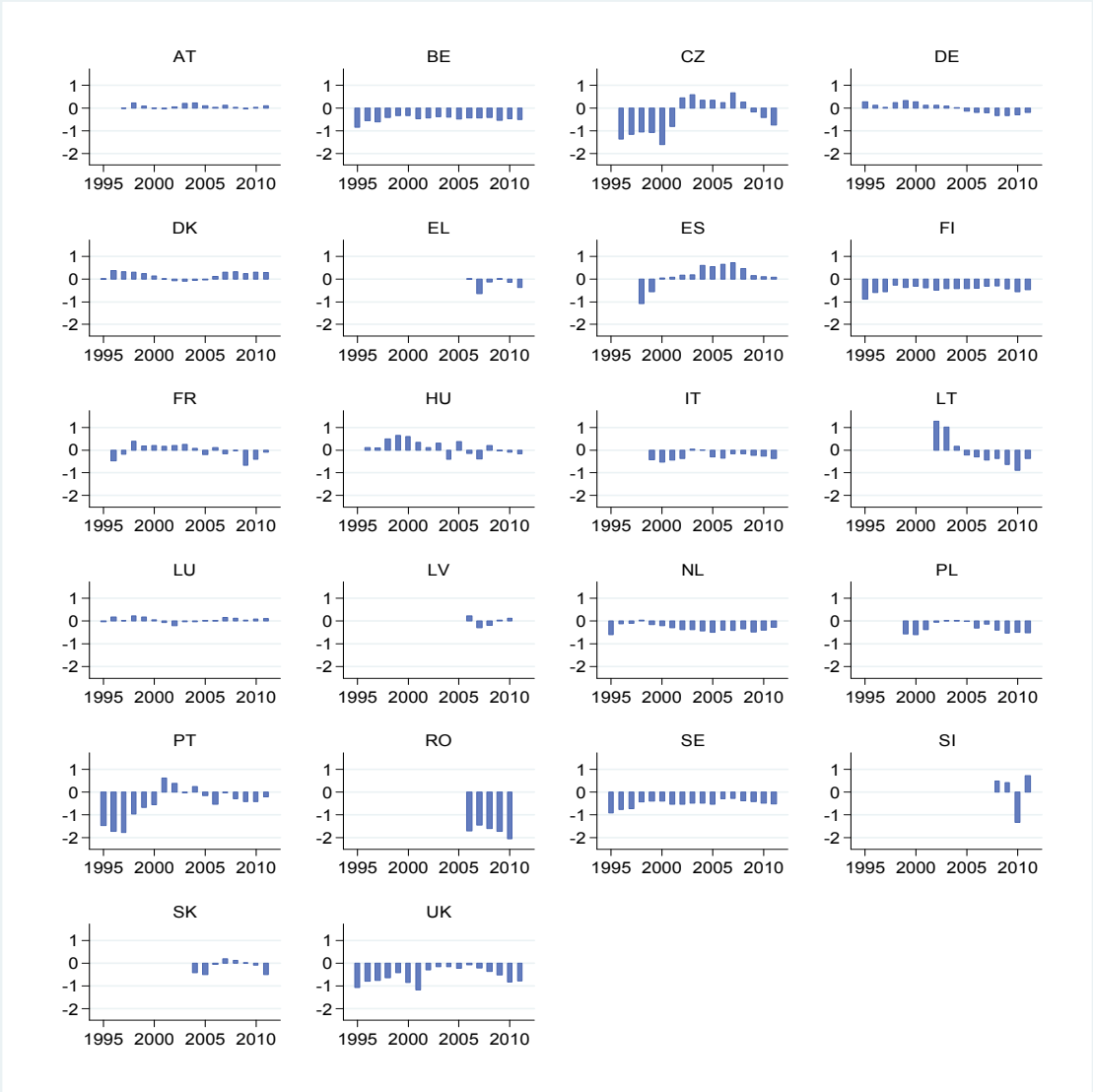
Graph 16 shows the unexplained component of mobility flows by origin country. There are more countries with marked movements in the unexplained component of outward mobility than inward mobility. There are a number of distinct patterns across countries.

- A marked U-shaped pattern of unexplained outward mobility can be observed in the case of Greece and Spain and to a lesser extent Estonia, Latvia and Slovenia. This suggests that flows of outmigration are more procyclical in these countries than in others. (For Spain, this could be confirmed also for immigration flows, but not for the other countries, potentially for lack of a sufficient number of observations).

- Among the vulnerable euro area member states, such a U-shaped development is much weaker in Italy and absent in Portugal and Ireland.

([15]) The weighting is done in proportion to the average magnitude of bilateral migration flows and to the number of observations in a given bilateral relation. The weighting ensures that the aggregate unexpected component of migration flows is not sensitive to large prediction errors in small bilateral migration flows. It is a consequence of the weighting that the unexplained component of migration flows by origin or destination country does not need to add up to zero over the sample period.

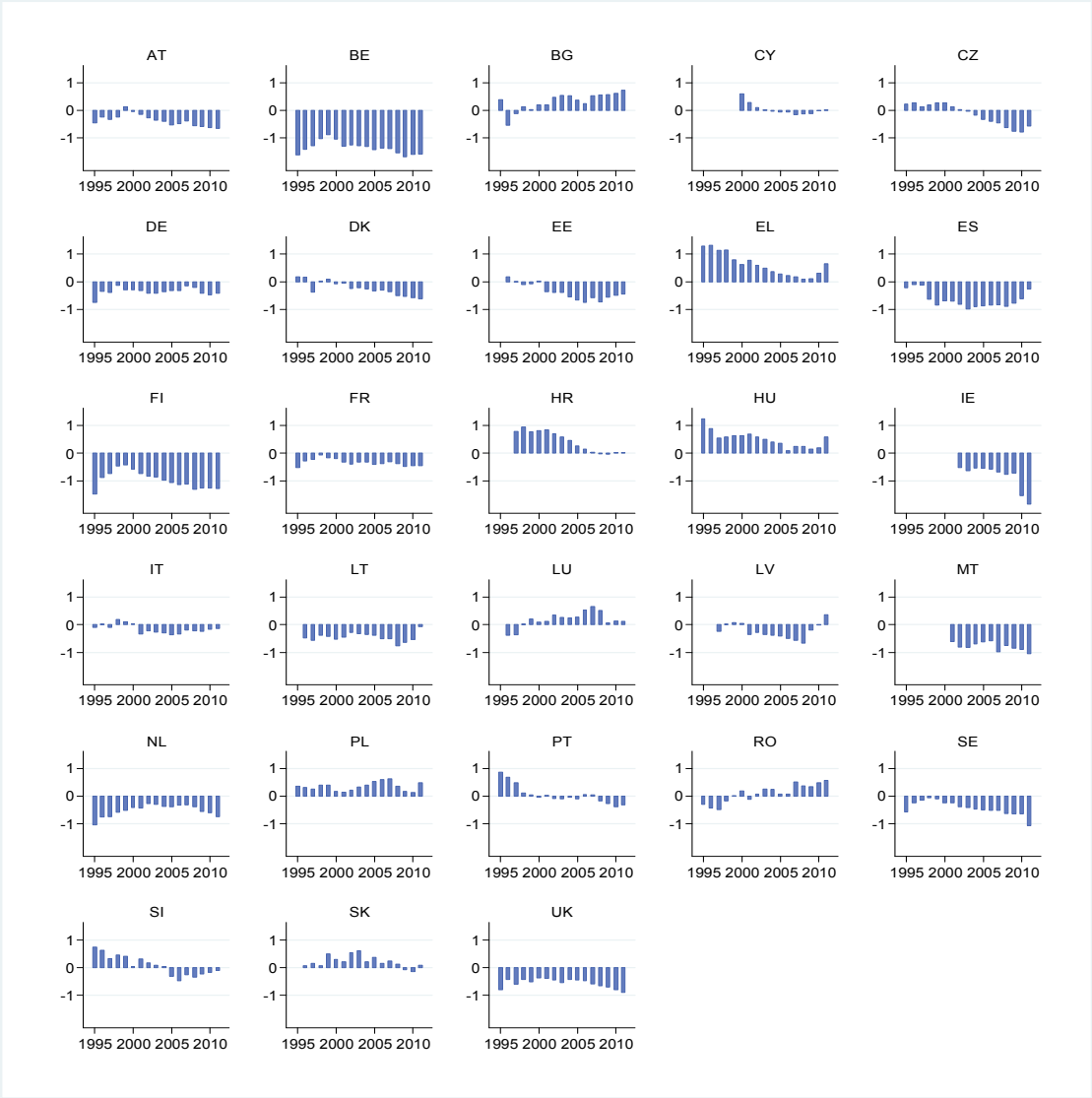
Graph 15: **Unexplained mobility flows: weighted average by destination country (EU-28 countries in the sample)**



(1) The graph depicts the weighted average of estimated residuals by destination country, as obtained from regression (3) of Table II.1.1. Weights are time-invariant; they take into account the average migration flow and the number of observations for a given pair of origin and destination countries.
(2) The graph includes EU member states for which there is information in the database. Estonia and Ireland have been excluded for a low number of observations. For a documentation of the sample, see the Appendix.
Source: Own calculations based on data from the OECD International Migration Database.

- In contrast, a hump-shaped development of unexplained outward mobility can be observed in some countries of the euro area core (Belgium, Finland, the Netherlands) and in countries that remained outside the euro area (Sweden, the UK and to a lesser extent Denmark).
- There are different patterns observed across New Member States though the sample period: while the unexplained component of outward flows has been increasing for Bulgaria and Romania, it is decreasing for the Czech Republic and Croatia.

Graph 16: **Unexplained mobility flows: weighted average by origin country (EU-28)**



(1) The graph depicts the weighted average of estimated residuals by origin country, as obtained from regression (3) of Table II.1.1. Weights are time-invariant; they take into account the average migration flow and the number of observations for a given pair of origin and destination countries.
(2) For a documentation of the sample, see the Appendix.
Source: Own calculations based on data from the OECD International Migration Database.

5. CROSS-COUNTRY LABOUR MOBILITY AND ADJUSTMENT: AN ENCOMPASSING FRAMEWORK

The previous sections have focused on the main patterns and trends of labour mobility across EU countries, and on their determinants. This section aims instead to analyse the role of labour mobility as an adjustment mechanism to asymmetric labour demand shocks.

5.1. Plan of the analysis

In a first step, a number of stylised facts concerning labour market dynamics are distilled, with a view to assess regularities in the co-movement of employment, activity rates, unemployment rates, and labour mobility. It will

also be assessed whether the dynamics of these variables in each country are closely linked to the dynamics observed for the whole EU. This in turn allows to assess whether labour demand shocks were mostly common or asymmetric.

Subsequently a VAR approach in the tradition of Blanchard and Katz (1992) is applied to investigate how labour mobility in a typical EU Member State economy responds to shocks. Compared with recent analyses (e.g., Dao et al, 2014, Beyer and Smets, 2014), the focus is on mobility across countries rather than regions. Such a focus permits a better identification of the role of labour mobility in response to national asymmetric shocks. Compared with previous studies taking a cross-country perspective, (e.g., l'Angevin, 2007a,b), the availability of a longer time series make it possible to examine if the contribution of labour mobility to labour market adjustment has changed since the launch of the monetary union and after the 2008-2009 crisis.

Moreover, the role of real wages could not be properly assessed in previous studies because of the lack of data on wages at regional level. Focusing on cross-country mobility allows exploring the response of real wages to labour demand shocks. With a view to asses if the labour market adjustment has changed after EMU, the dynamic interactions between wages, employment, and activity rate are investigated for the periods before and after the adoption of the common currency.

Annual data are used to estimate a VAR using the whole panel of available countries over the 1970-2013 period. The panel structure expands the sample size (and results in a gain in statistical degree of freedom) which allows the assessment of whether, on average, the response of labour mobility to shocks has changed over time, possibly as a result of evolving integration across EU Member States.

Finally, the labour market adjustment mechanism is evaluated for selected individual Member States. Due to the limited sample size, this analysis is conducted on quarterly data.

5.2. Analytical approach and literature review

In a monetary union, asymmetric shocks are expected to initially cause differences in unemployment and activity rates, which are absorbed over time via the adjustment of real wages, and via geographical mobility. In a country hit by a positive labour demand shock, workers are initially drawn from the unemployment pool and more inactive workers start entering the labour force. As time goes by, real wages grow and, if the shock persists, the labour force starts growing also thanks to the inflow of workers from other geographical locations. Similar dynamics play out in the opposite direction in case of a negative shock.

With limited data on net labour mobility, it has become standard in the literature to follow the approach applied to study the labour market adjustment in the US by Blanchard and Katz (1992).

Using a panel VAR, Blanchard and Katz (1992) explore the joint behaviour of employment, activity and employment rates across US states in response to state-specific labour demand shocks. Blanchard and Katz (1992) note that variations in relative employment levels across US states persist over time, while relative unemployment and activity rates are stationary variables. These features of the data are consistent with a structure of the economy where factor mobility ensures that asymmetric shocks have only transitory effects on relative wages, unemployment and activity rates, while the effects on relative employment are permanent. The main idea is that if asymmetric shocks have permanent effect on employment but not on unemployment and activity rates, the change in employment levels must be absorbed by changes in the working age population. Assuming that labour demand shocks do not influence demographic trends, the response of relative population must reflect the response of labour mobility.

Blanchard and Katz (1992) find that a 1 percent transitory negative labour demand shock raises unemployment in the first year in the typical state by 0.32 percentage points above the national average and lowers activity rate by 0.17 percentage points. The effects on the unemployment and

activity rates disappear after five to seven years; those on relative employment gradually build up, peaking at *minus* 2 percent after four years. This pattern implies a substantial role of inter-state mobility in the first years following the shock.

Subsequent analysis applied the framework developed in Blanchard and Katz (1992) to other geographical areas. Table 3 reports how much of the the initial labour demand shock is absorbed after 1 year by changes of unemployment rates, the participation rate and workers mobility.

Table 3: **Decomposition of the response of labour market variables after 1 year to an asymmetric labour demand shock**

	Unemployment	Participation	Mobility
Euro area (12 Member States 1973-2005) (1)	33	44	23
EU (51 regions 1975-87) (2)	21	74	4
EU (47 regions 1977-2011) (3)	30	40	31
EU (NUTS1 regions 1998-2009) (4)	16	60	24
United States (51 States 1978-1990) (5)	32	17	51
United States (51 States 1958-90) (2)	18	29	52
United States (51 States 1976-95) (6)	24	43	33
United States (51 States 1976-2005) (1)	22	34	44
United States (51 States 1977-2011) (3)	14	43	43
United States (51 States 1977-2009) (4)	22	24	54
Spain (1976-94) (7)	36	23	41
Italy (1969-95) (6)	23	56	22
Germany (1970-93) (6)	28	61	11
United Kingdom (1969-94) (6)	11	85	4
Canada (1976-96) (6)	46	43	11

Source: (1) L'Angevin (2007a,b); (2) Decressin and Fatás; (3) Beyer and Smets (2014); (4) Dao et al. (2014); (5) Blanchard and Katz (1992); (6) Obstfeld and Peri (1998); (7) Jimeno and Bentolila (1998).

Decressin and Fatás (1995) apply this framework to investigate regional labour mobility in the EU and compare the results to those obtained for the US states. Their sample covers the period 1975-1987 and comprises regions for France, Germany, Italy, the UK and Spain; Belgium, Denmark, Ireland, Greece, the Netherlands and Portugal are taken as single regions. They find that the labour market adjustment in the EU is characterised by a muted response of labour mobility as compared with the US, while the response of activity rates appear stronger. In Europe, it takes about four years for the effect on the activity rate and unemployment rate to disappear. In the US, net inter-state mobility accounts within the first year for 52 percent of the change in the relative employment and after three years for 70 percent. In Europe it is only after the third year that mobility accounts for a proportion similar to that reached in the US after only one year.

Bentolila and Jimeno (1998) analyse the response of the typical Spanish region to a labour demand shock and find that for the period 1976-1994 unemployment bears a significant fraction of the adjustment, accounting for about one third of the change in employment after three years.

Dao et al. (2014) reassess the adjustment of the US states extending the Blanchard and Katz sample to 20 additional years. Compared to Blanchard and Katz, they find that the role of participation and unemployment has increased, while the contribution of inter-state mobility has decreased. Applying the methodology to European regions, they find that the short-term response of labour mobility has increased overtime.

Beyer and Smets (2014) reconsider the comparison between the US and European labour market adjustments made by Decressin and Fatás. In particular, they assess separately the adjustment to region specific shocks, to common shocks with asymmetric effects and to national shocks. They find that a significant difference in between the EU and the US remains only in the response of mobility to common shocks with asymmetric effects. In contrast, the mobility response to region specific shocks plays a relatively minor role both for the EU and the US, which appears falling over time. Finally, inter-country mobility in response to country-specific shocks is less important than the inter-regional mobility in response to region-specific shocks.

Most studies on the EU focus on regional labour market adjustment. Only few have looked at the role of labour mobility for national labour market dynamics. In a study on the euro area covering the period 1970-2005, L'Angevin (2007b) finds that inter-state mobility plays a minor role in euro area countries and that, compared to the US, it takes more time for unemployment and participation to return to a long-run equilibrium after the shock. ([16]) Yet, restricting the sample to more recent years (1990-2005), the euro area labour markets respond in a similar manner to that of the US, with a larger contribution of labour mobility in the medium-term.

([16]) The effect of an asymmetric shock fades away after 7-8 years in the US and only after 15- 20 years in the euro area. However, after 1990 the persistence of national unemployment rates has diminished in the euro area.

5.3. Data and empirical implementation

Data

Both annual and quarterly data are used in the analysis. The analysis of annual data focuses on the typical response to asymmetric shocks obtained pooling all Member States, thus imposing common dynamics but allowing for country-specific factors representing constant differences between Member States' labour market variables. The analysis on annual data considers the 15 members of the EU before enlargement (Belgium, Denmark, Germany, Ireland, Greece, Spain, France, Italy, Luxembourg, Netherlands, Austria, Portugal, Finland, Sweden and United Kingdom); the EU15 is the aggregate based on these Member States. Annual data are taken from the Annual macro-economic (AMECO) database of DG ECFIN. Employment and compensation per employee are from National Accounts, unemployment and the activity rate from Labour Force Statistics, compensation per employee is deflated with the GDP deflator.

The analysis of the pooled data makes use of a panel Vector Auto Regression (VAR) framework that imposes the same dynamics on all countries. This restriction is removed when assessing the role of labour mobility for selected countries. Due to the limited sample size the analysis is based on quarterly data over the period 1998Q1-2013Q4. The source of the data is Eurostat. The analysis is conducted on selected member states for which available time series are the longest, namely Germany, Spain, France, Ireland, Italy and the UK.

Labour market adjustment: some stylised facts

Before exploring the contribution of labour mobility to labour market adjustment, it is useful to review some stylised facts on the dynamics of employment, unemployment and participation across EU countries.

Graph 17 reports growth rates of employment, activity and employment rates (defined in this methodology as 1 *minus* the unemployment rate) relative to the EU average since early 1970s. Therefore, the focus is on asymmetric shocks. Changes in labour mobility can be derived from changes in employment that cannot be attributed to changes in unemployment or the activity rate. In Graph 17, changes in mobility can be gauged by subtracting both activity and employment rate changes from employment growth along the vertical axis. ([17])

The visual inspection of the data reveals a rich diversity across countries, but few stylised facts stand out.

- Relative employment growth and relative changes in the activity and unemployment rates tend to oscillate around constant averages (i.e. they are mean reverting). This is consistent with the assumption of the Blanchard and Katz (1992) model (see Box 3).

- For some countries (e.g. Austria, Germany and Ireland until the crisis), national developments diverge only temporarily from the EU average, which is suggestive of the importance of common shocks.

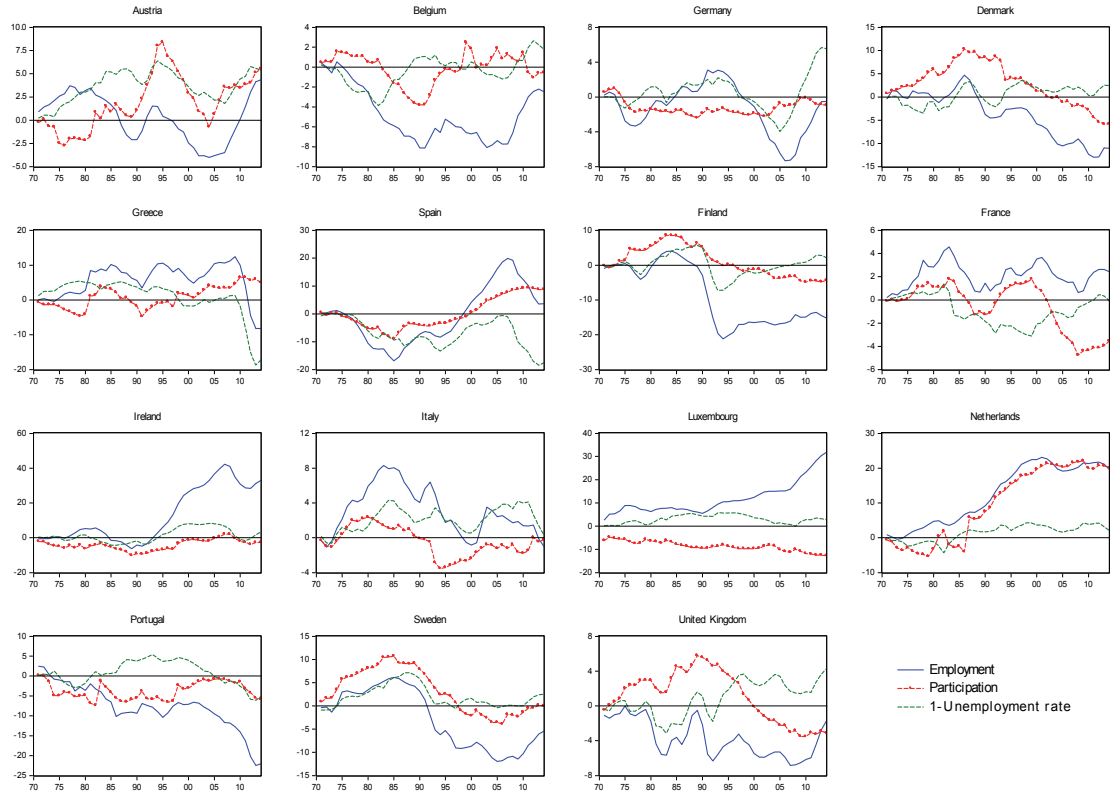
- The recessions that followed the two oil shocks of the early 70s had only a temporary effect on employment growth in several countries. This contrasts markedly with the very persistent effects of the deep financial recession that hit Sweden and Finland in the early 1990s or with the effects of the 2008 global financial crisis in countries such as Greece, Portugal and Spain. For these countries, shocks to employment growth had more persistent effects on unemployment, consistent with the evidence of Calvo et al. (2012) that labour market adjustment is particularly sluggish in recessions induced by disruptions of the credit channel. ([18])

- Fluctuations in employment growth relative to the EU average are matched by changes either in the activity or in the unemployment rate or both. For example, fluctuations in employment growth were accompanied by changes in relative unemployment in Germany, Ireland,

([17]) Since the activity rate and the unemployment rate expressed as $a = L/P$ and $u = 1 - E/L$ respectively, where a and u are the activity rate and the unemployment rate, E is employment, L the labour force, and P is the working age population, then, denoting growth rates by a dot, it is easily shown that $\dot{E} - \dot{a} - 1 \dot{-} u = \dot{E} - (\dot{L} - \dot{P}) - (\dot{E} - \dot{L}) = \dot{P}$.

([18]) Calvo et al. (2012) showed that recoveries that follow deep recessions are jobless or wage-less depending on the pattern of inflation during the recession episodes.

Graph 17: **Labour market dynamics in selected European countries relative to the EU average (cumulative growth since 1970)**



(1) The chart shows growth rates of national variables relative to EU15 growth rates. To focus on business cycle developments, each relative variable is expressed as deviation from its mean over the all period.
Source: AMECO database of DG ECFIN.

Italy, and Finland, while in the Netherlands, France and Sweden, relative employment growth moves together with the relative activity rate.

- The difference between employment growth and the sum of the growth of employment and the activity rates mirrors changes in labour mobility according. A tendency towards greater inward mobility is visible in Spain, Ireland, Luxemburg, the Netherlands, while outward mobility is observed in Finland, Portugal, and Sweden. A sustained inflow of workers was a key component of the increase in the Spanish and Irish employment observed before the 2008 crisis. The crisis reversed only partly this trend with the adverse labour demand shock leading to huge job destruction and limited decline in the growth of the working age population. This pattern contrasts with that of Finland in the aftermath of the deep recession of the early 1990s, when a strong increase in unemployment was accompanied by a persistent and sizeable decline in the activity rate.

The extent to which labour market disturbances are common across the EU or asymmetric can be inferred from Table 4. Following standard practice in the literature, country-level variations in the variables are regressed on developments for the EU15 aggregate. The β coefficients indicate how much of the change in the EU aggregate is transferred on national variables within the same year, while the R^2 measures the strength of the relationship between national and aggregate variables. A few facts are worth mentioning.

- On average, 40 percent of the fluctuations in national employment growth are explained by EU15 developments, which is consistent with what found by L'Angevin (2007a,b) over the

Table 4: **Common labour market disturbances: 1970-2013**

	Employment growth			Unemployment rate			Participation rate		
	β- coefficient	t-statistic	R2 adj	β- coefficient	t-statistic	R2 adj	β- coefficient	t-statistic	R2 adj
Austria	0.49	4.9	0.34	0.41	11.0	0.73	1.29	13.9	0.82
Belgium	0.76	7.3	0.55	0.81	10.4	0.71	0.98	19.5	0.90
Germany	0.74	5.5	0.41	0.68	6.6	0.50	1.10	33.9	0.96
Denmark	0.59	3.3	0.19	0.61	6.7	0.50	0.26	2.3	0.09
Greece	0.57	1.6	0.04	1.62	6.1	0.46	1.34	19.5	0.90
Spain	2.43	9.5	0.68	2.43	16.9	0.87	1.95	26.2	0.94
Finland	1.40	4.9	0.35	0.98	5.7	0.41	0.20	2.1	0.07
France	0.86	9.4	0.67	1.24	21.3	0.91	0.60	14.2	0.82
Ireland	1.89	5.1	0.37	0.93	4.3	0.28	1.35	15.9	0.85
Italy	0.80	5.1	0.37	0.68	11.1	0.74	0.73	16.0	0.89
Luxembourg	0.37	2.5	0.11	0.50	7.1	0.53	0.53	10.5	0.72
Netherlands	0.85	5.7	0.43	0.46	4.8	0.34	3.06	19.4	0.90
Portugal	1.20	5.5	0.41	0.80	4.9	0.34	1.27	19.2	0.86
Sweden	1.00	5.1	0.37	0.75	5.9	0.43	0.17	1.4	0.02
United Kingdom	0.96	5.5	0.41	0.77	7.5	0.56	0.50	7.4	0.55
Average	0.99		0.38	0.91		0.55	1.02		0.69
OLS estimate	0.99	16.8	0.30	0.91	16.2	0.28	1.01	11.8	0.17
Average D&F (1995)			0.20			0.89			0.27

(1) The (coefficients are from regressions of each variable on the relative EU-15 aggregate; they represent the response of a country-specific variable to the EU aggregate. Estimation over the sample period 1970-2013. D&F stands for Decressin and Fatàs (1995).
Source: Own calculations based on AMECO database of DG ECFIN.

1973-2005 period. This value suggests that common shocks in the EU are more relevant at country than at regional level, but less relevant compared with what found for US states. ([19])

- Employment growth is fairly highly correlated with EU-level developments for a majority of countries, while asymmetric shocks clearly prevail in Austria, Denmark, Greece and Luxembourg.

- Unemployment rate dynamics are generally more strongly correlated with those of the EU aggregate as compared with employment growth. The same is true for activity rates, with the relevant exceptions of Denmark, Finland and Sweden.

Analytical framework

Following Blanchard and Katz (1992), a vector auto regression (VAR) with two lags has been estimated for the following variables: the change in the logarithm of national employment, the logarithm of activity rate and the logarithm of the employment rate (defined as 1 *minus* the unemployment rate). All variables are relative to the respective EU means. Box 3 describes the methodology in details.

VARs are standard tools for examining the interrelationships between variables and their dynamics. With a VAR each dependent variable is regressed against its lags and the lagged values of each endogenous variable. Each equation can be simulated to trace out the response of each variable to a specific shock, at different time horizons.

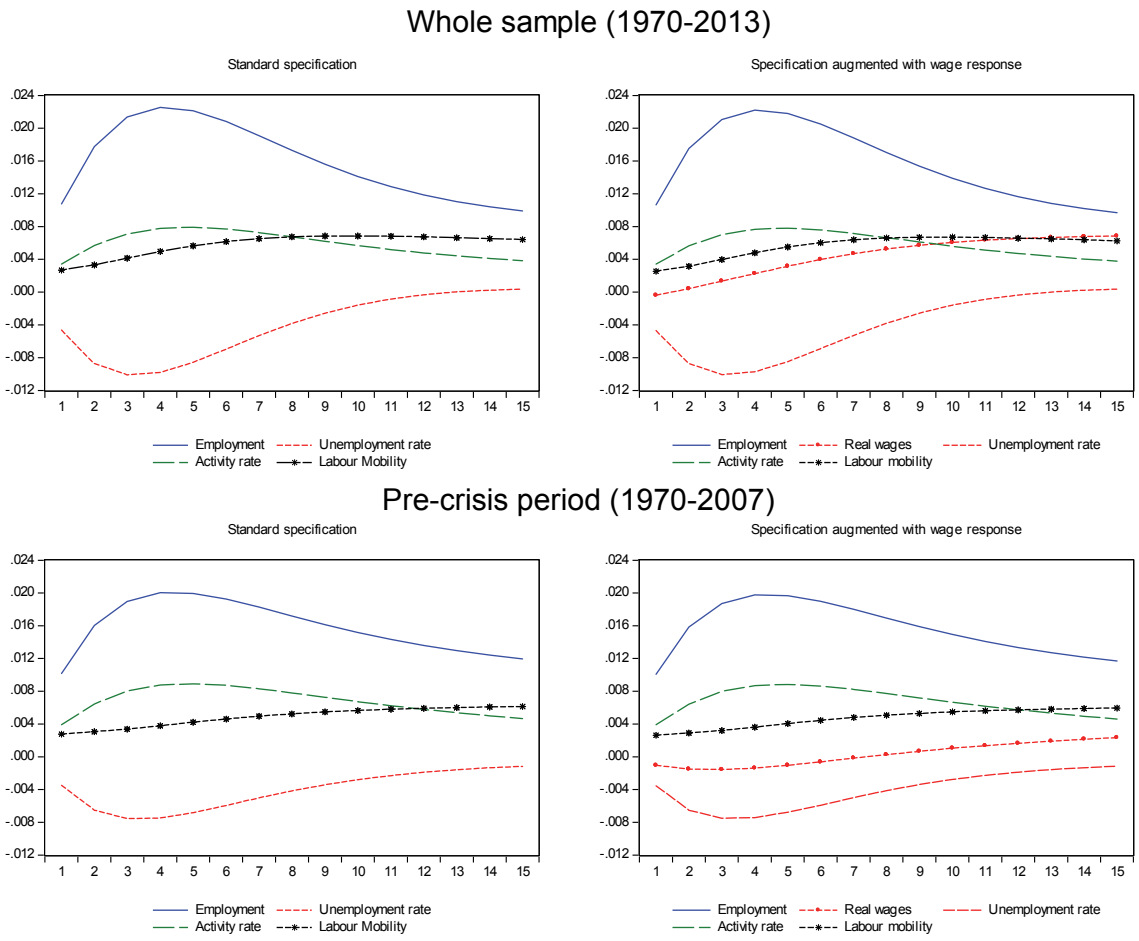
- The identification of the shocks is based on the assumption that unexplained changes in employment growth correspond to country-specific labour demand shocks. These shocks are assumed to influence within the year relative unemployment and activity rates, with a delayed feedback on employment growth. ([20])

- In a different specification of the VAR, real wages are included in the analysis, to gain insight on the role of relative wages in rebalancing Member States' labour markets. In the identification of the shocks, real wages are assumed to respond contemporaneously to labour demand shocks and to affect contemporaneously the labour supply through

([19]) The 0.4 regression coefficient is lower than the one found for the US (0.6) by Blanchard and Katz (1992), but higher than what found by Decressin and Fatás (1995) for regional data (0.2)..

([20]) Shocks are identified with Choleski decomposition of the variance-covariance matrix of reduced form residuals with the order: employment growth, employment rate, activity rate.

Graph 18: **Responses to a country specific positive labour demand shock**



(1) The horizontal axis represents years. All variables in logs; mobility is defined as the change in the employment rate not explained by changes in the employment rate (defined as 1 minus unemployment rate) or the activity rate.
Source: Own calculations.

changes in the employment or in the activity rate. ([21])

5.4. Adjustment to asymmetric labour demand shocks

Evidence from panel VAR analysis

Graph 18 shows the responses of employment, unemployment and the activity rate to a one-standard-deviation positive labour demand shock for the whole sample and for the pre-crisis period. ([22]) Results are shown separately in the parsimonious VAR specification with no real wages and for the specification including a wage equation; and for two sample definitions: one for the whole sample available and one excluding the years after the financial crisis.

It is visible that, according to expectations, labour demand shocks result mostly in a variation of unemployment and activity rates at impact. Such changes however get re-absorbed over time, while

([21]) The identification scheme amounts to order real wages after employment growth and before the other variables. Log of relative real wages are included in the VAR as first differences (i.e. they are assumed non-stationary). Panel unit roots tests confirm their non-stationarity.

([22]) The response to a negative shock is symmetric. For presentational purposes, confidence intervals are not shown. However the responses of the employment rate and the activity rate are significant at 5 percent for about 10 years while the response of the employment is always significant.

real wages and working age population adjust gradually but more persistently.

Over the whole sample (1970-2013), the size of the labour demand shock is about 1.1 percent. As postulated by the Blanchard and Katz framework, the shock is persistent and reaches a maximum after about 4 years, before converging to a value permanently higher than the initial level. Within one year, the unemployment rate falls and the activity rate rises respectively by about 0.5 and 0.3 percentage points above the EU average. The effect of the shock on the unemployment and activity rate is very persistent and lasts beyond 5 years.

As concerns labour mobility, it increases by 0.3 percent the first year and peaks after about 10 years. Thus, in the first year, the unemployment and the activity rates and labour mobility absorb respectively 43 percent, 32 percent and 25 percent of the initial labour demand shock. After 10 years, more than 60 per cent of the shock is absorbed via migration.

All in all, in analogy with previous studies, results indicate that, over the medium term, the large majority of asymmetric demand shocks are absorbed via an adjustment in relative activity rates and mobility, the former being more responsive in the first years after the shock, while the latter becoming predominant after some years. Over the whole sample, results indicate that after less than 8 years mobility tends to become the prevalent form of adjustment to asymmetric shocks.

Over the pre-crisis restricted sample (1970-2007), the shock, is equally sized but more persistent. In response to the shock, within the first year the unemployment rate decline by 0.3 percentage points and the activity rate increases by 0.4 percentage points. Within the first year unemployment and the activity rates absorb about 34 percent and 38 percent of the labour demand shock. ([23]) Compared to the whole sample, the response of unemployment is weaker and more persistent; in contrast, the response of the activity rate larger and more persistent. A key difference across the two periods is found in the response of labour mobility, which appears less responsive to the shock in the pre-crisis period. After 5 years, the response is about 5 percent in the whole sample while for the restricted sample it is below 4 percent.

In the long-term, the increase of the labour supply through higher activity rate and greater labour mobility accounts for respectively 40 percent and 60 percent of the overall increase in employment. The figures for the pre-crisis period are 40 percent and 50 percent. It also emerges that, while for the whole sample in less than 8 years mobility becomes the prominent form of adjustment, for the pre-crisis period it takes more than 11 years for mobility to overtake activity rates asn the most relevant adjustment channel.

All in all, the evidence indicates that mobility played a more important role in the labour market adjustment in the post-crisis period, while the adjustment of unemployment and activity rates was comparatively short-lived, which appears consistent with the weakening of discouraged worker effects observed during the crisis.([24])

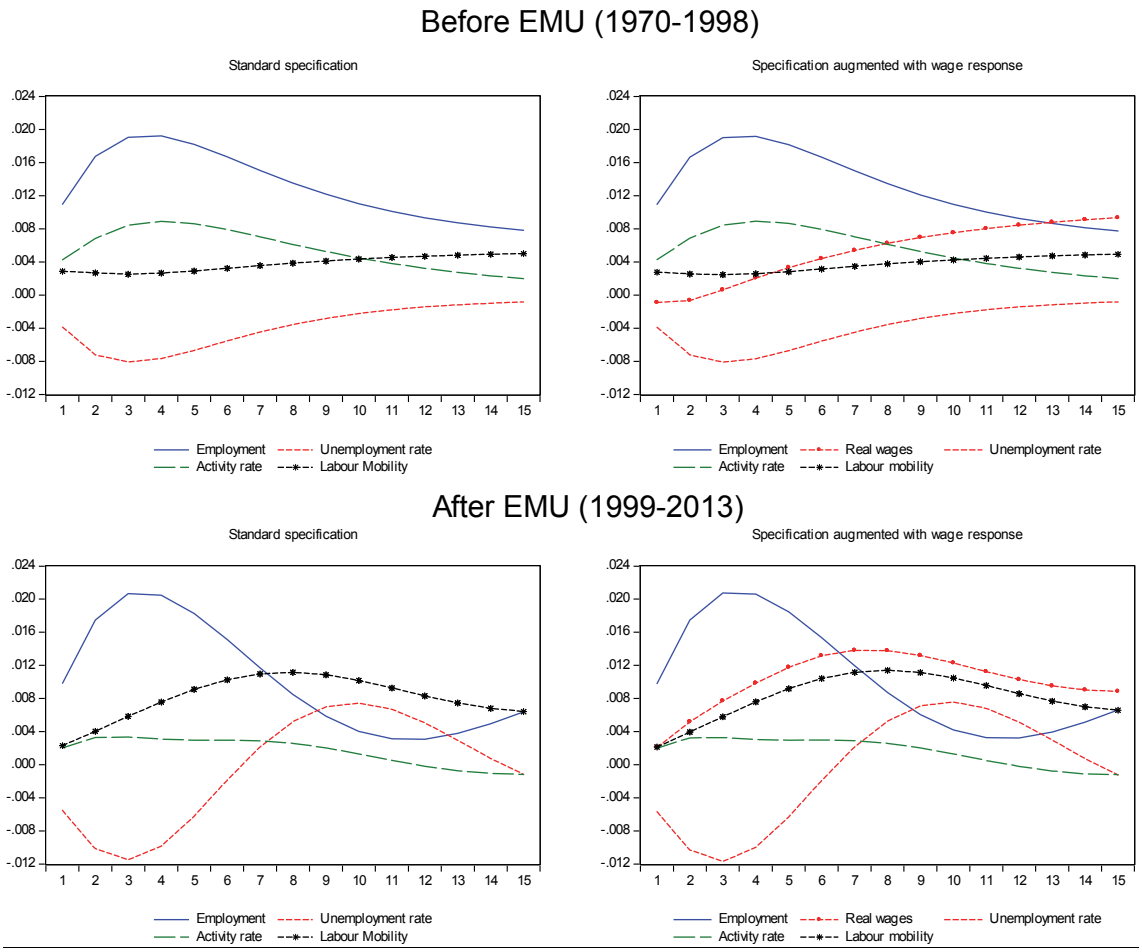
These results are largely confirmed when real wages (based on GDP deflator) are included in the analysis. For whole sample, relative real wages gradually increases in response to the shock and stabilise after about 10 years, broadly in correspondence with the stabilisation of unemployment. In response to a 1 per cent shock, relative wages change by about 0.5 per cent after 10 years. Having the response of wages endogenous in the model does not appear to matter significantly for the value reached by the relative unemployment rate in the long-term, which is consistent with the findings of Blanchard and Katz (1992) for the US states and Bayoumi et al (2006) for Canadian Provinces. ([25])

([23]) The response of the unemployment rate up to 4 years after the shock stays within the standard errors computed over the whole period; after the fourth year, the dynamics of the unemployment rate does not differ over the two samples. In contrast, the response of the activity rate is always within the standard errors computed for the whole period.

([24]) These findings are consistent with those by Jauer et al (2014).

([25]) These findings are robust to a specification where wages are an exogenous variable. The results are also robust to a different identification scheme where wages respond contemporaneously to labour demand and labour supply shocks but affect the unemployment and the activity rates only with a lag. Finally, the results do not change

Graph 19: **Responses to a country specific positive labour demand shock.**



(1) On the horizontal axis years. All variables in logs; mobility is defined as the change in the employment rate not explained by changes in the employment rate (defined as 1 minus unemployment rate) or the activity rate.
Source: Own calculations.

When restricting the sample to the pre-crisis period, the response of real wage appears considerably more muted. These findings suggest that relative real wages have responded faster and stronger after 2008.

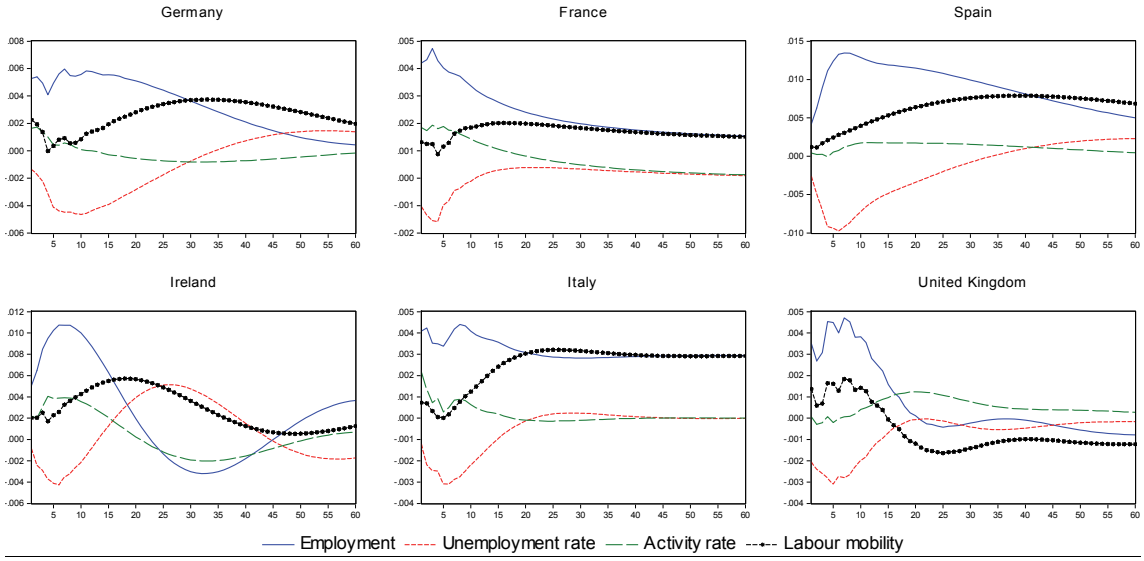
The responses to an asymmetric labour demand shock have also been computed for a different sample split: a pre-EMU and post-EMU period. Graph 19 shows that the labour market adjustment has changed during the EMU period in a number of respects. ([26]) First, despite the labour demand shock is equally sized over the two periods (1.1 percent in the first period and 0.98% in the second), the response of unemployment is quicker and less persistent in the post-EMU period. ([27]) Second, the activity rate exhibits a more muted ans short-lived reaction to the shock. Third, labour mobility appears to respond more quickly and strongly during the EMU period, absorbing a bigger fraction of the shock than the activity rate at any lag. A possible explanation for this finding could be linked to the fact that activity rates in EU countries have been driven to larger extent by

significantly for a specification where relative wages are stationary.

([26]) This is consistent with the results obtained by L'Angevin (2007a,b) comparing the 1990-2005 period with that over the 1970-2005 period. Results are robust to the exclusion from the sample of Denmark, Sweden and the UK.

([27]) This may reflect the persistency of the labour demand shock itself which is lower in the pst-EMU period.

Graph 20: **Responses to a country specific positive labour demand shock for selected EU member states.**



(1) The Impulse response functions are based on estimates of VARs with 4 lags for each country over the period 1998Q2-2013Q4. The horizontal axis represents quarters. All variables in logs; mobility is defined as the change in the employment rate not explained by changes in the employment rate (defined as 1 minus unemployment rate) or the activity rate.
Source: Own calculations.

structural factors, including linked to reforms and policies facilitating labour market participation by females and the elderly, and less by cyclical factors. Third, real wages in the post-EMU period seem to be more reactive to country specific labour demand shocks. Before EMU, the response of real wages to the shock is initially muted and becomes statistically significant after 5 years. In the post-EMU period, wages are significantly different from the pre-shock level after the second year. ([28])

Evidence of a change in the dynamic labour market adjustment after EMU is provided by table 5. The table shows the percentage of the variance of the error made in forecasting a variable due to a specific labour demand shock at a given horizon. It measures the contribution of this shock to the cyclical fluctuations of each variable. For example, 37 percent of the fluctuations in the activity rate are attributed at the 5 year horizon to a labour demand shock. The decomposition of unemployment is not reported because, trivially, labour demand shocks explain at all horizons the largest proportion of unemployment fluctuations.

Table 5: **Variance decomposition: percentage of the variance of each variable explained by a country specific labour demand shock.**

	Before EMU			After EMU		
Years after the shock	Growth of relative real wages	Activity rate	Labour mobility	Growth of relative real wages	Activity rate	Labour mobility
1	0.3	12.6	6.0	1.1	8.4	7.6
3	0.5	27.7	6.0	5.2	15.2	18.9
5	0.9	36.9	6.0	5.7	18.3	21.1
10	1.2	44.0	6.1	5.8	19.8	21.6
15	1.3	45.2	6.2	5.8	19.8	21.6

(1) FEVDs are computed estimating a VAR on relative employment growth, the relative growth of real wages, the relative change in the working age population and the relative activity rate with 4 lags over the period 1970-2014.
Source: Own calculations.

The results show that before EMU, labour demand shocks account for a sizeable proportion of the variance of the activity rate, while these shocks are less relevant for wages or labour mobility. After EMU, there is a considerable change in the relative importance of labour demand shocks. Within one year, they still remain more important for the activity rate than for labour mobility or real wage growth; however, over the medium- to the long-run, labour demand shocks become relatively more important for the variance of labour mobility. These results underscore the increased role of wages and mobility as adjustment mechanism to asymmetric labour demand shocks.

([28]) This finding is influenced substantially by change of relative wages over 2012-2013; in fact, the dynamic adjustment of real wages is closer when the response is computed for the 1999-2011 period is closer to that of the pre- than to that of the post-EMU period.

Box 3: **The VAR framework used to analyse the response of labour mobility to labour demand shocks:**

Blanchard and Katz's (1992) provide the standard framework to assess labour market dynamics. Each country specialises in the production of a particular good; production factors are mobile across states. The relative labour demand n depends on relative product demand z and relative wages w

$$w_{i,t} = -dn_{i,t} + z_{i,t}$$

All variables are relative to the aggregate weighted average. The relative labour demand depends on relative wages and country specific characteristics x_d that affects firms' locational decisions and do not change over time (i.e. are a source of permanent differences in employment levels)

$$z_{i,t+1} - z_{i,t} = -aw_{i,t} + x_{di} + \varepsilon^d_{i,t+1}$$

$\varepsilon^d_{i,t}$ is a country specific labour demand shock. Changes in the labour supply are driven by the relative wage differential, local labour market conditions (the unemployment rate u) and other country specific characteristics x_s that affects workers' locational preferences

$$n^s_{i,t+1} - n^s_{i,t} = bw_{i,t} - gu_{i,t} + x_{si} + \varepsilon^s_{i,t+1}$$

$\varepsilon^s_{i,t}$ is a country specific labour supply shock. The relationship between wages and unemployment is

$$w_{i,t} = -cu_{i,t}$$

The model is closed with the unemployment defined as the difference between labour supply and labour demand.

$$u_{i,t} = n^s_{i,t} - n_{i,t}$$

In the long run, relative employment growth and relative unemployment are determined by the following equations

$$\Delta n_i = \frac{cax_{si} + (cb+g)x_{di}}{ca + d(cb+g)}$$

$$u_i = -\frac{w_i}{c} = \frac{dx_{si} - x_{di}}{ca + d(cb+g)}$$

Employment growth is determined by country specific factors x_{di} and x_{si}. In countries more attractive to companies, the inflow of firms leads to higher wages and lower unemployment, which stimulates the arrival of workers that allow for employment growth to be permanently higher. In countries more attractive to individuals, the inflow of workers pushes wages down and unemployment up. Labour and firm mobility ensures that the effect of labour demand shocks on relative wages, unemployment and participation rates are transitory.

A VAR is estimated to investigate the response of employment, unemployment and participation rate to an asymmetric labour demand shock, i.e. all variables are expressed as deviations from the respective national means. For any variable, the following decomposition holds $y_{it} - y_t = (y_{it} - \beta y_t) + (\beta - 1)y_t$. The first component represents the asymmetric shock while the second common shocks with asymmetric effects. Therefore, the focus of the analysis is on country specific shocks and common shocks with asymmetric effects.

(Continued on the next page)

Box (continued)

The fact that asymmetric shocks have permanent effect on employment levels but not on unemployment and participation rates has two consequences. First, the change in employment levels must occur through labour mobility. Second, the VAR should be estimated with the relative employment in first differences and the employment rate (defined as 1–unemployment rate) and the activity rate in levels.

The following VAR with two lags has been estimated

$$z_{it} = A + A_1(L)z_{it-1} + f_i + \varepsilon_t$$

z_{it} is the following vector $(\Delta n_{it}, le_{it}, lp_{it})$; Δn_{it} is the first difference of the logarithm of employment in country i minus the logarithm of aggregate employment in the EU; le_{it} is the logarithm of the employment rate (*1- unemployment rate*) in country i minus the logarithm of the employment rate (*1- unemployment rate*) in the EU; lp_{it} is the logarithm of the participation rate in country i minus the logarithm of the participation rate in the EU.

A key identifying hypothesis of Blanchard and Katz (1992) framework is that innovations to the employment growth equation are exogenous labour demand shocks. This is a reasonable hypothesis when the correlation between unemployment rates and employment growth is negative, while this correlation is positive if growth derives mostly from labour supply. A panel regression of unemployment rate on employment growth gives a significant slope of -0.56, implying that the hypothesis that innovations to employment growth mostly represent demand shocks is valid also for the EU sample.

The hypothesis that innovations to the employment growth represent labour demand shocks is implemented through orthogonalised shocks, i.e. uncorrelated shocks. Since the variance covariance matrix of the estimated errors ε_t is unlikely to be diagonal (i.e. errors in the equation are correlated), the residuals of the equations have to be decomposed in such a way that they become orthogonal. The Choleski decomposition represents the standard way to do this. In practice, it consists in ordering the variables in the VAR so that shocks to the variables that comes earlier affect the following variables contemporaneously, while those that came after affect the previous variables only with a lag. Thus, it this assumed that labour demand shocks affect the unemployment rate and the participation rate contemporaneously. Supply side shocks effects are assumed to operate through uncorrelated shocks to the employment rate or the participation rate

Another identifying assumption is that country-specific characteristics create constant differences across countries that can be modelled as fixed effects f_i. Since the fixed effects are correlated with the repressors through the lagged dependent variables, fixed effects are eliminated expressing variables as deviation from their country specific means.

The availability of data on wages at the national level allows to explore how much of a labour demand shock is absorbed by changes in relative real wages. The inclusion of wages allows for a better identification of the labour demand shock, where their response should be positive, from labour supply shock, where their response should be negative.

Evidence for selected country-specific VAR analysis

The response to an asymmetric labour demand shock has been simulated for selected member states. Quarterly data are used; employment growth is computed quarter on quarter. For each country a VARs with 4 lags to control for autocorrelation has been estimated over the period 1998Q2-2013Q4.

Graph 20 suggests that results are qualitatively similar to those obtained for the representative EU member states with panel VAR analysis. A number of interesting findings stand out concerning differences in labour market responses across countries. Labour demand shocks appear more persistent in continental European countries than in the UK or Ireland. The response of labour mobility is faster and more short-lived in countries such as Ireland and the United Kingdom where mobility flows are quite high. Conversely, it is more persistent in continental countries (e.g. France and Italy). Finally, labour Mobility accounts for a large share of shocks in Spain and Ireland, which is consistent with the evidence of the post-EMU period obtained on annual data.

6. CONCLUSIONS

This paper attempts to take some steps forward in the understanding of the role of labour mobility as an adjustment mechanism in the EU.

Cross-country mobility flows in the EU are still much lower than those recorded in other highly integrated areas, notably the United States, and well below mobility within countries. The stock of migrants from within the EU is also generally much lower than that from non-EU. Nevertheless, some upward trend is visible, which is not only the result of the enlargement of the EU to Eastern European countries characterised by high outward migration.

It is confirmed that migration flows are affected by traditional explanatory variables like the distance between countries (negatively), common language, colonial history and past migration (positively). In particular, differentials in the unemployment rate are found to affect migration flows very significantly. EU membership is found to increase mutual migration flows positively (by about 25% in the global specification), while euro-area membership makes mobility considerably more sensitive to unemployment differentials (an elasticity of mobility flow to unemployment differentials in the order of 0.3). This finding is consistent with the expectation that, in monetary unions, mobility plays a more relevant role as an adjustment channel to unemployment divergences. It also indicates that, in light of the widened divergence in unemployment rates across the EU, should such divergences persist, within-EU mobility is expected to increase substantially in the coming years.

Evidence from gravity equations also reveal that labour mobility flows among the fifteen countries that were EU members before the 2004 enlargement have increased since the mid-2000s on top of what is explained on the basis of the evolution of fundamentals. The results also show that mutual EU membership increases mobility between countries. While mutual membership in the euro area does not appear to increase mobility flows by itself, it intensifies mobility flows from members with a relatively high unemployment rate to those with a relatively low rate, which suggests that mobility has increased in the monetary union. The results extend previous analyses of migration flows by analysing the interaction of European governance and economic dynamics. All in all, this evidence suggests that increased mobility flows within the EU are not simply due to the enlargement or the growing heterogeneity of EU countries, but are linked to a gradual deepening of the extent of labour market integration.

The analysis of the dynamic response of mobility flows to asymmetric shocks in the vein of Blanchard and Katz (1992) confirms the findings of the literature that in Europe unemployment and participation absorb the largest fraction of asymmetric labour demand shocks in the short- to medium-term. Over the whole sample, about one quarter of asymmetric labour demand shocks are absorbed by labour mobility within 1 year, while about 60 per cent of the shock is absorbed after 10 years, an estimate which is in line with that obtained in previous analogous analyses (see Table 3).

However, in line with L'Angevin (2007a,b) and Dao et al (2014), the paper also shows that

mobility in the EU has been playing a more relevant role starting from the completion of the monetary union. The response of real wages to demand shocks also appear to have strengthened.

Boyer and Smets (2014) found that the role of labour mobility as adjustment mechanism for the EU regions has fallen over the period 1994-201; however, their analysis is not in contradiction with those of this paper which focus on mobility across countries and not regions. The difference suggests that mobility adjustment within the EU are triggered more by country that by region specific shocks.

Overall the findings in the paper imply that, although labour mobility across the EU remains hindered on a number of fronts and the magnitude of flows remain below what could be expected in fully integrated areas and monetary unions, monetary unification was followed by increased responsiveness of labour mobility to asymmetric demand shocks.

Further analysis should investigate the reasons underlying such increased responsiveness of mobility flows in the euro area, notably the relative roles of the integration with the EU of Eastern European countries (see, e.g., Jauer et al., 2014) and the loss of the exchange rate and independent monetary policy as shock absorbers. Regional adjustment mechanism is a mixture of regional adjustment to region-specific shocks and to common shocks. Beyer and Smets (2014) show that mobility plays always a larger role in the US compared to the EU. However, the adjustment to regional adjustment to heterogeneous reactions to common shocks differs considerably across the EU and the US; on the other hand, the adjustment to region specific shocks The analysis also suggests that, in the coming years the persistence of the large unemployment differentials observed after the crisis could entail cross-country labour mobility flows of a considerable magnitude, which could require in some cases supportive policy frameworks to ensure the effective integration of mobile workers.

ANNEX 1

The appendix documents the sample composition of the gravity equations by year and destination country and it provides the list of origin countries included in the sample.

Table A1.1 shows that the number of observations progressively increases by year.

Table A1.1: **Sample composition of gravity equation by year**

Year	No of obs.
1992	183
1993	210
1994	217
1995	250
1996	521
1997	723
1998	1094
1999	1248
2000	1449
2001	1743
2002	1765
2003	1723
2004	1802
2005	1937
2006	2019
2007	2060
2008	2193
2009	2330
2010	2269
2011	2188
Total	**27924**

Source: Own calculations.

Table A1.2 shows the sample composition by 38 destination countries in the OECD International Migration Database. The table shows that the number of observations is very heterogeneous across countries. This has multiple reasons. First, few observations are available for some countries that were included in the database relatively recently (the Baltic countries, Greece, Slovenia). Second, few observations are available for some destination countries that report only few bilateral relationships per year (this is the case most notably for Ireland).

Table A1.2: **Sample composition of gravity equations by destination country**

Destination country	No of obs.
Australia	1449
Austria	1214
Belgium	678
Canada	1626
Chile	817
Czech Republic	288
Denmark	1391
Estonia	7
Finland	1266
France	1146
Germany	1596
Greece	36
Hungary	831
Iceland	791
Ireland	19
Israel	423
Italy	385
Japan	633
Korea, Rep.	904
Latvia	53
Lithuania	67
Luxembourg	1248
Mexico	330
Netherlands	758
New Zealand	1078
Norway	1525
Poland	800
Portugal	268
Romania	58
Russia	131
Slovak Republic	530
Slovenia	162
Spain	1329
Sweden	1264
Switzerland	563
Turkey	127
United Kingdom	506
United States	1627
Total	**27924**

Source: Own calculations.

Finally, the sample includes the following 163 origin countries: Afghanistan, Albania, Algeria, Antigua and Barbuda, Argentina, Armenia, Australia, Austria, Azerbaijan, Bahamas, Bahrain, Bangladesh, Barbados, Belarus, Belgium, Belize, Benin, Bermuda, Bhutan, Bolivia, Bosnia and Herzegovina, Botswana, Brazil, Bulgaria, Burkina Faso, Cambodia, Cameroon, Canada, Chile, China, Colombia, Costa Rica, Croatia, Cuba, Cyprus, Czech Republic, Côte d'Ivoire, Denmark, Djibouti, Dominica, Dominican Republic, Ecuador, Egypt, El Salvador, Estonia, Ethiopia, Fiji, Finland, France, Georgia, Germany, Ghana, Greece, Grenada, Guatemala, Guyana, Haiti, Honduras, Hong Kong, Hungary, Iceland, India, Indonesia, Iran, Iraq, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Kazakhstan, Kenya, Korea Rep., Kuwait, Kyrgyz Republic, Lao People's Dem. Rep., Latvia, Lebanon, Lesotho, Liberia, Lithuania, Luxembourg, Macedonia, Madagascar, Malawi, Malaysia, Maldives, Mali, Malta, Marshall Islands, Mauritania, Mauritius, Mexico, Moldova, Mongolia, Morocco, Mozambique, Namibia, Nepal, Netherlands, New Zealand, Nicaragua, Niger, Norway, Pakistan, Palau, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Poland, Portugal, Puerto Rico, Qatar, Romania, Russia, Rwanda, Samoa, San Marino, Saudi Arabia, Senegal, Seychelles, Sierra Leone, Singapore, Slovak Republic, Slovenia, Solomon Islands, South Africa, Spain, Sri Lanka, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Sudan, Suriname, Swaziland, Sweden, Switzerland, Syrian Arab Republic, São Tomé and Principe, Tajikistan, Tanzania, Thailand, Timor-Leste, Tonga, Trinidad and Tobago, Tunisia, Turkey, Tuvalu, Uganda, Ukraine, United Arab Emirates, United Kingdom, United States, Uruguay, Vanuatu, Venezuela, Vietnam, Yemen, Zambia, Zimbabwe.

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