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No. 137/April 2007
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* Views expressed are those of the authors and do not necessarily reflect official positions of De Nederlandsche Bank.
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April 3, 2007

Abstract

We analyse the role of labour mobility as a mechanism for regional adjustment in Europe. We find that only a small share of migration can be explained by economic differences. Moreover, despite European integration and structural reforms, the role of labour migration in regional adjustment has not increased since the late 1980s. We conclude that regional migration in Europe currently acts as a source of disturbances rather than an adjustment mechanism.

Key words: labour mobility.
JEL codes: F2, J60, R1

1 Introduction

Labour mobility is a potentially important channel of adjustment to regional shocks. The mobility of labour figures prominently in the theory of optimum currency areas (Mundell, 1961) and in empirical research on the United States (Blanchard and Katz, 1992). The evidence on Europe indicates that interregional labour mobility is generally of lesser importance there, while changes in participation rates play a relatively large role in the absorption of

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regional shocks (Decressin and Fatás, 1995). Eichengreen (1993), Bayoumi and Prasad (1997) and Bentivogli and Pagano (1999) find that migration flows in Europe tend to be less responsive to economic shocks than in the United States and that, as a result, economic differences between European regions tend to be more persistent. Huber (2004) argues that institutional factors such as employment protection, and the share of owner-occupied housing play an important role in explaining low internal migration rates in Europe.

We address the question whether regional migration is primarily an adjustment mechanism or a source of shocks. We study whether migration responds to regional economic differences and whether migration flows make an economically significant contribution to restoring equilibrium. If in a monetary union, regional migration does not help in the adjustment to asymmetric shocks, then the burden of adjustment on other channels of adjustment will be larger. We rely on a simple regression model the roots of which go back to the seminal work by Harris and Todaro (1970). Next, we study whether the role of migration has changed over time. Most of the available research uses data until the late 1980s. Europe has undergone some important changes since then: (a) the completion of the Single Market in 1992 has lifted some of the formal barriers for cross-border migration; (b) monetary union has shut off the exchange rate as an adjustment channel for a large subset of European countries, which has enhanced the need for alternative adjustment mechanisms, such as labour migration; (c) efforts to transform the European social security ‘hammock’ into a ‘spring-bed’ may have changed the dynamics of the participation rate and the unemployment rate in response to adverse economic shocks. In the first part of the analysis, we can use actual migration data. However, in the second part, we analyse changes over time. This requires data series which span several decades. Given the lack of regional migration data for such a long period of time, we follow Blanchard and Katz (1992) and Decressin and Fatás (1995) in calculating migration as a residual from regional data on population, employment and participation rates. We have extended the dataset used by Decressin and Fatás (1995), which ends in 1987, by another sixteen years.

The remainder of the paper is organised as follows. In the next section, we study to what extent migration is an adjustment mechanism or a source of disturbances. In section 3, we analyse whether the role of labour mobility has changed over time. Section 4 concludes.
2 Adjustment mechanism or source of disturbance?

In this section, we analyse whether regional migration acts as an effective adjustment channel or that it should primarily be regarded as a source of shocks instead.

Data

We have data for regional migration between countries and within countries. These data cover 38 European regions for a recent four-year period (1996-99). See appendix A for a detailed data description.

Gross migration flows between regions in the same country are in the order of 1.5 to 2.0% of population, depending on whether the UK regions (for which no cross-border migration data are available) are included. See Table 1. International arrivals are 0.6% of population. Based on another source, we estimate that around 75% of international arrivals are from outside the European Union, implying that migration between EU countries amounts to only 0.15% of population. Thus, regional migration within EU countries is much more sizeable than between these countries. Given that these cross-border data are contaminated by migration flows from outside the European Union (which is likely to be determined largely by differences in national policies towards immigrants from outside the EU), we will focus on regional migration within national borders.

[TABLE 1 AROUND HERE]

Even large migration flows may not have a significant impact at the macro level, if inflows and outflows are of the same magnitude. Therefore, in what follows, we focus on net migration.

A simple model

We expect net migration across regions to be mainly driven by expected income gains. This approach goes back to Harris and Todaro (1970), who introduced the idea of migration of workers being driven by expected future

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1 New Chronos Database (data for 1995-97).
2 We have analysed migration across national borders as well. It turns out that these flows exhibit a higher degree of persistence than regional migration within national borders and also show some responsiveness to regional economic differences. These results are not reported here.
income. The unemployment rate is used as a proxy for the migrant’s expected chance of finding a job and income per capita is used as a proxy for the expected wage rate.

The model for net migration is (see appendix B for derivation):

\[
MIG_{j,t} = \alpha_j + \beta \log \left( \frac{w_j}{\bar{w}} \right)_{t-1} + \gamma (u_j - \bar{u})_{t-1} + \varepsilon_{j,t},
\]

where \(MIG_{j,t}\) is net migration into region \(j\) (as a % of population in region \(j\)) in time period \(t\), \(w_j\) is the average wage rate in region \(j\), \(u_j\) is unemployment as a % of the labour force in region \(j\), \(\bar{w}\) and \(\bar{u}\) are (weighted) averages for wages and unemployment over all regions belonging to the same country as region \(j\), and \(\alpha_j, \beta, \gamma\) are constants.

We use explanatory variables in relation to the national average, in line with the fact that we seek to explain migration flows within national borders. Note that the coefficient \(\beta\) indicates the impact of a 1% increase in income, whereas the coefficient \(\gamma\) indicates the impact on migration of a 1 percentage point increase in the unemployment rate.

Empirical results

We look at cross-sectional variation first. We take simple averages over the 1996-1999 period for all variables in order to obtain a cross-sectional dataset. When estimating equation (1), we find a negative coefficient for the unemployment rate and a coefficient for income which is not significant in individual regressions, even though the point estimate is consistently positive in all regressions. See Table 2. This confirms the theoretical prediction that migrants are attracted by low unemployment, but not the idea that income is an important pull factor.

The evidence with respect to unemployment is more convincing when using the ratio of regional unemployment over national unemployment \((u_i / \bar{u})\), than when using the deviation from national averages \((u_i - \bar{u})\). The explanation could be that migration is less responsive to regional unemployment differences when the unemployment rate is high.\(^3\)

Recall that we use income per capita as a proxy for the wage rate and note that income per capita may also be affected by the rate of (un)employment. We take account of this possible source of multicollinearity between the two

\(^3\)Using the unemployment ratio is equivalent to assuming that the coefficient on the deviation of regional unemployment from the national average is inversely related to national unemployment. This can be seen by noting that: \(\frac{u_i}{\bar{u}} = 1 + \frac{1}{\bar{u}} (u_i - \bar{u})\). See Pissarides and McMaster (1990).
main explanatory variables by including them both simultaneously and individually and then assess the stability of the coefficients across regressions. The results in Table 2 suggest that multicollinearity is not a serious problem here.

Next, we analyse the full panel. Our data show that migration within national borders exhibits a rather strong degree of persistence.\textsuperscript{4} This is in line with the findings of Eichengreen (1993), who reports that migration patterns tend to be rather persistent, and more so in Europe than in the US, and Rappaport (2000), who argues that population flows are more persistent than almost any economic variable. In order to capture this high degree of persistence in regional migration flows we estimate the model with region-specific fixed effects.

As before, we find a negative coefficient for the unemployment rate and a coefficient for income which is not significant in individual regressions, but with a point estimate which is consistently positive in all regressions. See Table 3. The coefficients are fairly stable across regressions I-IV, suggesting that multicollinearity is not an important issue here. Comparing columns II and IV confirms that the responsiveness of migration to unemployment differences depends on the general level of unemployment, in the sense that regional unemployment differences are less likely to trigger migration flows when the average national unemployment rate is high.

The analysis has implicitly assumed that the explanatory variables are exogenous. Appendix C presents evidence that this assumption is not violated.

[TABLES 2 AND 3 AROUND HERE]

**Economic significance of migration**

We have found that migration responds to regional differences in unemployment. But does migration play an important role in eliminating those differences? The estimates imply that migration accounts for adjustment equal to roughly 3\% of the initial unemployment difference in the first year and 16\% of the initial difference after five years (Table 4).\textsuperscript{5}

\textsuperscript{4} The Augmented Dickey-Fuller and Phillips-Perron tests yield p-values well below 5\%, so that the null hypothesis of a unit root is clearly rejected.

\textsuperscript{5} From our final specification for the level of migration (results in column IV in Table 3), the coefficient of the unemployment rate is 1.57, whereas the influence of income differences is not statistically significant. Thus, a difference in the unemployment rate of 6\% of the
Our final specification for the level of migration (specification IV in Table 3) explains 97% of the variation in the migration rate. This high $R^2$ is largely due to the high persistence of migration flows, which implies a high explanatory power of the fixed effects. To obtain a more realistic impression of the explanatory power the unemployment rate, one could compare the $R^2$ of regression IV (0.97) to the $R^2$ when only a constant and region-specific constants are included (0.81). This yields a difference of 16 percentage points, suggesting that only 10-20% of net migration flows should be regarded as a shock absorber, whereas the remaining 80-90% should be regarded as an exogenous shock. Thus, migration flows should be largely seen as a source of disturbance, rather than as a shock absorber.

3 Has the role of migration changed over time?

In order to analyse whether the role of migration has become different over time, we need data which cover several decades. Given the lack of migration data for such a long time period, we must resort to an indirect approach.

Methodology

We apply the approach by Blanchard and Katz (1992), who investigate the role of migration in the regional adjustment to asymmetric labour demand shocks. The economic reasoning is that a negative regional demand shock initially causes an increase in unemployment and a decrease in labour participation. The shock will also negatively affect real wages. These effects in turn triggers two adjustment channels, that eventually restore equilibrium. Firstly, the lower real wages eventually create new jobs, either by attracting new firms from outside the region, or by inducing existing firms

\begin{table}
<table>
<thead>
<tr>
<th>Year</th>
<th>Increase in Unemployment</th>
<th>Decrease in Labour Participation</th>
<th>Shock Absorber</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.2%</td>
<td>1.0%</td>
<td>0%</td>
</tr>
<tr>
<td>5</td>
<td>0.7%</td>
<td>3.0%</td>
<td>0.0%</td>
</tr>
</tbody>
</table>
\end{table}

We have implicitly assumed that fixed effects in the panel analysis pick up persistence in migration which is unrelated to differences in the unemployment rate. Therefore, the coefficient of the unemployment rate provides the marginal impact of regional differences in unemployment on migration.
to expand their workforce. This will partly reverse the decline in employment. Secondly, both the lower real wages and the higher unemployment lead to an outward migration of workers. In the end, both participation and unemployment return to their original values, while the effect on employment depends on the relative strength of the two channels.

To measure this, we estimate the joint dynamic response of employment, the (un)employment rate and the participation rate to a regional employment shock in a panel for European regions. The migration response is derived indirectly (see below). We are not interested in the developments at the aggregate European level, but only look at the regional adjustment to asymmetric shocks. Therefore, regional employment \( n_i \), unemployment rates \( e_i \) and participation rates \( p_i \) are defined as deviations from the European average.

Following Blanchard and Katz, we assume on theoretical grounds that employment is nonstationary, while the (un)employment and participation rates return to their "natural value" (an assumption that will be checked below). Therefore, in our basic specification, employment is used as a growth rate (first difference), while unemployment and participation rates are used in levels. Data are all in logs. This results in the following system of equations, with a maximum of two lags \((L=2)\):

\[
\Delta n_{it} = \alpha_{i1} + \beta_1(L)\Delta n_{it-1} + \gamma_1(L)e_{it-1} + \lambda_1(L)p_{it-1} + \epsilon_{i1t} \quad (2)
\]

\[
e_{it} = \alpha_{i2} + \beta_2(L)\Delta n_{it} + \gamma_2(L)e_{it-1} + \lambda_2(L)p_{it-1} + \epsilon_{i2t} \quad (3)
\]

\[
p_{it} = \alpha_{i3} + \beta_3(L)\Delta n_{it} + \gamma_3(L)e_{it-1} + \lambda_3(L)p_{it-1} + \epsilon_{i3t} \quad (4)
\]

We associate regional employment shocks \((\epsilon_{i1})\) with shocks in the relative demand for labour. This assumptions seems reasonable, since labour supply developments tend to evolve more slowly over time. To identify these

\[6\] Instead of the unemployment rate \(u\), we use the employment rate \(e\) in the following analysis. The difference is trivial, since \(u = 1 - e\).

\[7\] This paper focuses on the final responses of migration, unemployment and participation to a regional shock. To determine these responses, it is not necessary to make the role of wages explicit in the model, since they only serve as an intermediate variable in the adjustment. Moreover, existing research suggests that the role of wages is relatively small. Fatás (2000) finds that relative wages do not respond to regional demand shocks in Europe, while Obstfeld en Peri (1998) find that the response of relative prices is marginal at best. Nevertheless, it would be interesting to determine the exact role of regional wage adjustment more explicitly. We leave this to further research.

\[8\] To be more specific: \(n_{it} = \log(N_{it}) - \log(N_{EU1})\), where \(N\) is employment in fte’s; \(e_{it} = \log(E_{it}) - \log(E_{EU1})\), where \(E\) is the employment rate (employment divided by the labour force) and \(p_{it} = \log(P_{it}) - \log(P_{EU1})\), where \(P\) is the gross participation rate (labour force divided by population).
demand shocks, we allow current shocks in relative employment growth to have a direct effect on the employment rate and the participation rate, but not vice versa.

We incorporate region-specific constants (‘fixed effects’) in each equation. The fixed effects can be interpreted as a region-specific rate of relative employment growth and region-specific natural rates of unemployment and participation, respectively. As a consequence, these permanent differences do not trigger any adjustment in our model. This implies that we do not look at the possible migration response to permanent differences in unemployment. Our model only measures the migration response to temporary shocks, that drive the variables away from their long-term averages.

The migration response is not observed directly, but is computed as a residual from the following identity:

\[
\Delta \log(n_{it}) \equiv \Delta \log(e_{it}) + \Delta \log(p_{it}) + \Delta \log(pop_{it})
\]  

This equation simply states that observed changes in employment can only come from three sources: a change in the employment rate, a change in the participation rate or a change in the (working age) population. The changes in the population derived from equation (5) are completely attributed to changes in migration. This is possible because population growth from natural demographic developments (i.e. excluding migration) is essentially a long-term trend phenomenon, and our specification ensures that these are filtered out.\(^9\)

**Patterns of adjustment in different periods**

Applying this approach to European regions, we combine data until 1987 from Décressin and Fatás (1995) with more recent data. This results in an annual data set for 54 European regions for the period 1960-2003 (see appendix). We estimate this model for three periods with a comparable amount of observations: 1970-1980, 1981-1990 and 1991-2003. We use Generalized Least Squares (GLS) with cross-section weights to take into account the possibility of heteroskedasticity across regions.\(^10\) We correct the standard

\(^9\)The general increase in population is filtered out because all regional variables are relative to the European average. Any remaining regional trends in population growth are captured by the region-specific constants in the employment growth equation.

\(^10\)Ideally, one would like to use Seemingly Unrelated Regression (SUR), also taking into account possible correlation between regions. Since our method of removing aggregate European developments is not perfect, it is possible that the region-specific shocks are correlated across regions. Unfortunately, the number of cross sections in our sample (54)
errors for the possibility of correlation (panel-corrected standard errors). The impulse responses following a shock in regional employment are shown in figures 1 to 3. The adjustment is relatively similar across time periods, and matches the pattern described above. In the short term, a positive regional shock in employment growth increases the regional participation and employment rates, while the effect of migration is very small. After some time, both the participation rate and the employment rate return to their original values, whereas inward migration from other regions becomes relatively more important over time.

The role of migration has changed slightly over time, but there is no increasing trend. If regional employment increases by 100 people, the migration response after five years is roughly 12 people in the 1970s, 23 people in the 1980s and 15 people in the last period. If we consider the migration response after one or two years, the story is somewhat different, in the sense that the response in the period since 1990 is stronger than before. See Table 5. So the long-run response of migration in Europe has not become larger over time, but the migration response starts somewhat more quickly.\(^{11}\) The responses of the employment rate and the participation rate show no clear trend. Our results confirm the finding by Decressin and Fatás (1995) that the participation rate is the most important shock absorber in Europe. After one year, the participation rate, the employment rate and migration account for roughly 60, 30 and 10% of the adjustment, respectively.\(^{12}\) After five years, the responses have evolved to roughly 25, 15 and 15% of the initial shock.\(^{13}\) Thus, the participation rate is relatively quick to respond, whereas migration is a relatively slow adjustment mechanism. Decressin and Fatás attribute the strong response of participation rates in Europe to the use of generous disability and early retirement schemes in response to adverse economic shocks.

\(^{11}\)We do not discuss the response after more than five years. Although migration flows are highly persistent (Rappaport, 2000), it should be pointed out that the response function is increasingly determined by the stationarity restriction at longer horizons.

\(^{12}\)These figures are from the regression of the last period, 1991-2003.

\(^{13}\)The responses add up to only 55% of the initial employment shock, as the effect of the initial shock on employment has been partly reversed after five years.
The analysis in this section makes various assumptions, including the stationarity of regional unemployment and participation rates, the relevance of region-specific fixed effects, the similarity of response coefficients across regions and the independence of the disturbance terms across equations. Appendix C checks the validity of these assumptions and checks the sensitivity of our results in cases where the assumptions may not be satisfied. The alternative specifications confirm the baseline results presented above.

To conclude, we generally find a relatively small response of migration to shocks. The role of migration has not increased over time, although the migration response seems to start somewhat more quickly.\textsuperscript{14} Our basic specification suggested that migration accounts for 15\% of the adjustment to a shock in employment growth after five years.\textsuperscript{15} The average yearly shock in employment growth is 0.98\% of the population and would thus trigger a yearly migration response around 0.03\% of the population.\textsuperscript{16}

\section{Conclusions}

We have analysed the role of regional migration on Europe. We studied whether migration should primarily be regarded an adjustment channel or a source of shocks, using migration data for a recent four-year period. Also, we analysed possible changes in the role of migration over time, using regional employment data for a period of over three decades, extending the dataset used by Decressin and Fatas (1995) by another sixteen years. This leads to the following conclusions.

First, regional migration within national borders is partly driven by differences in the unemployment rate, in the sense that people move from

\textsuperscript{14} We re-ran all the regressions in this section with data at the country level (1960-2003), rather than the regional level. The results are very similar, in the sense that we do not find an increasing role of migration in our basic specification, in the specification in first differences or in the "beta-differenced" specification. Also the slightly decreasing role of participation is confirmed in these estimates.

\textsuperscript{15} We report the estimates for the period 1991-2003 here, as these are the most relevant when comparing with the results from the approach in section 2, which uses data for 1996-99.

\textsuperscript{16} The shock in employment growth is calculated as the standard deviation of the residuals in the employment growth equation (1.5\%), multiplied by the average European employment rate (94\%) and participation rate (68\%). The average yearly migration response is calculated as one-fifth of the response after five years, i.e. $\frac{1}{5} \times 0.98\% \times 15\%$. 
regions with high rates of unemployment towards regions with low rates of unemployment, but there is little evidence that income differences play a role as well. This result is in line with Huber (2004), who finds that regional unemployment disparities create stronger migration incentives than regional income disparities.

Second, we find a migration response of around 15% of the original shock after five years. This suggests that the importance of migration as an adjustment mechanism is small. Moreover, only around 10-20% of net migration seems to be related to regional differences in income and unemployment. This suggests that migration in Europe presently acts as a source of disturbance, rather than an adjustment mechanism.

Third, the role of migration has not increased in the 1990s, even though the migration response may start somewhat sooner. This suggests that the completion of the European internal market and the introduction of the euro have had no significant positive impact on labour mobility as a channel of adjustment within the European Union so far.

We conclude that the contribution of labour mobility between regions to economic adjustment in Europe is almost negligible. As long as this does not change, a larger burden will be put on other channels of adjustment.
Appendix

A Data description

Data for the approach in section 2 were obtained from Eurostat’s New Chronos database. Data for the unemployment rate (an important candidate explanatory variable, derived from employment and labour force data) are available at the regional level only from 1996 onwards.

Yearly migration data are available for regions in nine EU member states. Within this group, data for the German regions only cover the first half of the 1990s. For Italy, some regional migration data are available, but the lack of regional population data precludes the use of these data in our analysis. Thus, we come to a (fairly) complete panel data set for 38 regions (at the NUTS-2 level) for 1996-99, distributed over 7 EU member states. These are Belgium (3 regions), Spain (7), Netherlands (4), Austria (3), Finland (2), Sweden (7) and United Kingdom (12).

There are no data on international migration for the UK regions. Several other data were missing as well.\textsuperscript{17} This left us with 87 observations for regional migration within national borders, out of a maximum of (4x26=) 104 observations.

Data for the approach in section 3 are largely based on the data we kindly obtained from Antonio Fatás. These are yearly data on employment, labour force and working-age population for 54 European regions for 1960-87 obtained from the OECD and Eurostat. See Decressin and Fatás (1992, appendix B) for a more precise description. We have updated their dataset by including another 16 years, using regional data from Eurostat. Regional data on employment are only available for the period 1996-2002, labour force data for the period 1990-2002 and data on total population for the period 1987-2002. Due to the redefinition of some regions in Germany, the UK and Spain, we have merged some regions in the new dataset, in order to make them comparable to the data from Fatás. We also rescaled the new

\textsuperscript{17}Other missing data are: national and international migration for the 3 Belgian regions for 1997, international migration for one Spanish region (the Canaries) for 1996 and migration and/or population data for two (small) Swedish regions for several years, national migration for all 12 UK regions for 1999, unemployment for one Finish region for 1996-98. The following data have been excluded, as they contained apparent errors: national migration for the Spanish regions for 1996 (net migration exactly equal to zero for all regions) and international migration for the Austrian regions for 1999 (international migration exactly equal to national migration for all regions).
We used data on total population, in order to make them comparable to the data on population between 15 and 64 in the Fatás dataset. Even then, we must keep in mind that the regional dataset suffers from gaps for some years.

Our regional dataset consists of data from Germany (8 regions), France (8 regions), Italy (11 regions), the UK (11 regions) and Spain (7 regions). These regional data are complemented by data for 9 smaller European countries as a whole (Belgium, Denmark, Greece, Portugal, Finland, Ireland, The Netherlands, Austria and Sweden), bringing the total amount of regions in our dataset to 54. For these 9 countries, we used a new, fully consistent dataset for the period 1960-2003 from Eurostat. In our robustness check, we have also used data from the 15 EU countries as a whole.

B Derivation of estimation equation

Following Harris and Todaro (1970), we assume migration to be determined by the expected income gain and migration costs. The expected income gain is approximated by the average wage times the probability of employment in the region of destination compared to the average wage times the probability of employment in the home country. Migration costs are assumed to include any monetary or non-monetary cost of migration, as well as a risk premium for the uncertainty involved in moving to another country. Then

\[
MIG_{ij} = E\left[ \frac{w_j(1-u_j)}{w_i(1-u_i)} ; C_{ij} \right],
\]

where \( MIG_{ij} \) is net migration from region \( i \) to region \( j \), expressed as a percentage of the population in the region of destination, \( w_i \) is the average level of wages in region \( i \), \( 1-u_i \) is employment as a percentage of the labour force in region \( i \), which is used as a proxy for the probability of employment, and \( C_{ij} \) is migration costs when moving from region \( i \) to \( j \).

Define \( MIG_j \) as total net migration into region \( j \). Then

\[
MIG_j = E\left[ \frac{w_j(1-u_j)}{\bar{w}(1-\bar{u})} ; C_j \right],
\]

where \( \bar{w}, 1-\bar{u} \) and \( C_j \) are (weighted) averages of the wage, the employment rate and migration costs over all regions, respectively. We have implicitly assumed that each region has a negligible impact on the average of all regions.
Next, we choose a specific functional form, assuming log-separability in migration costs and expected gains:

\[ M_{IGj} = \beta \log\left( \frac{w_j}{\bar{w}}(1 - u_j) \right) - \log C_j = \]
\[ = \beta \log\left( \frac{w_j}{\bar{w}} \right) + \beta(\pi - u_j) - \log C_j, \]

with \( \beta > 0 \) and we have used that \( \log(1 + x) \approx x \), for \( x \) small.

Allowing for the possibility that agents are more sensitive to either income differences of employment chances and defining the constant \( \alpha_j = \log C_j \), the model for net migration into region \( j \) becomes

\[ M_{IGj} = \alpha_j + \beta \log\left( \frac{w_j}{\bar{w}} \right) + \gamma(u_j - \bar{\pi}), \]

with \( \beta > 0 \), \( \gamma < 0 \).

The interpretation of the coefficients becomes clear after taking total derivatives:

\[ dM_{IGj} = \beta(\hat{w}_j - \hat{w}) + \gamma(du_j - d\pi), \]

where \( \hat{x} = dx/x \), so that the coefficient \( \beta \) indicates the impact on migration of a 1% relative increase in wages, whereas \( \gamma \) indicates the impact on migration of a 1 percentage point relative increase in the unemployment rate, with migration expressed as a percentage of population.

C Sensitivity analysis

Robustness of the analysis in section 2

An issue to be addressed is whether the explanatory variables used in section 2 are truly exogenous. It is easy to see how feedback effects could occur: immigration has an upward effect on labour supply which could depress wages and raise the unemployment rate. There are several reasons to believe that feedback effects are relatively small in this case. First, immigration implies higher demand for products and services, which could dampen if not reverse the impact of additional labour supply on wages and unemployment. Second, given the very small size of regional migration flows in Europe feedback effects are likely to be very small. We use explanatory variables with a one-year lag in order to ensure weak exogeneity of the explanatory variables (i.e. the explanatory variables are contemporaneously uncorrelated with the
error term). However, estimating the equation using ordinary least squares with fixed effects requires strong exogeneity of the explanatory variables (i.e. also no lagged dependent variables, no feedbacks). We carry out an informal test of strict exogeneity by estimating the relationship also in first differences. This results in a coefficient for the unemployment rate \( \left( \frac{u}{u} \right)_{t-1} \) equal to -1.51 and a coefficient for income \( \log(\frac{w}{w})_{t-1} \) equal to 0.036. Comparison with the regression in levels (columns IV in Table 3) shows that the parameter estimates for the unemployment rate are quite similar, suggesting that we do not make a large mistake by assuming the unemployment rate to be strictly exogenous. The parameter for income cannot be estimated with a sufficient degree of precision. The estimates are not significantly different from zero, nor significantly different from each other.

We also assess whether the insignificance of the parameter for income could be explained by migration responding to relative income growth rather than relative income levels. Pissarides and McMaster (1990) argue that relative wage differences may exist in equilibrium, due to preferences to live in certain regions and composition effects. An example of the latter would be a higher share of white-collar workers, which pushes up the average wage level in certain regions. Then, keeping other things equal, a change in relative wage, rather than a level difference, could trigger migration. However, including income growth in our regressions did not yield any significant results in any of the cases (not reported), so we conclude that neither income levels nor income growth differences are important in explaining regional migration.

**Robustness of the analysis in section 3**

We have checked the robustness of the results presented in section 3 to various assumptions in the model. We start by testing the significance of the region-specific fixed effects, following Debelle and Vickery (1998).\(^{18}\) Likelihood-ratio tests indicate that the fixed effects are significant in the equation for the (un)employment and the participation rate, but not in the employment growth equation. However, we want to allow for region-specific trends in employment growth, as excluding them would make it impossible to distinguish between migration and other demographic developments.\(^{19}\)

\(^{18}\)We also tested whether the equations could be estimated with random-effects, rather fixed effects. This was rejected by the Hausmann-test for all three equations.

\(^{19}\)By splitting the sample in three periods, we allow the fixed effects to differ across time periods. We checked whether this has influenced the results, by imposing each period the fixed effect from a regression for the sample as a whole (1970-2003). It turned out that this does not qualitatively affect our conclusions.
Our basic specification assumes a universal response to shocks across European regions. However, this approach does not take into account that labour market institutions differ across European countries. We therefore re-estimate our model, adding the national replacement rate and the national NAIRU (as estimated by the OECD) as control variables to each equation. These variables serve as a rough proxy for national labour market characteristics. The results hardly differ from our basic specification.\(^{20}\)

Thirdly, our method assumes that the disturbance terms are independent across equations, while equation (5) suggests that the variables in our model are correlated. We re-estimated our model for each individual European country separately (based on country data instead of regional data). In each of the countries, using SUR rather than GLS improves the significance, but does not lead to changes in the coefficients.

In the main text, we have followed Blanchard and Katz (1992) and Décressin and Fatás (1995) in imposing - on theoretical grounds - that the employment rate and the participation rate are both stationary. However, the Dicky-Fuller and Phillips-Perron unit root tests for individual regions indicate that this assumption may not be valid.\(^{21}\) A re-estimation in first differences allows for a drift in the unemployment rate and the participation rate in response to a regional employment shock (figure 4). For the period 1970-2003, the estimated migration response after five years is around 12% of the original shock, roughly the same as in our original specification. The long run responses differ, consistent with the results of Fatás (2000), who rightly emphasises that the long-run responses in this model should be interpreted with some caution.

[FIGURE 4 AROUND HERE]

A final robustness check is the use of a ‘beta-differenced’ approach. The regional variables used so far have been calculated by simply subtracting the European average, as in Fatás (2000). The implicit assumption is that all regions respond similarly to developments at the aggregate European

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\(^{20}\) The inclusion of region-specific (deterministic) trends in each equation did not make a difference either.

\(^{21}\) For the unemployment rate, we could only reject the null-hypothesis of a unit root for 5 (ADF) and 1 (PP) of the 54 regions. For the participation rate, the number of rejections is 9 and 8, respectively. The more powerful Dicky-Fuller and Phillips-Perron panel unit root tests cannot reject the null hypothesis of a unit root in the unemployment and participation rates for the sample as a whole. The results of these tests should be interpreted with caution in this case, since both variables may be correlated across regions (Pesaran, 2003).
level. Décrèsin and Fatás (1995) estimate the model with ‘beta-differenced’ regional variables, where the regional response to aggregate developments is allowed to differ per region. In line with their results, we find a larger migration response when re-estimating our model for the period 1970-2003 with beta-differenced regional variables (figure 5). The migration response after five years is around 50% of the original shock, against only 15% in our baseline specification. Upon closer inspection, this is mainly due to the fact that the beta-differenced approach tends to understate the role of the participation rate. In case of the participation rate, the estimated $\beta$’s vary widely, with a negative value for almost half of the European regions. For these regions, an increase in the participation rate has coincided with a decline in the European-wide participation rate and vice versa. It is difficult to argue that this should be seen as a regional response to a European-wide shock, but this is what the beta-differenced approach imposes. By attributing too much of the variation of the participation rate to European-wide developments, the beta-differenced approach under-estimates region-specific changes in the participation rate. As a result, the role of migration (which – as we have seen above – is derived as a residual) will be over-estimated.

[FIGURE 5 AROUND HERE]

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22 The beta-differenced variables for employment growth are the residuals from the regression $\Delta n_{it} = \alpha_i + \beta_{i} \Delta n_{EU,t} + \epsilon_{it}$, where $\beta_{i}$ is the region-specific response to European employment growth. Similar procedures hold for the other variables.

23 The estimated $\beta$’s are positive for all 54 regions in case of the employment rate, and for 53 out of 54 regions in the case of employment growth, as one would expect.

24 Recall that the participation rate is relatively important in absorbing regional employment shocks. This may explain that the role for migration found by the beta-differenced approach is so much larger than in the baseline approach.
References


Pesaran (2003), A simple panel unit root test in the presence of cross-section dependence, Cambridge working papers in Economics, nr. 0346.


## Tables and charts

### Table 1  Sample characteristics

<table>
<thead>
<tr>
<th></th>
<th>excluding UK mean</th>
<th>standard deviation</th>
<th>including UK mean</th>
<th>standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>international migration</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- arrivals</td>
<td>0.6</td>
<td>0.4</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>- departures</td>
<td>0.4</td>
<td>0.4</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>- net arrivals</td>
<td>0.2</td>
<td>0.2</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>national migration</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- arrivals</td>
<td>1.5</td>
<td>1.1</td>
<td>2.0</td>
<td>1.4</td>
</tr>
<tr>
<td>- departures</td>
<td>1.5</td>
<td>1.1</td>
<td>2.0</td>
<td>1.4</td>
</tr>
<tr>
<td>- net arrivals</td>
<td>0.0</td>
<td>0.3</td>
<td>0.0</td>
<td>0.3</td>
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<tr>
<td>unemployment rate</td>
<td>10.5</td>
<td>6.5</td>
<td>9.5</td>
<td>5.7</td>
</tr>
<tr>
<td>gdp per capita</td>
<td>104.2</td>
<td>17.2</td>
<td>100.0</td>
<td>15.6</td>
</tr>
</tbody>
</table>

Migration is expressed as a percentage of population. A positive number indicates net arrivals. The unemployment rate is expressed as % of the labour force, GDP per capita as % of European average. Migration between regions within national borders cancels out at the national level. International migration includes migration to and from non-EU countries.
Table 2 Regional migration, cross-section

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>c</td>
<td>-0.014</td>
<td>-0.012</td>
<td>0.337*</td>
<td>0.309*</td>
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<tr>
<td></td>
<td>(-0.31)</td>
<td>(-0.27)</td>
<td>(2.11)</td>
<td>(1.90)</td>
</tr>
<tr>
<td>\log(\frac{w_i}{\bar{w}})</td>
<td>0.293</td>
<td>0.203</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.33)</td>
<td>(0.94)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(u_i - \bar{u})</td>
<td>-2.30*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-1.73)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(\frac{u_i}{\bar{w}})</td>
<td>-3.45*</td>
<td>-3.16*</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-2.31)</td>
<td>(-2.07)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>adjusted R^2</td>
<td>0.02</td>
<td>0.05</td>
<td>0.10</td>
<td>0.10</td>
</tr>
</tbody>
</table>

Dependent variable is 100 x net migration as a share of population. The coefficient of \(\frac{u_i}{\bar{w}}\) has been multiplied by \(1/\bar{w}\), in order to facilitate a direct comparison with the coefficient of \(u_i - \bar{u}\). n=38; *, ** indicates significance at the 10%, 5% and 1% level; t-statistics in parentheses.

Table 3 Regional migration, panel

<table>
<thead>
<tr>
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<th>II</th>
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<th>IV</th>
</tr>
</thead>
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<tr>
<td>c</td>
<td>-0.005</td>
<td>-0.003</td>
<td>0.158*</td>
<td>0.116*</td>
</tr>
<tr>
<td></td>
<td>(-0.67)</td>
<td>(-0.36)</td>
<td>(2.13)</td>
<td>(2.13)</td>
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<tr>
<td>\log(\frac{w_i}{\bar{w}})_{-1}</td>
<td>0.259</td>
<td>0.296</td>
<td>0.238</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.44)</td>
<td>(1.64)</td>
<td>(1.37)</td>
<td></td>
</tr>
<tr>
<td>(u_i - \bar{u})_{-1}</td>
<td>-0.81</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>(-1.43)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>(\frac{u_i}{\bar{w}})_{-1}</td>
<td>-1.62*</td>
<td>-1.57*</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-2.26)</td>
<td>(-2.20)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>adjusted R^2</td>
<td>0.97</td>
<td>0.97</td>
<td>0.97</td>
<td>0.97</td>
</tr>
</tbody>
</table>

Dependent variable is 100 x net migration as a share of population. The coefficient of \(\frac{u_i}{\bar{w}}\) has been multiplied by \(1/\bar{w}\), in order to facilitate a direct comparison with the coefficient of \(u_i - \bar{u}\). n=82; *, ** indicates significance at the 10%, 5% and 1% level; t-statistics in parentheses.
Table 4 Simulation results

<table>
<thead>
<tr>
<th>year</th>
<th>$u$</th>
<th>migration ($%$ of LF)</th>
<th>(idem, cumulative, $%$ of POP)</th>
<th>(idem, cumulative, $%$ of LF)</th>
<th>(idem, cumulative, $%$ of $u_0$)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>I</td>
<td>II</td>
<td>III</td>
<td>IV</td>
</tr>
<tr>
<td>1</td>
<td>6.0</td>
<td>0.09</td>
<td>0.1</td>
<td>0.2</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>5.8</td>
<td>0.09</td>
<td>0.2</td>
<td>0.4</td>
<td>7</td>
</tr>
<tr>
<td>3</td>
<td>5.6</td>
<td>0.09</td>
<td>0.3</td>
<td>0.6</td>
<td>10</td>
</tr>
<tr>
<td>4</td>
<td>5.4</td>
<td>0.08</td>
<td>0.4</td>
<td>0.8</td>
<td>13</td>
</tr>
<tr>
<td>5</td>
<td>5.2</td>
<td>0.08</td>
<td>0.4</td>
<td>1.0</td>
<td>16</td>
</tr>
<tr>
<td>6</td>
<td>5.0</td>
<td>0.08</td>
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<td>1.2</td>
<td>19</td>
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<tr>
<td>7</td>
<td>4.8</td>
<td>0.08</td>
<td>0.6</td>
<td>1.3</td>
<td>22</td>
</tr>
<tr>
<td>8</td>
<td>4.7</td>
<td>0.07</td>
<td>0.7</td>
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<td>25</td>
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<td>9</td>
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<td>0.7</td>
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<tr>
<td>10</td>
<td>4.4</td>
<td>0.07</td>
<td>0.8</td>
<td>1.8</td>
<td>30</td>
</tr>
</tbody>
</table>

These results are derived under the assumption that migration has its maximum effect in reducing regional differences in unemployment, in the sense that migrants are unemployed before moving and find a job upon arrival in the new region. $u = \text{regional difference in the unemployment rate.}$ LF = labour force. POP = population. We have used that the labour force is around 45% of the working-age population (defined as all people between 15-64 years old) in most European countries.

Table 5 Impulse response of migration in three periods

<table>
<thead>
<tr>
<th>year</th>
<th>Migration response (% of shock)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1.7</td>
</tr>
<tr>
<td>5</td>
<td>11.7</td>
</tr>
</tbody>
</table>

22
Figure 1: Impulse response to a regional shock in employment growth, 1970-1980.
Figure 2: Impulse response to a regional shock in employment growth, 1981-1990.
Figure 3: Impulse response to a regional shock in employment growth, 1991-2003.
Figure 4: Impulse response 1970-2003, all variables in first differences.
Figure 5: Impulse response 1970-2003, "beta-differenced " regional variables.
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<td>Kerstin Bernoth, Juergen von Hagen and Casper de Vries</td>
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<td>136</td>
<td>Nicole Jonker and Thijs Kettenis</td>
<td>Explaining Cash Usage in the Netherlands: The Effect of Electronic Payment Instruments</td>
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