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Abstract

This paper examines the macroeconomic consequences of the diversion of migration flows away from Germany towards the UK in the course of the EU's Eastern Enlargement. The EU has agreed transitional periods for the free movement of workers with the new member states from Central and Eastern Europe. The selective application of migration restrictions during the transitional periods has resulted in a reversal of the pre-enlargement allocation of migration flows from the new member states across the EU. Based on a forecast of the migration potential under the conditions of free movement and of the transitional arrangements, we employ a CGE model with imperfect labour markets to analyse the macroeconomic effects of this diversion process. We find that EU Eastern enlargement has increased in the GDP per capita in the UK substantially, but that the diversion of migration flows towards the UK has reduced wage gains and the decline in unemployment there. The effects of the EU Eastern enlargement are less favourable for Germany, but the diversion of migration flows has protected workers there against a detrimental impact on wages and unemployment.

Keywords: EU Eastern enlargement, international migration, computable equilibrium model, wage-setting.

JEL code: F15, F22, C68, J61, J30.

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1 Introduction

This paper examines the macroeconomic consequences of the diversion of migration flows during the transitional periods for the free movement of workers in the course of the Eastern enlargement of the European Union (EU). The EU has admitted eight new member states from Central and Eastern Europe in 2004[1] and another two countries in 2007.[2] The income gap between the incumbent and the new member states is in case of the EU Eastern enlargement larger than in previous accession rounds. At current exchange rates, the gross national income per capita of the ten new member states (NMS-10) amounts to 21 per cent of the EU-15, and – measured in purchasing power parities – to roughly 40 per cent of the EU-15 at the outset of accession in 2004 (World Bank, 2009). This large income gap has fanned fears that the removal of immigration restrictions will yield a mass migration wave which will subsequently depress wages and increase unemployment in the incumbent EU member states.

Against this background the EU-15 countries decided at the Goeteborg summit of the European Council to impose transitional periods for the free movement of workers from the NMS. The so-called "2+3+2" formula allows the individual member states to suspend the free movement of workers for a period of up to seven years. An extension of the transitional arrangements for the free movement of labour is first considered after two years, then for a second time after three years. A second prolongation of the transitional period requires that the member state announces serious imbalances in its domestic labour market. However, the application of transitional arrangements for the free movement remains a sovereign decision of the individual member state.

In the course of the 2004 enlargement round, only Sweden applied fully the Community Law for the free movement of workers since the beginning, and the UK and Ireland opened their labour markets without restrictions. Although most other EU member states have opened their labour markets partially by granting work permits for seasonal workers, (small) immigration quotas or by concluding bilateral guestworker agreements, the remaining migration restrictions can be regarded as relatively tight in the sense that they effectively hindered labour migration between the new and the incumbent member states.[3]

[1] The Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, the Slovak Republic and Slovenia joined the EU at May 1, 2004. Cyprus and Malta also joined the EU in 2004, but the transitional periods for the free movement of workers do not apply to them.

[2] Bulgaria and Romania joined the EU at January 1, 2007.

[3] For details see European Commission (2006, 2007) and Brücker *et al.* (2009a).

The selective application of migration restrictions during the transitional periods had two effects: First, the existing restrictions have hindered migration such that total migration into the EU is presumably lower than in case of an EU-wide application of the Community Law for the free movement of workers. Second, migration flows have been diverted away from the preferred destinations towards countries which have opened their labour markets immediately after the EU Eastern enlargement.

Table 1 about here

Table 1 presents the migration development in the course of the EU Eastern enlargement. Migration data are poorly reported in most EU member states, such that some uncertainty surrounds the estimates of the actual scale of east-west migration.[4] Based on the information of those countries which provide migration figures by country of origin and on the information of the European Labour Force Survey (LFS) for those countries which do not, we can estimate the net increase in the number of foreign residents from the NMS-8 in the EU-15 at about one million people or about 250,000 persons per annum during the first four years following the EU's Eastern enlargement. First data suggest that migration flows from the NMS-8 into the EU-15 have contracted in the course of the financial crisis, but EU wide data which would provide a comprehensive picture are not yet available.

This increase in the migration flows is associated with a distinct diversion of migration flows away from Germany and Austria as the main destinations prior to Enlargement towards the UK and Ireland: In 2003, the year before the EU's Eastern enlargement, nearly 60 per cent of the foreign citizens from the NMS-8 residing in the EU were registered in Austria and Germany. This share has fallen to 41 per cent in 2007, while that of the UK and Ireland has increased to 52 per cent. At a net increase of the foreign population of 166,000 persons per annum in the first four years following the EU Eastern enlargement, the UK and Ireland receive 70 per cent of the net inflows since 2004 compared to 18 per cent before enlargement. In contrast, Austria and Germany receive only 18 per cent of the inflows since 2004.

Interestingly enough, this diversion process did not affect the Scandinavian countries: although Sweden has opened its labour market completely

[4]This is particularly true for Ireland and the UK, the main destinations of migration from the NMS since enlargement. For a detailed examination of the UK immigration data see Blanchflower *et al.* (2007) and Brücker *et al.* (2009a).

and Denmark largely, the cumulative net migration flows into these two countries have been - at some 34,000 persons - almost negligible in the first four years since enlargement. Language, and, perhaps, differences in labour market institutions, might have also played an important role in shaping the direction of east-west migration flows (Ivlevs 2007).

In this paper we analyse the macroeconomic effects of this diversion process for the two economies which are mainly affected in absolute terms, Germany and the UK. We apply different policy scenarios for identifying the macroeconomic effects of migration diversion. The first policy scenario simulates the case that the status quo regarding the immigration conditions is maintained until the end of the transitional periods in 2011, i.e. that Germany has a restrictive immigration policy in place while the UK keeps the doors for labour migration from the eight new member states from Central and Eastern Europe (NMS-8) open. The second policy scenario relies on the counterfactual assumption that both Germany and the UK have opened their labour markets for migrants from the NMS-8 already in 2004, which implies that Germany receives more and the UK less migrants. The comparison of these two scenarios enables us to analyse the effects of the diversion of migration flows from Germany to the UK.

The migration scenarios are based on forecasts of the migration potential from the NMS-8. We proceed in two steps to derive our scenarios. First, we estimate the aggregate migration potential from the NMS-8 into the entire EU-15 under the conditions of free movement and of the transitional arrangements, using the recent migration episode from the NMS and the migration experience from other countries for identification. Second, we derive the migration scenarios for Germany and the UK from reasonable assumptions about the allocation of migrants between the EU member states under free movement and the transitional arrangements.

Our macroeconomic analysis employs a computable general equilibrium (CGE) model, which allows simulating the impacts of migration, trade and capital movements simultaneously. Following Layard *et al.* (2005) and Layard and Nickell (1986), we employ a wage-setting framework which considers wage rigidites and unemployment. Considering imperfect labour markets is in our view particularly relevant in the European context with high and persistent unemployment rates.

We find that the removal of barriers to trade and factor movements in the context of the EU Eastern enlargement generates benefits for Germany and the UK in terms of a higher GDP per capita and a higher factor income of the native population. The labour market results of our model are similar to findings of Barell et.al. (2007) who use a dynamic new-Keynesian macroeconometric model to analyse the effects of a migration shock follow-

ing EU-enlargement. Higher migration involves higher aggregate GDP and employment levels in the receiving country, but reduces the wage increase and raises unemployment compared to a situation with less migration. The diversion of migration flows away from Germany towards the UK yields thus a higher GDP, employment growth and total factor income of the native population in the UK and a lower one in Germany, while Germany benefits slightly in terms of higher wages and lower unemployment compared to the UK.

The remainder of this paper is organised as follows. Section 2 presents our estimate of the EU-wide migration potential from the NMS-8 under the conditions of the transitional arrangements and of free movement of workers and the migration scenarios for Germany and the UK which forms the basis for our further analysis. Section 3 discusses the methodology and theoretical foundations of the CGE model. Section 4 presents the results of our simulations under the transitional arrangements and under the counterfactual assumption of an EU-wide application of the Community laws for the free movement of labour already in 2004. Section 5 concludes.

2 Estimation of the migration potential

The migration scenarios which we apply in the further analysis of the macroeconomic effects of the diversion effects have to be based on forecasts of the migration potential under the conditions of the transitional arrangements and of the free movement of workers. There exists a large literature which has estimated the migration potential from the NMS-8 and other countries to the EU-15 before the EU Eastern enlargement.[5] While the aggregate net increase in the stock of migrants from the NMS-8 in the EU-15 which took place during the first four years after the accession is consistent with most estimates which have been carried out prior to the EU Eastern enlargement, the diversion of migration flows away from Germany and Austria towards the UK and Ireland has not been predicted by the existing literature. The long-run migration stock from the NMS-8 in the EU-15 has been forecasted by most econometric studies at about three to five per cent of the population of the new member states, while the net inflows have been estimated at about 200,000 to 300,000 persons per annum (Alvarez-Plata *et al.*, 2003; Bauer and Zimmermann, 1999; Boeri and Brücker, 2001; Bruder, 2004). These estimates have been confirmed by some recent estimates which have been carried out after enlargement and use current data (Brücker *et al.*, 2009b;

[5]For reviews and a critical evaluation of this literature see Brücker and Siliverstovs (2006a, 2006b), Brücker *et al.* (2009b) and Zaiceva (2007).

Pytlikova, 2007; Zaiceva, 2006). Nevertheless, some studies have obtained significantly lower (Fertig, 2001; Fertig and Schmidt, 2001; Dustmann *et al.*, 2003) or higher estimates of the long- and short-run migration potential (Sinn *et al.*, 2001).

All these econometric forecasts rely on the counterfactual assumption that all EU member states open their labour markets at the same time. Under this assumption, most studies forecasted a higher migration potential for Austria and Germany and a substantially lower one for Ireland and the UK compared to the actual development after EU enlargement (see e.g. Dustmann *et al.*, 2003). However, since the rules of the free movement of workers have not been applied in the entire EU at the same time, we cannot falsify the existing studies. Note that it was not possible to forecast the migration potential from the NMS under transitional arrangements before EU enlargement, since the selective application of transitional arrangements for the free movement of labour has no historical precedent.[6]

The selective application of the transitional arrangements and the subsequent diversion of migration flows away from Germany and Austria towards the UK and Ireland highlights a methodological problem which affects to the best of our knowledge all studies which have forecasted the migration potential from the NMS: They rely on the irrelevance of independent alternatives (IIA) assumption, i.e. that migration flows to one country do not depend on economic and institutional conditions in an other country (see Grogger and Hanson, 2008, for a discussion). While this assumption is likely to be violated in most cases since migrants maximise utility across different countries. This is particularly obvious in the context of the EU's Eastern enlargement where the selective application of transitional arrangements for the free movement of labour has resulted in the diversion of migration flows.

Therefore, we employ another approach here. Instead of estimating a migration model for bilateral country pairs, we estimate the migration from a number of destinations into the entire EU-15. This approach relies on the assumption that the choice to move into the EU-15 is independent from other possible destinations. Since the overwhelming share of the migrants from the NMS and the other countries included in our sample moves to the EU-15, ignoring other destinations does not seem to be too restrictive in our view. By treating the EU as a single destination country, we circumvent the IIA problem and should obtain unbiased and consistent estimates of the parameters as long as other alternative destinations outside the EU do not

[6]Transitional measures had also been applied at the accession southern EU countries like Greece (1981), Spain and Portugal (1986). Nevertheless, there was no selective application of transitional agreements. All EU countries agreed on a period of six years in the case of Greece and a transition period of seven years in the case of Portugal and Spain.

affect the scale of migration into the EU-15 and as long the EU-15 countries are relatively homogeneous in their characteristics.

In the second step we use the pre- and post-Enlargement shares of Germany and UK in the total migration stocks and flows from the NMS for the calculation of migration scenarios for the UK and Germany under the assumptions (i) that the pre-Enlargement distribution of migration shares across the EU-15 destination countries would have been constant in case of an EU-wide introduction of the free movement and (ii) that the post-Enlargement distribution of migration flows will remain constant if the transitional arrangements are applied until 2011.

2.1 Specification of the migration function

Building on Boeri and Brücker (2001), Fertig (2001) and Hatton (1995) we apply a parsimonious specification of the macro migration function here. The theoretical approach follows a temporary migration framework with heterogeneous agents originally developed by Brücker and Schröder (2006). Individuals have the choice to stay at home or to move for a certain period of their life time or their entire life to another country. They choose the length of the stay in the foreign country such that they maximise utility over their life time. The utility of individuals depends on their income in the respective locations, but also on non-monetary factors such as social relations, cultural links etc. At a given difference in the net present value of earnings, the time spent abroad depends on the weight individuals assign to monetary earnings and to the non-pecuniary factors relevant for their utility in the respective locations (see Djajic and Milbourne, 1988; Dustmann and Kirchkamp, 2002, for similar models). Under the assumption that these preferences are not uniform across individuals, an equilibrium relationship between migration stocks and the difference in income levels between the host and the home country emerges. At this equilibrium, the gross emigration rate and the gross return migration rate are equal, such that net migration ceases (Brücker and Schröder, 2006).

More specifically, the long-run macro migration function is specified in the following form:

$$mst^*_{fit} = a_0 + a_1 \ln\left(\frac{w_{ft}}{w_{it}}\right) + a_2 \ln(e_{ft}) + a_3 \ln(e_{it}) + \nu_{fit} \qquad (1)$$

where mst^*_{fit} denotes the long-run or equilibrium share of migrants residing in destination f in the population from sending country i, w_{ft} and w_{it} the wage rate in the destination and the sending country, and e_{ft} and e_{jt} the

employment rate in the respective countries and ν_{fit} the disturbance term. The subscript f denotes the destination, i.e. the EU-15 in our case, the subscript i the index of sending countries and the subscript t the time index.

The variables of the model are derived from the standard human capital model of migration, i.e. utility is determined by expectations on income levels, which are in turn conditioned by employment opportunities. Individuals are risk averse, but uncertainty focuses on employment opportunities. Hence, it is expected that the coefficient for the employment rate in the receiving country is larger than the coefficient for the employment rate in the home country (Hatton, 1995).

The dynamics of the model are specified here in form of a simple partial adjustment mechanism, i.e. as

$$mst^*_{fit} = b_0 + b_1 \ln\left(\frac{w_{ft}}{w_{it}}\right) + b_2 \ln(e_{ft}) + b_3 \ln(e_{it}) + b_4 mst_{fi,t-1} + \upsilon_{fit} \quad (2)$$

where the coefficient b_4 captures the dynamic adjustment of the model. We assume that $b_4 < 1$, i.e. that the model is dynamically stable. Note that this does not rule out that networks of previous migrants alleviate migration costs and facilitate further migration. In contrast, we follow here the literature that migration networks or migration chains reduce migration costs (Massey and Espana, 1987). However, since the preference for amenities in the home country tends to increase for the marginal individual the higher the share of the population is that already lives abroad, the declining costs for migration resulting from networks are eventually offset by the high costs to move abroad for individuals in the remaining population.

2.2 Identification strategy

As outlined above, we treat the EU-15 here as a single destination in order to circumvent or at least to mitigate the IIA problem. Although income levels and employment opportunities across the individual EU-15 countries are relatively homogeneous, there still exist some differences which might be hidden if we average all variables of the model across the destination countries in the EU-15. We have therefore weighted all earnings and employment variables of individual EU-15 countries by their share in the EU-15 migrants from a specific sending countries. In order to avoid an endogeneity problem, we have used the average shares during the entire sample period. We expect that this procedure increases the explanatory power of the model compared to simply using the EU-15 averages of the explanatory variables.

For the identification of the impact of different immigration regimes we

use the variance in the data from different country groups. We assume that immigration regimes affect both the absolute terms and the slope parameters of the model. In general form we write the migration function in equation (2) under consideration of immigration restrictions as

$$\begin{aligned} mst_{fit} &= \alpha' \mathbf{x}_{ft} + \beta' \mathbf{y}_{it} + \gamma' \mathbf{z}_{fit} \\ &+ \eta' \left(\mathbf{z}_{fit} \times \mathbf{x}_{ft} \right) + \lambda' \left(\mathbf{z}_{fit} \times \mathbf{y}_{it} \right) \\ &+ \delta \, mst_{fi,t-1} + \upsilon_{it} \end{aligned} \tag{3}$$

where $\mathbf{x}_{ft}$ denotes a vector of variables which captures the relevant explanatory variables such as the per capita income level and the employment rate in the EU-15, $\mathbf{y}_{it}$ a vector of explanatory variables which affects migration incentives in the sending country, $\mathbf{z}_{fit}$ a vector of dummy variables which captures an institutional regime which affects migration opportunities and costs between the EU-15 and sending country i, and α, β, γ, η and λ denote the corresponding vectors of coefficients.

The error term υ_{fit} is specified here as one-way error component model, i.e. as

$$\upsilon_{fit} = \mu_{fi} + \xi_{fit}, \tag{4}$$

where μ_{fi} is a country specific fixed effect which captures all time-invariant variables such as geographical distance, language, and cultural proximity which affect migration decisions, and ξ_{fit} is white noise.

The specification of the error term can have important implications for migration forecasts. Most macro migration models in the literature are either estimated by pooled ordinary least squares or with a fixed effects estimator. Brücker and Siliverstovs (2006a, 2006b) have tested the forecasting performance of different macro migration models based on a data set which is similar to that we employ here and found that a standard model with country specific fixed effects outperforms pooled OLS, random effects, GMM and heterogeneous estimation procedures, i.e. estimators which allow the slope parameters of the model to differ across countries. Therefore, we apply a standard fixed effects estimator here.

The model in equation (3) considers different immigration regimes, which can affect the scale of migration both via the absolute terms and via the slope parameters. Under the assumption that the slope parameters are uniform across countries for a given institutional regime, we can use the estimated parameters of the model to identify how a change in the institutional regime affects migration. As an example, if the NMS respond similarly as other EU member states under free movement to explanatory variables such as the income differential and the employment rate, we can use the estimated

parameters of the free movement dummy and the interaction dummies of free movement with explanatory variables for identifying the impact of a switch from the transitional arrangements to free movement. However, it is worthwhile noting that countries might be heterogeneous, i.e. that the migration behaviour of the NMS may differ in one way or another from that of the EU-15 member states. The assumption of homogenous slope parameters is, however, needed for the identification of the effects of different institutional conditions.

In the specification of the model we consider the following institutional regimes:

- transitional arrangements for the NMS-8 between 2004 and 2007 and for the NMS-2 in 2007 ($TRANS_{fit}$);
- bilateral (guestworker) agreements between individual EU-15 and Bulgaria and Romania which were in place since the end of the 1990s ($GUEST_{fit}$);
- restricted immigration, which holds for third countries such as Turkey, Morocco and Tunisia as well as for the NMS before the transitional arrangements or the bilateral agreements were in place ($RESTR_{fit}$);
- emigration restrictions which were in place for citizens from most NMS under the so-called iron curtain ($IRON_{fit}$).

For each regime we created a dummy variable, which was included as a level variable and as an interaction variable with all other explanatory variables of the model. Moreover, we considered an intercept dummy in order to capture the migration conditions for countries which are affected by the wars in the former Yugoslavia (WAR_{fit}).

2.3 Data

Our sample consists of 28 sending countries during the period 1982 to 2007: The "old" EU member states with the exception of Luxembourg (14), the NMS-8, the NMS-2 (Bulgaria and Romania), the (former) Yugoslavia, Morocco, Tunisia, and Turkey. This sample thus covers - with the exception of the Commonwealth of Independent States (CIS) - the entire European continent and the main sending countries in the Mediterranean region. Moreover, the EU-15 is the main destination for migrants from these countries such that the assumption of the irrelevance of independent alternatives is not too demanding. For this reason we have excluded the CIS countries from the

sample, since ethnic disentangling plays an important role there. Other destinations such as Russia are therefore important alternatives to the EU-15 in case of the CIS.

Altogether, our sample covers more than 80 per cent of the immigrants residing in the EU-15. Due to data limitations, the sample is not balanced. Note that we can include only those sending countries for which (almost) the entire EU-15 report migration stocks. The data on migration stocks are derived from the statistics of the EU-15 destination countries. Whenever possible, we have used the national population statistics, and the Eurostat Labour Force Survey in the remaining cases. However, in order to avoid structural breaks we rely only on one data source for a given destination. These data have then been aggregated to calculate the number of migrants in the EU-15. Since national data sources and nationality concepts differ across the EU, some measurement error is unavoidable.

As an approximation for average earnings we have used the GDP per capita at current exchange rates and at purchasing power parities. The GDP per capita at current exchange rates have been taken from the World Development Indicators of the World Bank (2009) and the GDP per capita at purchasing power parities from the series provided by Angus Maddison and the University of Groningen. Our findings suggest that the forecasting performance of the GDP variable at current exchange rates has turned out to be better as the income measured at purchasing power parities, we decided to use the GDP per capita at current exchange rates in the regressions presented here. Note that time series of wage data are not available for our country sample.

For the calculation of the employment rates we used the standardised unemployment rates (ILO norm) provided by Eurostat which have been complemented by national statistical sources in some cases. The population figures have been taken from Eurostat. The destination country variables (i.e. the EU-15 variables) have been calculated by weighting the variables across the destinations with the immigrant shares as outlined above.

The panel is not balanced due to data limitations in some countries. For a detailed description of the data set see Brücker *et al.* (2009b).

2.4 Estimation results

The estimation results are displayed in Table 2. We have estimated four specifications of the model here. First, we estimated a simple fixed effects model which considers the income difference between the EU-15 and the sending country and the immigration restrictions including the interaction terms between the immigration restrictions and the income differential only. Second,

we employed a fixed effects model which considers in addition the employment rates in the EU-15 and the sending countries. Third, we estimated this model also with Feasible GLS and cross-sectional weights allowing for heteroscedasticity in the disturbances. Testing this model against the second specification suggests that heteroscedasticity is present. Moreover, the predictive power of the model is higher compared to the second model. Finally, we estimated the same model allowing furthermore for serial correlation in the error terms since our specification tests suggest that the disturbances are indeed serially correlated.

Table 2 about here

Since we are interested in the forecasting performance here, we report in Table 2 beyond the standard regression statistics also the root mean squared per centage forecasting error (RMSPE) for the NMS-8 in the period 2001-2007. We find that the forecasting error declines from model to model. In our preferred specification, the FGLS model with cross-sectional weights and serial correlation, the RMSPE is at 8.9 per cent reasonably low given the substantial uncertainty which surrounded the migration potential from the NMS after the introduction of the transitional arrangements for the free movement of labour.

The qualitative results confirm largely our theoretical expectations. The income difference between the EU-15 and the sending countries has in all four specifications the expected positive sign and appears significant. The employment rate in the EU-15 has the expected positive sign, while the employment rates in the sending countries have the expected negative signs, although both variables do not appear as significant.

The interaction dummy variables can only be interpreted together with the signs and the size of the level dummy variables. As a consequence, the impact of the income gap as well as the impact of the employment variables are either reduced or increase with the respective dummy variables. As expected, the civil wars in the former Yugoslavia have exerted a strong positive impact on migration from the affected countries into the EU-15.

2.5 Migration scenarios

The coefficients of the feasible GLS model with serial correlation in the disturbances (FGLS-2) in Table 2 are used for the simulation of potential migration from the NMS-8 into the EU-15 under different institutional conditions

for the period from 2004 until 2011. In our simulations we have assumed that the GDP per capita at current exchange rates converges to the level of the EU-15 at an annual rate of 3 per cent.[7] Furthermore, we have assumed that unemployment rates remain constant at their 2007 levels, since it is not possible to predict unemployment rates. Thus, our scenario is based on a convergence scenario under "normal" economic conditions, but does not consider the recent changes in the economic environment since the begin of the financial crisis.

Figure 1 displays three simulations: The "migration restrictions" scenario assumes that the migration restrictions which have been in place before the EU Eastern enlargement are maintained beyond 2004. The "transitional arrangements" scenario assumes that the transitional arrangements for the free movement of labour which have been in place from 2004 onwards are maintained until the end of 2011. Finally, the "free movement" scenario assumes that the EU applies the rules for the free movement of labour already at the beginning of its Eastern enlargement in 2004.

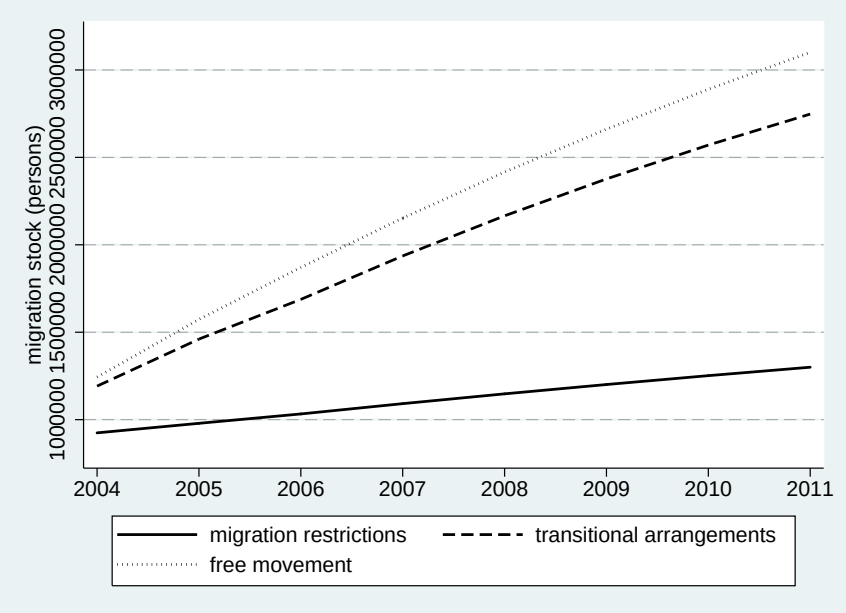

Figure 1: Potential migration stocks from NMS-8 in EU-15, 2004-11

According to our estimates the stock of foreign residents from the NMS-8

[7]This is empirically supported by convergence regressions for the EU-15. Note that the GDP per capita at current exchanges rates converges faster than the GDP per capita at purchasing power parities due to the appreciation of the currency in the course of real convergence.

in the EU-15 would have increased without EU Eastern enlargement moderately from about 900,000 persons in 2002 to 1.3 millions by the end of 2011. The partial removal of the migration barriers under the transitional arrangements yields a substantial increase in the number of migrants according to our projections: the stock of foreign residents from the NMS-8 is estimated to number 2.75 million persons at the end of 2011. Finally, the introduction of the free movement would have triggered an additional migration of 350,000 persons compared to the transitional arrangement scenario such that the stock of foreign residents from the NMS-8 in the EU-15 would amount 3.1 million persons at the end of 2011. The scenario presented here refer to point estimates, confidence intervals can be pretty large (see Brücker *et al.*, 2009b).

A number of caveats apply to these estimates: First, the estimates under the current institutional conditions are based on only few annual observations, which might be insufficient to identify the parameters of the model properly. Second, the free movement scenario assumes that the slope parameters for the explanatory variables such as the income difference and the employment rates are the same under free movement for the EU-15 sending countries and the NMS. This need, however, not to be the case. Third, particularly the migration data used for the estimates are subject to measurement error which may bias the results in one way or another. Finally, the projections presented here are based on estimates of long-run equilibrium relationships between the migration stocks and the explanatory variables and the speed of adjustment to these long-run relationships. The estimates do therefore not capture short-term fluctuations in the business cycle appropriately, such that short-term migration movements may deviate substantially.

The later aspect is particularly relevant in the context of the current financial crisis. As can be observed already in a number of countries, actual migration figures have declined substantially as a consequence of the deterioration in the economic conditions in the receiving countries.

Thus, Figure 1 presents a forecast for the development of the aggregate migration stocks from the NMS-8 in the EU-15 under different institutional conditions, although actual figures may deviate in one way or another from these scenarios. Nevertheless, the root mean squared percentage forecasting error has been at about 9 per cent relatively moderate under the conditions of the transitional arrangements.

For our further analysis we need not only a projection of the aggregate migration potential from the NMS-8 in the EU-15, but also one for Germany and the UK under the transitional arrangements and under the counterfactual situation of an EU-wide introduction of the rules for the free movement of labour already in 2004 in order to capture the diversion of migration flows.

Since a free movement counterfactual does not exist for the NMS, we have to base these scenarios on reasonable assumptions rather than on econometric estimates.

We apply the following assumptions to capture the diversion effect: First, we assume that the shares of Germany and the of UK in the migration flows from the NMS-8 between 2004 and the end of 2007 will remain constant until 2011 if the transitional arrangements for the free movement of labour are maintained. This is in our view a reasonable assumption, since the 2004-2007 allocation of migration flows from the NMS-8 across the EU-15 countries is not likely to change much in the years 2008-2011 if the same institutional conditions continue.

Second, we assume that the shares of Germany and the UK in the migration stock of the NMS-8 before the EU Eastern enlargement remains constant if the free movement would have been introduced in the entire EU already in 2004. This assumption is a bit more arbitrary than the first one, since the pre-Enlargement allocation of migration flows and stocks might have been already distorted by institutional barriers in one way or another. Nevertheless, since all destination countries had similar immigration restrictions in place before enlargement, the pre-Enlargement shares may serve as a reasonable approximation of the shares of Germany and the UK in the migration flows from the NMS under the free movement counterfactual.

Table 3 about here

Table 3 displays the migration scenarios for Germany and the UK under the transitional arrangements and the free movement in the 2004-11 period. In the transitional arrangement scenario we used the actual migration figures for the 2004-2007 period, the figures for the 2008-11 period are estimated. Under the assumptions and estimates outlined above, the UK receives a cumulative net influx of almost 900,000 persons in the 2004-2011 period under the transitional arrangements according to our scenarios, while this net inflow is reduced to 321,000 persons under the counterfactual assumption of an EU-wide introduction of the free movement of workers in 2004. Conversely, Germany receives a cumulative net inflow of 269,000 persons under the transitional arrangements, but of 1.26 millions under the conditions of the free movement in the 2004-2011 period according to our projections.

The difference between the two scenarios captures mainly the diversion of migration flows away from Germany towards the UK and other destinations due to the selective application of the transitional arrangements. The EU-15

would have received some 360,000 migrants more from the NMS-8 in case of an EU-wide introduction of the free movement in 2004 compared to the situation under the transitional arrangements.

3 The macroeconomic framework

We use an applied general equilibrium model which considers wage rigidities and unemployment for our analysis of the macroeconomic effects of migration diversion. In the European context, it is particularly important to consider imperfect labour markets and unemployment. Building on Boeri and Brücker (2005), Brücker and Jahn (2011) and Levine (1999) we apply therefore a wage-setting framework here for analyzing the wage and employment effects of immigration. Our model is based on the assumption that actors in the labour market set the wage such that it declines if the unemployment rate increases. This is consistent with right-to-manage models of collective wage bargaining (e.g. Nickell and Andrews, 1983) or efficiency wage theories derived from turnover cost (Salop 1979) or shirking models (Shapiro and Stiglitz, 1984). We do not present an explicit wage bargaining or efficiency wage model here since both types of models are relevant in our context. While the papers quoted above rest on a simple one good framework, we derive the macroeconomic effects of migration here from multi-sectoral CGE model which considers trade, capital mobility and intergovernmental transfers.

The wage-setting framework explains unemployment by the interaction between price- and wage-setting. The traditional labour supply function is replaced by a wage-setting function, which assumes that the real wage rate is a declining function of the unemployment rate and may deviate from market clearing levels. Applying the right-to-manage assumption, firms hire labour up to a level where the profits are maximized at the given wage rate.

The conventional assumptions of the wage-setting framework on labour demand enables us to apply a CGE framework for the analysis of the remaining features of the economy. The model we apply here has a comparative-static character and follows the neoclassic-structuralist tradition which has inspired most of the CGE-literature (see Dervis *et al.*, 1982).[8] The equations of the model are derived from microeconomic assumptions about the behaviour of price taking agents. Based on recent input-output tables, we

[8]Our specific model is based on the well-established framework of the International Food Project Research Institute (IFPRI) developed by Lofgren *et al.* 2002. We have extended this model to a one country-two regions model and used recent input-output matrices from Poland and the UK.

apply an open-economy framework which considers beyond immigration the impact of the EU Eastern enlargement on trade, capital mobility and intergovernmental transfers.

A complete description of the CGE model we apply here is beyond the scope of this paper. Instead we outline the theoretical framework in Section 3.1 and briefly describe the CGE model which we apply here in Section 3.2. Further details on the CGE model are presented in the technical appendix.

3.1 Outline of the wage-setting framework

Suppose that the revenue function of the destination country is given by $Y(\mathbf{p}, \mathbf{L}, K)$, where $\mathbf{p}$ is a k-dimensional vector of commodity prices, $\mathbf{L}$ an n-dimensional vector of labour inputs, and the scalar K the physical capital stock of the economy. Consumers are price takers and maximize utility subject to their budget constraint. Competition on output markets is perfect such that firms are price takers as well and minimize unit costs. The production possibility set of the economy is assumed to be closed, bounded from above and convex. Under these assumptions, the revenue function is increasing, linear homogenous and concave in the input factors.

Let $\bar{N}_i$, $i = 1, ..., n$ be the pre-migration labor force in each cell i of the labour market. The post-migration labour force is then given by

$$N_i = \bar{N}_i + \gamma_i M, \qquad \sum_{i=1}^{n} \gamma_i = 1, \tag{5}$$

where the scalar M is the total labour influx and γ_i is the share of workers of type i among the total immigrants.

Wages and the demand for labour are determined sequentially. In the first stage, wages are fixed. In the second stage, profit-maximizing firms hire workers until the marginal value of labour productivity equals the ongoing wage rate. Writing the wage for labour of type i, w_i, as a function of the unemployment rate, u_i, gives

$$w_i = \phi_i(u_i), \qquad \phi_i' < 0, \tag{6}$$

where ϕ_i is a function that captures the response of the wage to the unemployment rate, and the unemployment rate is defined as $u_i = 1 - \frac{L_i}{N_i}$, where L_i and N_i denote the employed workforce and the labour force, respectively. Note that we have normalized the numeraire good to one without loss of generality.

When commodity prices are given, the wage rate w_i equals the partial

derivative of the GDP function with respect to labour input i:

$$\frac{\partial Y}{\partial L_i} = w_i(\mathbf{p}, \mathbf{L}, K), \tag{7}$$

where w_i is linearly homogeneous in $\mathbf{p}$ and homogeneous of degree zero in the input factors.

The condition that the wage rate in equation (6) equals the value of the marginal product of labour in equation (7) determines the employment response to a change in labour supply. Solving for the employment response requires solving a system of equations. This system has to satisfy in each cell of the labour market the implicit function

$$\Phi_i(\mathbf{L}, M) \equiv w_i(\mathbf{p}, \mathbf{L}, K(M)) - \phi_i(u_i(L_i, N_i(M))) = 0, \qquad \forall\ i. \tag{8}$$

Differentiating this system implicitly with respect to a marginal migration shock yields for the change in employment

$$\frac{d\mathbf{L}}{dM} = \left(\frac{\partial \mathbf{w}}{\partial \mathbf{p}}\frac{\partial \mathbf{p}}{\partial \mathbf{L}} + \frac{\partial \mathbf{w}}{\partial \mathbf{L}} - \frac{\partial \mathbf{f}}{\partial \mathbf{u}}\frac{\partial \mathbf{u}}{\partial \mathbf{L}}\right)^{-1} \times \left(\frac{\partial \mathbf{f}}{\partial \mathbf{u}}\frac{\partial \mathbf{u}}{\partial \mathbf{N}}\frac{d\mathbf{N}}{dM} - \frac{\partial \mathbf{w}}{\partial K}\frac{dK}{dM}\right), \tag{9}$$

where $\mathbf{f}$ is a vector of functions that determine the wage response to the unemployment rate, and $\mathbf{N}$ a vector of the labour force in each segment of the labour market. We assume that the capital stock may adjust to a labor supply shock through migration, i.e., that $\frac{dK}{d\mathbf{M}} \geq 0$.

Finally, having solved for the employment response, it is straightforward to derive the wage effects of migration:

$$\frac{d\mathbf{w}}{dM} = \frac{\partial \mathbf{w}}{\partial \mathbf{p}}\frac{d\mathbf{p}}{dM} + \frac{\partial \mathbf{w}}{\partial \mathbf{L}}\frac{d\mathbf{L}}{dM} + \frac{\partial \mathbf{w}}{\partial K}\frac{dK}{dM}. \tag{10}$$

Equations (9) and (10) enable us to derive the channels by which immigration can affect (un-)employment and wages.

To illustrate the mechanics of the model it is useful to distinguish three extreme cases: first, consider the case of a small open economy where the number of goods equals the number of factors. According to the Rybczynski-theorem, the composition of output changes under these conditions, while output prices and the marginal product of labour remain constant. Thus, if $\frac{\partial \mathbf{p}}{\partial \mathbf{L}} = \frac{\partial \mathbf{w}}{\partial \mathbf{L}} = \frac{\partial \mathbf{w}}{\partial \mathbf{K}} = 0$, we have from equations (9) and (10)

$$\frac{dL_i}{dM} \to (1 - u_i)\frac{dN_i}{dM}, \qquad \frac{dw_i}{dM} \to 0,$$

in every segment of the labour market.

Second, assume that $\frac{\partial p_i}{\partial L_i} < 0$ and $\frac{\partial w_i}{\partial L_i} < 0$, but that labour markets are perfectly flexible, which requires that $\phi_i' \to -\infty$ and that $u_i \to 0 \ \ \forall \ \phi_i$. In this case, equation (9) simplifies to

$$\frac{d\mathbf{L}}{dM} \to \frac{d\mathbf{N}}{dM},$$

and the wage response is given by equation (10) with $\mathbf{L} \to \mathbf{N}$. This case corresponds to the textbook model of migration with perfect labour markets.

Finally, assume that labour markets are completely inflexible, i.e., that $\phi_i' \to 0 \ \forall \ i$. In this case, equation (9) yields

$$\frac{d\mathbf{L}}{d\mathbf{M}} \to \left(\frac{\partial \mathbf{w}}{\partial \mathbf{p}} \frac{\partial \mathbf{p}}{\partial \mathbf{L}} + \frac{\partial \mathbf{w}}{\partial \mathbf{L}} \right)^{-1} \times \left(-\frac{\partial \mathbf{w}}{\partial K} \frac{dK}{d\mathbf{M}} \right),$$

which equals zero if the capital stock does not adjust to the labour supply shock, i.e. if $\frac{\partial \mathbf{w}}{\partial \mathbf{K}}$ is zero. As in the case of the famous Harris and Todaro (1970) model, the wage rate remains constant if the capital stock is fixed, while the increase in unemployment equals the additional labour supply of the immigrants.

In our empirical specification we consider however the empirically relevant case, i.e., when $0 > \phi_i' > -\infty$, where employment adjusts partially to a labour supply shock through migration.

3.2 Outline of the CGE model

Following Boehringer (2003) the general equilibrium in the CGE model is specified as a mixed complementarity problem (MCP) where equilibrium conditions are formulated as weak inequalities and conditions of complementary slackness between variables and equilibrium conditions. The model is set up as a Arrow-Debreu economy with 16 commodities and 16 domestic industries. In total there are 2 agricultural industries, 4 manufacturing industries and 10 service industries. Each commodity corresponds to an industry.

Most parameters in the model are calibrated, a procedure commonly used in CGE modeling (e.g. Mansur and Whalley, 1984). To calibrate the model a consistent one year dataset is needed. For the calibration we employ country-specific input-output matrices provided by Eurostat. This enables us to consider the recent developments in the interconnection between trade, factor movements and production. For Germany and the UK we use the latest available tables, describing the economy in 2004. These matrices satisfy the microeconomic equilibrium conditions and therefore can be used to calibrate

the model.

The elasticities of substitution between capital and labour and the Armington elasticities of substitution between international and domestic consumption goods cannot be calibrated. We therefore use standard substitution elasticities and estimates of Armington elasticities provided by the GTAP database (see Table A1).

The elasticities of the wage-setting curves have been estimated (see Baas *et al.*, 2009). We find an elasticity between wages and the unemployment rate of -0.10 for Germany and of -0.13 for the UK, which might reflect differences in labour market institutions and the wage-setting mechanism in both countries. We have estimated the elasticity of the wage-setting curves at the macro-level using the variance over time for identification. Our findings are however very close to those of the regional wage curve literature, which and elasticity of about -0.1 on average (Blanchflower and Oswald, 1994, 1995; Nijkamp and Poot, 2005). Applying for both countries an elasticity of -0.1 does not change our results substantially.

The model is solved using the GAMS software initially developed by the World Bank. Within the GAMS package we use the Path Solver which is designed to solve mixed complementarity problems.

4 Simulation results

The EU Eastern enlargement does not only affect migration, but also trade and capital movements. We assume therefore in both migration policy scenarios that the removal of barriers to trade and capital movements is irreversible and that therefore the dynamic development in trade and capital flows continues. Trade and capital movements have considerably increased before and after the EU-enlargement, but the individual member states are affected in different ways: The EU-15 countries neighbouring the NMS such as Austria and Germany have the highest trade shares with the NMS, while the UK and Ireland are only moderately affected. As an example, Germany exported goods of a value of 89.7 billion Euros to the NMS and imported goods of a value 74.2 billion Euros from the NMS in 2006 (Deutsche Bundesbank, 2007), while exports of the UK to the NMS amounted to 31.2 billion Euros and imports to 41.1 billion Euros (ONS, 2006). We assume here that the dynamic development of trade and capital movements continues. The impact of opening labour markets to migration on trade and capital movements is reflected by our CGE model, i.e. the size of trade and capital movements is determined endogenously.

In order to identify the effects of migration diversion on the economy of

Germany and the UK, we simulate a baseline and two policy scenarios. The baseline scenario describes a world without enlargement and no immigration from the NMS-8. As outlined in Section 2.5, the effects of migration diversion are captured by two policy scenarios: the first policy scenario displays the status quo in immigration policies for both Germany and the UK under the transitional periods for the free movement of workers. The second scenario is based on the counterfactual assumption that all EU-15 member states have opened their labour markets for migration from the NMS-8 already in 2004. We can thus compare the counterfactual scenario of a EU with free movement with a EU where migration barriers hinder migration and divert migration flows away from the preferred destinations. The difference between the transitional arrangement and the free movement scenario is treated here as the diversion effect.

The scenarios are calculated for the period from 2004 to 2011, i.e. they capture the period until the end of the transitional arrangements for the free movement of workers.

Table 4 about here

Table 4 presents the macroeconomic effects of the EU Eastern enlargement for the UK and Germany. It reports the change of the two policy scenarios compared to the baseline scenario for all variables except for the unemployment rate in per cent and for the unemployment rate in percentage points. The simulations presented here consider the impact of Eastern enlargement on migration, trade, capital movements and governmental transfers. Please note that governmental transfers do not cover the impact of migration on the welfare state.

The EU Eastern enlargement increases through a reduction of transaction costs GDP, trade, investment, private and governmental consumption and employment in both countries. Moreover, the EU enlargement has increased not only the aggregate GDP, but also the real GDP per capita in Germany and the UK. The gains are however not equally distributed. While in the UK both capital and labour gain from the EU Eastern enlargement, the wage rate declines slightly and the unemployment rate increases moderately in Germany under the transitional arrangement scenario. The different development in UK and Germany can be traced back to the fact that industries with low wages increase their activity more than proportionally in Germany, while industries with wages above the average benefit in the UK.

The migration flows in the aftermath of EU-enlargement has increased the labour stock of Germany and the UK, but the UK attracted much more

migrants due to lower labour market restrictions during the transitional periods. This yields a higher GDP gain for the UK under the transitional arrangements: 2.24 per cent compared to 1.08 per cent in case of an EU-wide free movement. In contrast, the German GDP increases from 0.64 in the transitional arrangement scenario compared to 1.59 per cent in the free movement scenario. The converse development can be observed for the GDP per capita: The GDP per capita gains increase from 0.48 per cent in the transitional arrangement scenario to 0.84 per cent in the free movement scenario in the UK. This can be traced back simply to the fact that immigrants don't bring capital. In the German case, the GDP per capita gains of 0.3 per cent under the transitional arrangements decline only marginally in case of free movement. This can be explained by the fact that migrants move in Germany more than in the UK to high productivity sectors.

Accordingly, the migration diversion towards the UK involves that the growth of investment, private consumption, governmental consumption and trade is about 1.2 per cent higher in the transitional arrangement scenario compared to the free movement scenario, while it is reduced under the transitional arrangements in Germany by a similar amount.

Migration and trade are complements in our simulations, which can be traced back to the fact that labour tends to move more than proportionally into manufacturing and other tradable sectors. However, this tendency is much more pronounced in the UK compared to Germany, where also non-tradable sectors increase their activities substantially (see below). The diversion of migrants towards the UK under the transitional arrangements increases EU and RoW exports and imports there by about 1.2 per cent compared to the free movement scenario, while German exports fall by 0.5 and imports by about 1 per cent under the transitional arrangement scenario compared to the free movement scenario.

The diversion of migration flows increases the income of capital owners in the UK by almost 0.9 per cent and reduces it in Germany by 0.7 per cent. In contrast, the wage gains drop by 0.17 per cent in the UK as a result of migration diversion, while the diversion process prevented that German wages would have declined by about 0.45 per cent. Moreover, the diversion process reduces the decline in the unemployment rate of the UK marginally by 0.07 percentage points, while the German unemployment rate would have increased by almost 0.43 percentage points in case of free movement compared to 0.15 under the transitional arrangements.

Altogether, the migration diversion increases GDP gains from Eastern enlargement and the income of capital owners in the UK, but reduces the gains of workers in terms of higher wages and lower unemployment risks. The converse is true for Germany. The transitional arrangements have moreover

reduced the joint GDP gain of Germany and the UK by 0.11 per cent as a consequence of less migration and migration diversion (not displayed here).

Table 5 about here

The sectoral effects of the EU's Eastern enlargement and our migration scenarios are presented in Table 6. As can be seen there, the manufacturing industries expand their activities more than proportional in the UK. Under the transitional arrangements, some other sectors such as hotels and restaurants, construction, health and household services increase their activity also more than proportional. In contrast, the German manufacturing sector benefits much less from EU Eastern enlargement compared to that of the UK. The influx of labour expands particularly non-tradable activities such as household work, hotels and restaurant and construction there. As a consequence, the immigration surge in the free movement scenario has a more detrimental impact on labour markets in Germany compared to the UK, where the expansion of tradable sectors mitigates the labour supply shock.

Note that we find larger economic gains from the EU Eastern enlargement than previous studies. As an example, Baldwin *et al.* (1997) calculate the total gain in GDP for the EU-15 at 0.2 per cent, while Heijdra *et al.* (2002) predicted that EU enlargement will increase the GDP in Germany by 0.67%. The Hejdra *et al.* (2002) study is inter alia based on a migration projection which is similar to our free movement scenario. The difference between the findings in the previous literature and ours can be traced back mainly to the fact that trade links between the incumbent and the new EU member states have been largely underestimated in models using input-output tables before 1995.

5 Conclusion

The transitional periods for the free movement of workers have resulted in a reversal of the pre-enlargement distribution of migrants from the NMS across the EU-15. Based on a counterfactual scenario, which relies on the assumption that the free movement of workers would have been granted to the citizens of the NMS-8 in all EU-15 countries already in 2004, we have analysed the macroeconomic consequences of this diversion process for two mainly affected countries, Germany and the UK. Our findings indicate that the diversion of migration flows increased the GDP, employment growth and

total factor income of the native population in the UK whereas Germany could not benefit from an increase in labour.

The transitional periods for the free movement of workers also impact the distribution of income. The productivity gains from the EU Eastern enlargement and the increase in trade implies that the income of workers and capital owners increase in the UK, while the unemployment rate declines there in all scenarios. The situation is less favourable in Germany, where wages decline and unemployment increases slightly in the free movement scenario. The diversion of migration flows has reduced the wage gains in the UK marginally, while the unemployment rate declines slightly less than in case of an EU-wide introduction of the free movement there. In contrast, workers in Germany benefit from the diversion of migration flows during the transitional periods. Thus, although the transitional migration restrictions in Germany and other EU-15 countries create an aggregate loss for the incumbent EU member states, their distributional impact remains ambiguous.

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Technical Appendix

The wage-setting framework which we use for our analysis of the macroeconomic effects of immigration has been outlined in Section 3.1. Following Boehringer *et al.* (2003) the general equilibrium in the CGE model is specified as a mixed complementarity problem (MCP). The main difference to the framework sketched in Section 3.1 is that we consider not only labour and capital as inputs, but also intermediate goods. For a compact presentation of the model we have changed the notation.

Consider an Arrow-Debreu economy where the endogenous variables can be classified into three categories (Mathiesen 1985). A non-negative a-dimensional vector of prices $\mathbf{p}$ for all goods and factors including export and import goods, $\mathbf{Y}$ a non-negative m-dimensional vector for activity levels of production sectors including foreign production and $\mathbf{E}$ a non-negative q-dimensional vector of incomes and earnings including transfers.

In equilibrium, the zero-profit condition for firms which produce under constant returns to scale has to be fulfilled:

$$\Pi_j(\mathbf{p}) = R_j(\mathbf{p}) - C_j(\mathbf{p}) \geq 0 \qquad \forall\ j, \tag{11}$$

where $\Pi_j(\mathbf{p})$ is the unit profit function, $R_j(\mathbf{p}) \equiv \max\left\{\sum_i p_i \frac{\partial \Pi_j}{\partial p_i} \mid g_j(.) = 1\right\}$ the unit revenue function and $C_j(\mathbf{p}) \equiv \min\left\{\sum_i p_i \frac{\partial \Pi_j}{\partial p_i} \mid f_j(.) = 1\right\}$ the unit cost function. The functions f_j and g_j characterize feasible input-output combinations in sector j. Finally, i is an index for commodity or factor i. In this general framework, we consider not only capital and labour, but also intermediaries as inputs.

The condition for market clearing on goods and factor markets is given by

$$\sum_j Y_j \frac{\partial \Pi_j(\mathbf{p})}{\partial p_i} + \sum_h B_{ih} \geq \sum_h D_{ih} \qquad \forall\ i, \tag{12}$$

where Y_j is output of sector j, B_{ih} is the initial endowment of commodity or factor i of household h and D_{ih} the final demand for good i of household h.

We apply the right-to-manage assumption in our wage-setting framework. Consequently, once wages are fixed, firms hire labour up to an amount where profits are maximized. This implies that the employed labour force can be below the initial labour endowment of households, i.e. $L_{ih} \leq N_{ih}$, where L_{ih} denotes employed labour and N_{ih} the initial labour endowment. Thus, the

following inequality holds for labour demand:

$$\sum_j Y_j \frac{\partial \Pi_j(\mathbf{p})}{\partial w_i} + \sum_h (1 - u_{ih}) N_{ih} \geq 0 \qquad \forall\ i, \tag{13}$$

where w_i denotes the wage rate and u_i the unemployment rate. Note that $(1 - u_{ih})N_{ih} = L_{ih}$. As outlined in Section 3.1, the wage rate is a function of the unemployment rate. Thus, if we replace each labour input N_i by $(1 - u_i)N_i$ in the vector of initial endowments $\mathbf{B}$, we can apply equation (12) for deriving the demand on goods and factor markets.

The demand for good i of household h is derived from utility maximization:

$$d_{ih}(\mathbf{p}, E_h) \equiv \arg\max \left\{ U_h(x) \mid \sum_i p_i x_i = E_h \right\}, \tag{14}$$

where E_h denotes income and U_h utility of household h. The budget constraint of households is given by

$$\sum_h p_i\ B_{ih} = E_h \geq \sum_h p_i\ D_{ih} \qquad \forall\ h. \tag{15}$$

We use a Stone-Geary utility function which is non-satiation. Therefore households are always on their budget line, i.e. $\sum_h p_i\ B_{ih} = E_h = \sum_h p_i\ D_{ih}$ and Walras' law holds.

Applying Walras law, aggregation of market clearing conditions and zero profit conditions yield:

$$\sum_j Y_j \Pi_j(\mathbf{p}) = 0, \tag{16}$$

$$Y_j \Pi_j(\mathbf{p}) = 0, \qquad \forall\, j, \tag{17}$$

$$p_i \left(\sum_j Y_j \frac{\partial \Pi_j(p)}{\partial p_i} + \sum_h B_{ih} - \sum_h D_{ih} \right) = 0 \qquad \forall\, i, \tag{18}$$

$$E_h \left(\sum_h p_i B_{ih} - \sum_h D_{ih} \right) = 0 \qquad \forall\, h. \tag{19}$$

The general equilibrium problem features complementarity between equilibrium variables and equilibrium market conditions. Therefore it can be described as a mixed complementarity problem (MCP) (Cottle and Pang,

1992; Rutherford, 1995):

$$\begin{aligned} \text{Given} &: f\colon R^n \mapsto R^n && (20)\\ \text{Find} &: \mathbf{z} \in R^n && (21)\\ \text{s.t.} &: f(\mathbf{z}) \geq 0, \mathbf{z} \geq 0, \mathbf{z}^T f(\mathbf{z}) = 0 && (22) \end{aligned}$$

with $\mathbf{z} = [\mathbf{y}, \mathbf{p}, \mathbf{E}]$ and $f(\mathbf{z}) = [\Pi_j(\mathbf{p}), \xi_i, (\sum_h p_i b_{ih} - \sum_h p_i d_{ih})]$.

The presentation of the equilibrium problem here is very compact. A detailed description of the equations of the model is available from the authors upon request.

Table 1: *Residents from the NMS-8 in the EU-15, 2003-2007*

	2003	2004	2005	2006	2007	2003	2004	2005	2006	2007
	in 1,000 persons					*in % of host population*				
AT[1]	60.3	68.9	77.3	84.0	89.9	0.7	0.8	0.9	1.0	1.1
BE[1]	16.2	19.5	25.6	32.2	42.9	0.2	0.2	0.2	0.3	0.4
DK[1]	9.8	11.6	14.3	16.5	22.1	0.2	0.2	0.3	0.3	0.4
FIN[1]	15.8	16.5	18.3	20.8	24.0	0.3	0.3	0.4	0.4	0.5
FR[2]	33.9	43.1	36.2	44.2	37.0	0.1	0.1	0.1	0.1	0.1
DE[1,3]	480.7	438.9	481.7	525.1	554.4	0.6	0.5	0.6	0.6	0.7
GRE[2]	16.4	15.2	19.5	18.4	19.1	0.1	0.1	0.2	0.2	0.2
IE[4]	n.a.	43.5	94.0	147.9	178.5	n.a.	1.1	2.3	3.5	4.1
IT[1]	54.7	66.2	77.9	91.3	117.0	0.1	0.1	0.1	0.2	0.2
LX[1]	1.6	2.3	3.5	4.2	5.1	0.4	0.5	0.8	0.9	1.1
NL[1]	13.0	17.8	23.2	28.3	36.3	0.1	0.1	0.1	0.2	0.2
PT	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
ESP[1]	46.7	61.8	77.8	100.8	131.1	0.1	0.1	0.2	0.2	0.3
SWE[1]	21.1	23.3	26.9	33.8	42.3	0.2	0.3	0.3	0.4	0.5
UK[5]	122.5	121.0	219.8	357.5	609.4	0.2	0.2	0.4	0.6	1.0
EU-15	892.6	949.5	1,195.9	1,505.0	1,910.4	0.2	0.3	0.3	0.4	0.5

All figures refer to December 31 of each year.

Notes: 1) National population statistics.– 2) Eurostat Labour Force Survey.– 3) 2006 and 2005 are not comparable to previous year due to data revisions.– 4) Irish LFS (4th quarter).– 5) UK LFS (2nd quarter).

Table 2: *Estimation Results*

	FE (1)		FE (2)		FGLS (1)		FGLS (2)	
	coeff.	t-stat.	coeff.	t-stat.	coeff.	t-stat.	coeff.	t-stat.
$mst_{i,t-1}$	0.949	50.01	0.940	44.90	0.940	47.14	0.954	50.78
$\ln \frac{y_{f,t-1}}{y_{i,t-1}}$	0.003	2.21	0.003	2.18	0.003	2.35	0.003	2.74
$\ln e_{f,t-1}$			0.015	1.39	0.015	1.43	0.012	1.28
$\ln e_{i,t-1}$			-0.004	-0.71	-0.004	-0.76	-0.006	-1.00
$TRANS_{it} \times \ln \frac{y_{f,t-1}}{y_{i,t-1}}$	-0.002	-1.64	0.001	0.42	0.001	0.45	0.001	0.45
$TRANS_{it} \times \ln e_{f,t-1}$			0.091	2.34	0.090	2.43	0.083	2.57
$TRANS_{it} \times \ln e_{i,t-1}$			-0.019	-1.19	-0.019	-1.22	-0.017	-1.34
$GUEST_{it} \times \ln \frac{y_{f,t-1}}{y_{i,t-1}}$	-0.002	-1.70	-0.008	-1.90	-0.008	-1.91	-0.004	-0.85
$GUEST_{it} \times \ln e_{f,t-1}$			-0.131	-1.40	-0.131	-1.40	-0.038	-0.34
$GUEST_{it} \times \ln e_{i,t-1}$			-0.011	-0.64	-0.011	-0.65	-0.006	-0.24
$RESTR_{it} \times \ln \frac{y_{f,t-1}}{y_{i,t-1}}$	-0.004	-3.27	-0.003	-2.49	-0.003	-2.66	-0.003	-3.07
$RESTR_{it} \times \ln e_{f,t-1}$			0.011	0.88	0.011	0.91	0.007	0.59
$RESTR_{it} \times \ln e_{i,t-1}$			0.002	0.31	0.002	0.26	0.004	0.59
$IRON_{it} \times \ln \frac{y_{f,t-1}}{y_{i,t-1}}$			-0.002	-0.59	-0.002	-0.59	-0.001	-0.32
$IRON_{it} \times \ln e_{f,t-1}$			-0.019	-0.15	-0.018	-0.14	-0.033	-0.28
$IRON_{it} \times \ln e_{i,t-1}$			-1.054	-0.14	-1.135	-0.15	0.334	0.05
$TRANS_{it}$	0.002	1.40	0.003	2.11	0.003	2.16	0.002	1.93
$GUEST_{it}$	0.002	0.90	0.002	1.17	0.002	1.12	0.002	0.98
$RESTR_{it}$	0.001	1.39	0.002	1.78	0.002	1.81	0.001	1.57
$IRON_{it}$	-0.001	-0.91	-0.001	-0.81	-0.001	-0.81	-0.001	-0.74
WAR_{it}	0.007	4.82	0.008	4.93	0.008	4.98	0.006	3.26
$CONSTANT$	0.002	2.15	0.002	1.98	0.003	2.26	0.002	1.83
observations	552		529		529		529	
groups	28		28		28		28	
R^2	0.870		0.880					
Wald $\chi(48)^2$ stat.					79,284		109,568	
RMSPE	12.90		12.33		9.11		8.94	

Notes: The dependent variable is the migration stock mst_{it}.– FE (1) and FE (2) are fixed effects regressions.– FGLS (1) is a Feasible GLS regression with panel-specific weights. – FGLS (2) is a Feasible GLS regression with panel-specific weights and panel specific autocorrelation (AR1).– RMSPE denotes the root mean squared percentage error.

Table 3: *Scenarios of potential migration from NMS-8 into EU-15, 2004-11*

	DE		UK		EU-15	
	stock	net flow	stock	net flow	stock	net flow
			in 1,000 persons			
			transitional arrangement scenario			
2004	438.9	30.3	121.0	-1.5	949.5	56.9
2005	481.7	42.8	219.8	98.8	1,195.9	246.4
2006	525.1	43.4	357.5	137.7	1,505.0	309.1
2007	554.4	29.3	609.4	251.9	1,910.4	405.4
2008	589.2	34.8	725.5	116.1	2,240.8	242.7
2009	621.2	32.0	832.4	106.9	2,464.3	223.5
2010	650.6	29.4	930.7	98.2	2,669.7	205.4
2011	677.6	27.0	1,020.7	90.0	2,857.9	188.2
$\sum$ 2004-11		269.0		898.2		1,877.5
			free movement scenario			
2004	438.9	211.6	121.0	53.9	1,270.0	393.0
2005	650.5	186.0	168.4	47.4	1,615.3	345.3
2006	836.5	167.5	211.1	42.7	1,926.3	311.0
2007	1,004.0	159.4	251.7	40.6	2,222.3	296.0
2008	1,163.4	148.7	289.6	37.9	2,498.4	276.1
2009	1,312.1	138.5	324.9	35.3	2,755.5	257.1
2010	1,450.5	128.8	357.7	32.8	2,994.7	239.2
2011	1,579.3	119.7	388.2	30.5	3,216.9	222.2
$\sum$ 2004-11		1,260.1		321.1		2,339.8

Notes: The 2004-07 figures in the transitional arrangement scenario refer to actual migration flows and stocks, the 2008-11 figures are projected based on the regression results of model (4) in Table 2 and the assumption that the shares of Germany and the UK in the cumulative net flows during the period 2004-07 remain constant until 2011. – The figures of the free movement scenario are based on the regression results of model (4) in Table 2 and the assumption that the shares of Germany and UK in the 2003 migration stock from the NMS-8 in the EU-15 remain constant until 2011.– The scenarios are based on the further assumptions that (i) the GDP per capita level at current market prices of the NMS-8 converges at a rate of 3 per cent p.a. to that of the EU-15 and (ii) that the unemployment rates remain constant at their 2007 level. – Net flow figures are assumed to be equal to the change in migration stocks.

Table 4: *Macroeconomic effects of enlargement and migration diversion*

	transitional arrangement scenario[1]		free movement scenario[2]		diversion effect[3]	
	UK	DE	UK	DE	UK	DE
	change in %, unemployment rate: change in %-points					
real GDP	2.24	0.64	1.08	1.59	0.65	-0.44
real GDP per capita	0.48	0.30	0.84	0.29	-0.36	0.01
private consumption	2.62	1.44	1.45	2.33	1.17	-0.89
investment	2.56	0.98	1.40	2.33	1.16	-1.35
government consumption	2.32	0.51	1.08	2.28	1.24	-1.77
tax revenue	2.54	0.68	1.35	1.55	1.29	-0.87
exports to EU[4] countries	4.03	2.26	2.86	2.78	1.17	-0.52
exports to RoW[5] countries	2.98	0.05	1.82	0.59	1.16	-0.54
imports from EU countries	5.05	4.03	3.83	5.18	1.22	-1.15
imports from RoW countries	4.17	1.82	2.84	2.88	1.33	-1.06
capital income	1.35	0.25	0.48	0.95	0.87	-0.70
wage rate	0.60	-0.05	0.77	-0.50	-0.17	0.45
employment	2.20	0.40	0.79	1.87	1.41	-1.47
unemployment rate	-0.23	0.15	-0.30	0.43	0.07	-0.28

Notes: 1) The transitional arrangement scenario assumes that Germany maintains its migration restrictions and that UK keeps its labour markets open until 2011.– 2) The free movement scenario assumes that all EU-15 countries grant free movement for workers from the NMS-8 from 2004.– 3) The diversion effect is calculated as the difference between the transitional arrangement and the free movement scenario.– 4) EU countries are the other EU-25 member states.– 5) RoW countries are all other trading partners.

Table 5: *Sectoral effects of enlargement and migration diversion*

	transitional arrangement scenario[1]		free movement scenario[2]		diversion effect[3]	
	UK	DE	UK	DE	UK	DE
	change of value added in %					
Agriculture, hunting and forestry	0.3	-0.9	-0.8	-0.7	1.0	-0.2
Fishing	-4.1	3.6	-5.0	2.7	0.9	0.9
Mining and quarrying	-4.5	2.2	-4.3	2.9	-0.2	-0.7
Manufacturing	3.3	0.1	2.0	0.6	1.3	-0.5
Electricity, gas and water supply	2.0	0.6	0.9	1.6	1.1	-1.0
Construction	2.4	0.7	1.3	2.1	1.1	-1.4
Wholesale and retail trade	2.2	-0.2	1.0	0.3	1.2	-0.5
Hotels and restaurants	2.4	1.2	1.3	2.3	1.1	-1.1
Transport, storage and communication	1.6	0.1	0.5	1.1	1.1	-1.0
Financial intermediation	1.9	0.1	0.8	1.2	1.1	-1.1
Real estate, renting and business activities	1.7	0.2	0.6	1.0	1.1	-0.8
Public administration and defence	2.3	0.5	1.1	2.2	1.2	-1.7
Education	2.2	0.6	1.0	2.2	1.2	-1.6
Health and social work	2.3	0.6	1.1	2.3	1.2	-1.7
Other service activities	2.0	0.4	0.8	1.7	1.2	-1.3
Activities of households	2.3	1.5	1.0	2.6	1.3	-1.1
Total	2.1	0.2	1.0	1.1	1.1	-0.9

Notes: 1) The transitional arrangement scenario assumes that Germany maintains its migration restrictions and that UK keeps its labour markets open until 2011.– 2) The free movement scenario assumes that all EU-15 countries grant free movement for workers from the NMS-8 from 2004.– 3) The diversion effect is calculated as the difference between the transitional arrangement and the free movement scenario.–

Table A1: *Key parameter values of the CGE model*

	elasticities of substitution	Armington elasticities
Agriculture, hunting and forestry	0.8	2.2
Fishing	0.8	2.2
Mining and quarrying	0.8	2.8
Manufacturing	0.8	2.8
Electricity, gas and water supply	0.8	2.8
Construction	0.8	1.9
Wholesale and retail trade	0.8	1.9
Hotels and restaurants	0.8	1.9
Transport, storage and communication	0.8	1.9
Financial intermediation	0.8	1.9
Real estate, renting and business activities	0.8	1.9
Public administration and defence	0.8	1.9
Education	0.8	1.9
Health and social work	0.8	1.9
Other service activities	0.8	1.9
Activities of households	0.8	1.9