Determinants of interregional migration among German states and its implications for reducing East-West disparities: Results from a Panel VAR

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Abstract

In this paper we analyse the causal linkages between regional labour market variables and bilateral net migration flows among German federal states for the sample period 1991 to 2006. In particular, our empirical analysis seeks to determine whether regional differences in real wages and (un–)employment rates among other factors affect migratory behaviour as predicted by the neoclassical migration model. We employ different estimators for dynamic panel data models in single as well as multiple equation settings, where the latter is particularly useful to identify feedback effects among migration and labour market variables. We thus put a focus on specifying Vector autoregressive (VAR) models for panel data using efficient GMM estimation methods such as the 'system' GMM instrumental variable approach proposed by Blundell & Bond (1998). By the computation of impulse-response functions for the Panel VAR we are able check the dynamic properties of the system and evaluate the responses of regional net migration flows to various shocks (and vice versa). We also use the fitted PVAR model to track the evolution of the specific East-West migration pattern since reunification aiming to shed more light on on the question whether there is still an "empirical puzzle" for East Germany, where both high regional disparities and regional immobility coexist – contrary to the neoclassical model predictions. One of our main results is that throughout the 1990s East-West migration was indeed distorted (downward biased) and driven by factors outside the macroeconomic framework set up in the Panel VAR. For this period the size of the East-West migratory movements (though considerably high in absolute terms) were insufficient for contributing decisively to balance the regional labour market disparities. Likely explanations may be seen in huge income transfers, fast politically driven wage adjustment and the possibility of East-West commuting (especially for East–West border regions). However, taking the whole sample period up to 2006 as point of reference, the specified dummies variables for East Germany as a whole as well as East–West border regions capturing unmodelled factors turns out to be insignificant. This in turn supports the hypothesis that recent (upward rising) East–Westmigration flows are well explained by our macroeconomic migration models with a prominent role given to regional differences in key labour market variables such as wage and (un)employment rates in a Harris–Todaro (1970) fashion. Since this second wave of huge East–West migration flows around 2001 comes along with a gradual fading out of macroeconomic distortions, this supports the role given to migratory movements in balancing regional labour market disparities among the East–West macro regions in Germany as one important condition for a sufficiently high labour market flexibility in Germany.

JEL-Classification: C33, J61, R23
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1 Introduction

Both from a national and supranational (EU-wide) perspective the integration of goods, financial and labour markets has been identified as an important source for potential welfare gains and is thus a primary goal for economic policy making. Given the specific characteristics of labour as factor input in the production process, both from the academic and policy perspective a prominent role is typically assigned to the analysis of labour market The latter in turn can be subdivided into different categories as i.) production, ii.) labour cost or iii.) labour supply flexibility (see e.g. Monastiriotis, 2003, for details). While the former two aspects typically comprise indicators measuring the degree of employee protection, wage bargaining and union power as well as the institutional design with respect minimum wages and unemployment benefits, labour supply flexibility among other factors deals with the job and geographical mobility of the work force. In this paper we take a closer look at the latter geographic mobility of workers for German regional labour markets at the federal state level (NUTS 1) with a special focus on the integration of the West and East German labour markets after re–unification. Such an analysis may be an important benchmark for policy implications with respect to the EU-wide labour market integration of 'old' and 'new' EU member states (see also Sinn, 2000, on this point).

As the Lisbon agenda shows, the extent to which the regional differences in real income and unemployment (e.g. in response to asymmetric demand shocks) can be balanced through labour migration is a subject of obvious interest for economic policy given the rather low geographical mobility rates for EU nation states compared to economies such as the US and Australia (for details see e.g. Bonin et al., 2008). According to traditional neoclassical theory the link between migration and regional labour market variables works as follows: Regions with relatively high unemployment and lower wage levels should experience labour outmigration into regions with better employment opportunities. Rising number of available jobs in the target region as well as a decline in job opportunities in the home region ensure that the regional disparities in wages and unemployment will disappear over time.[1] In the long-run cross-regional labor market equilibrium unemployment differences can thus only be explained with differences in regional wage levels as a compensation for the higher unemployment risks otherwise factor prices are assumed to equalize across regions. Thus, together with correspondingly high regional unemployment rates increasing wage levels balance the expected real wage between regions.[2]

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[1] Naturally, the wage mechanism should also contribute to the elimination of regional differences in unemployment. Lower wages due to higher unemployment in a region raise the demand for work in those areas (and reduce the supply further). For details see e.g. Armstrong & Taylor (1993).

[2] Compare with Siebert (1994) for a similar argumentation with respect to regional labor markets in Germany. However,

The empirical support for this neoclassical migration model provided by recent macroeconomic studies for European countries is however somewhat mixed:[3] While the regional disparities in (un)employment are often shown to be important factors in determining migratory flows, the influence of regional wage or income level is difficult to prove in many examinations. For British regions, Pissarides & McMaster (1990) report an insignificant influence of the behavior of the regional wage level on the net migration rate. Likewise for British regions, Jackman and Savouri (1992) find no significant influence with false indications of bilateral gross migration rates for regional wage decrease. Westerlund (1997) shows that the wage variables have a significant influence only on the gross outward migration rate in Swedish regions. In the gross in-migration function, the wage rate of neither the origin nor target region appears significant. While Bentolila & Dolado (1991) indicate a quantitatively low positive influence of a relative rise in wages on the net migration of Spanish regions, there is a false sign for wage differences in the explanation of bilateral gross migration flows in the study by Devillanova & Garcia-Fontes (2004). Only in Daveri & Faini (1998) regional wage levels correspond to the theoretically expected sign for gross out-migration in Italy from southern to northern regions. Similar evidence is given Fachin (2007) considering long-run trends of Italian South–North migration. He finds that income growth in the sending region is a significant driving force of migration, while unemployment rates have only weak effects. In contrast to these latter two contributions the overall rather weak empirical support for wage rate differentials in the European context may be due to the lack of controlling for regional price level differences, which may actually result in much different regional income disparities than using variables in nominal or in some standard form deflated (e.g. by output prices) real terms (see e.g. Roos, 2006).

Taking a closer look at German interregional migration, Decressin (1994) examined gross migration flows for the 11 West German states between 1977 and 1988. His results show that a wage increase in one region relative to others causes a disproportional rise the gross migration levels in the first region, while a rise in the unemployment in a region relative to others disproportionally lowers the gross migration levels. On the contrary, the author does not find a significant connection between bilateral gross migration and regional differences in wage level or unemployment when purely cross-sectional estimate

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this view has been called into question recently by Blanchflower and Oswald's (1994) wage curve, linking low wages and high the unemployment in a particular region. Studies by Wagner (1994), Baltagi & Blien (1998) and Baltagi et al. (2007) indeed give evidence of a 'wage curve' in Germany. Blien (2001) however, points out that the wage curve cannot be interpreted as a geometric shape composed of long term balance conditions, but rather as reflecting temporary balances. According to this point, "*a wage curve can also be valid over the course of time when migration occurs, so long as the rates of spatial mobility are sufficiently low.*" (Blien, 2001).

[3] This short literature review does not aim to give a full and exhaustive picture of all available empirical work done, but rather aims to highlight some central tendencies in recent research effort.

are considered.[4] Difficulties in proving a significant influence of regional wage decreases on the migratory behavior within Germany are also found in earlier empirical studies based on micro-data which directly address the motivation for individual migratory behavior in Germany. Among these are Hatzius (1994) for the West German, as well as Schwarze & Wagner (1992), Wagner (1992), Burda (1993) and Büchel & Schwarze (1994) for the East German states. Subsequent micro studies succeed in qualifying the theoretically unsatisfactory result of an insignificant wage influence: Schwarze (1996) shows that by using the expected wage variables instead of the actual ones, the wage drop between East German and West German states has a significant influence on the migratory behavior.[5] In a continuation of Burda (1993), Burda et al. (1998) also indicates a significant, however non-linear influence on the household income.

Contrasting to the earlier evidence, recent macroeconomic studies with an explicit focus on intra-German East-West migration flows assign a more prominent role to regional wage rate differentials in predicting migration flows (see e.g. Parikh & Van Leuvensteijn, 2003, Hunt, 2000, as well as Burda & Hunt, 2001). Parikh & Van Leuvensteijn (2003) use the core neoclassical migration model with regional wage and unemployment differentials as driving forces of interregional migration augmented by additional indicators such as regional housing costs, geographical distance and inequality measures. For the short sample period 1993 to 1995 the authors find significant non-linear relationship between disaggregated regional wage rate differences and East-West migration (of a U-shaped form for white-collar workers and of inverted U-form for blue-collar workers), while unemployment differences are tested be insignificant. Similarly, the relationship between income inequality and migration did not turn out to be strong. Hunt (2000) and Hunt & Burda (2001) analogously identify wage rate differentials and particularly the closing gap in regional differences driven by a fast East-West convergence as a powerful indicator in explaining observed state-to-state migration patterns. Using data up to the late 1990s Hunt & Burda (2001) find that the decline in East-West migration starting from 1992 onwards can almost exclusively be explained by wage differentials and the fast East-West wage convergence, while unemployment differences do not seem to play an important part in explaining actual migration trends (which actually increased during that period).[6] When

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[4] Decressin (1994) interprets these results in favor for long-term validity of an equilibrium relationship among regions: "*This finding probably indicates that there are nominal wage and salary differences prevailing in equilibrium which compensate for differences in regional price levels and amenities*". It should be noted that Decressin did not check for regional price level differences.

[5] This result is also confirmed in Brücker & Trübswetter (2004). The latter study also focuses on the role of self-selection in East-West migration, finding that East-West migrants receive a higher individual wage compared to their non-migrating counterparts after controlling for the human capital level.

[6] For a critical reflection of the results of Hunt & Burda (2001) see e.g. Yellen (2001) and Wolff (2006).

interpreting the latter results in favor of wage differentials as driving force of migration (contrary to earlier evidence for Germany and Europe) one has to bear in mind that the latter studies use only data until the mid/late-1990s, where (politically driven) East-West wage convergence was indeed an overriding trend and the overall pattern of East German macroeconomic development was subject to several structural breaks. However, in the second half of the 1990s wage convergence substantially lost pace, so that the results may be possibly subject to a sample selection bias, when assigning a prominent role to the wage rate in determining migration flows as long run driving force beyond the 1990s.

Taking up the research questions dealt with in the recent literature we aim at analysing whether (and by what magnitude) regional differences in wage levels, unemployment and other economic (push and pull) factors have significantly influenced the migratory behaviour within Germany since reunification and also expand the focus to an analysis of bi-directional influence between migration, wage and unemployment. Our motivation is threefold: 1.) As the literature review shows, there less consensus among empirical contributions analysing intra-German migration flows with respect to which (set of) explanatory variables may be best suited to track back actual flows, 2.) there is also a clear gap between the sample period employed in recent empirical work (only until the mid/late-1990s) and recently available data. Finally, 3.) new methodological advances in the analysis of (dynamic) panel data models have only rarely been applied to the analysis of regional migration flows (for Germany). Taken together, all aspects call for an updated analysis of regional migration patterns in Germany.

To do so, in the following we will analyse internal migration between the German federal states (NUTS1 level) for the period from 1991 until 2006 using (dynamic) panel data methods starting from a macroeconomic perspective, which we will further augment by variable input from micro evidence (e.g. with respect to the role of human capital or in a broader sense the regional innovative activity, housing prices and prices for building land as well as sectoral differences among regions). The remainder of the paper is organised as follows: In the next section, we will give a short overview of the data used for the empirical analysis, as well as present some stylized facts for intra-German migration patterns since 1991. Section 3, sketches the underlying theoretical model that will serve as a starting point in specifying testable empirical specifications for estimation. Section 4 contains the results of the regression analysis and their interpretation where we both deal with single and multiple equation models in a dynamic panel data setting. A special focus is given to Panel VAR models in section 4.2. In section 5, we test the explanatory power of the regression results for predicting interregional East-West migration flows since re–unification. Section 6 finally concludes.

2 Data and Stylized Facts of Intra-German Migration Patterns

This section serves to give a short overview of the data employed in this study as well as to present some (macro-) regional trends for the intra-German migration patterns since unification.[7] Especially the (descriptive) analysis of interstate migration between West and East Germany throughout the process of East German economic transition and cohesion has gained considerable attention in the recent literature (for surveys see e.g. Heiland, 2004, Berentsen & Cromley, 2005, as well as Wolff, 2006). Alongside economic transformation and cohesion the East German states have witnessed a substantial loss of population through East-West net outmigration. Moreover, East-West migration has not been stable over time with peaks in the early and late 90s.[8] Thus, to take a closer look at the characteristics of intra-German migration flows we compute a set of simple summary statistics that give a first glance of the relative 'performance' among German states. Among the most frequently indicators are (see e.g. Rinne, 1996, for details)

$$w_{i,t}^{inm} := \left(\frac{Inm_{i,t}}{Pop_{i,t}}\right) \tag{1}$$

$$w_{i,t}^{outm} := \left(\frac{Outm_{i,t}}{Pop_{i,t}}\right) \tag{2}$$

$$w_{i,t}^{nmr} := \left(\frac{Inm_{i,t} - Outm_{i,t}}{Pop_{i,t}}\right) \tag{3}$$

$$w_{i,t}^{gmv} := \left(\frac{Inm_{i,t} + Outm_{i,t}}{Pop_{i,t}}\right) \tag{4}$$

Eq.(1) and eq.(2) define gross in- and outmigration rates as the number of migrants relative to the population level for region i and time period t and may be seen as general measures of regional (labour market) attraction or distraction respectively. While the net migration rate in eq.(3) is able to identify the 'winner' and 'looser' regions in the context of interregional migration, the gross migration value in eq.(4) measures the total migration intensity in the respective regions. The latter is typically positively correlated

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[7] German interregional migration data track the movement of all resident Germans (including foreigners). Since registration of residency is legally mandated and necessary in order to qualify for transfer benefits, the data should be quite complete and accurate.

[8] The general phenomenon of "migration volatility" has been subject to considerable research effort recently (see e.g. Manson & Groop, 1996). As Berentsen & Cromley (2005) argue, such ocillative processes with relative brief periods of abrupt systematic change in established migration patterns followed by longer periods during which new migration equilibria will be established are likely to apply to the interstate pattern of migration in Germany as well - given the social, economic and political changes associated with German unification.

with the overall economic performance of region i, that is regions experiencing strong (growth) dynamics typically also have both higher in- and outmigration rates relative to its population level compared with less dynamic regions. Figure 1 and 2 present the above defined indicators for the two German macro regions West and East Germany.[9] The figures show the time evolution of the macro regional aggregate together with the standard deviation measured as degree of variability in the disaggregated state level indicators for the respective macro region.

[Figure 1 and 2 about here]

The figures show the different time pattern in the East and West German aggregates. Looking at in- and outmigration patterns first, in figure 1 the gross in-migration rate of the East German states shows an upward trend throughout the 90s and has remained rather stable since then. On the contrary, the gross outmigration rate for East Germany is much more volatile with two peaks in the early 90s and around 2001. While the former may be seen as a direct response to German unification, the later coincides with economic stagnation in the East and improving job prospects in the West (see e.g. Heiland, 2004). In all, during the second wave outmigration rates to the West increased across all East German states and reached levels close to those observed during the first Reunification induced migration wave. For the West German aggregate the two time patterns are rather stable over time. While the population adjusted in-migration rates are of the same magnitude for East and West, the out migration rate for East Germany is much higher over the sample period. However, the standard deviation among Western states is higher than for the more homogeneous Eastern regions. The discrepancy between East German in- and outmigration is also reflected in the net migration rate displayed in figure 2. For the West German average the net migration rate remains rather time stable with a small surplus. The East German net migration rate reflects the volatile trend of gross outmigration. Finally, the migration intensity reflecting the mobility of the population is higher in East Germany. State level details for each indicator are given in table 1 to 4.

[Table 1 to 4 about here]

Another way to graphically classify ’winner’ and ’looser’ regions of intra-German migration trends is to simply plot state level in- and outmigration flows for a fixed time

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[9] The latter aggregate also includes Berlin.

period against each other. Figure 3 displays such scatter plots using annual observations for 1991, 1996, 2001 and 2006. The interpretation of the figure is straightforward: The closer data points are to the diagonal (45-degree line), the more balanced are their net migration patterns: That is, for data points on the diagonal net migration is equal to zero, while the area above (below) the diagonal indicate positive (negative) net migration flows. Further, data points which are closer to the origin inhibit smaller gross migration volumes and vice versa. Figure 3 additionally accounts for population size by weighting the size of the data point (circle) with its absolute population value for the respective period. The figure confirms the tendency that high population states on average have higher absolute gross migration flows (moving towards the upper right of the scatter plot).

[Figure 3 about here]

Starting in 1991, figure 3 shows that all East German states are clearly below the diagonal symbolizing population losses with Saxony being hit the most. All West German states except Schleswig-Holstein are either on or above the diagonal line indicating net migration inflows. This strong response to German unification is less present in subsequent periods where all state values are much closer to the diagonal. However, as already described above in 2001 this trend is partially offset around 1999-2001, where a second wave of increased East-West migration has been observed (see also figure 1 and 2). The strong negative outlier effect of the West German state Lower Saxony (Niedersachsen) is due to the specific migration pattern of German resettlers from Eastern and Southern Europe (Spätaussiedler), which typically first migrate to the central base Friesland in Lower Saxony and only subsequently move on to other states. Hence, taking also external migration for Niedersachsen into account this negative effect vanishes. At the end of the sample in 2006 interregional migration among German states seems to be much more balanced than in the early 1990s. Figure 4 finally, reports the cumulative net migration flows at the state level for 1990-2006. Ignoring Lower Saxony due to the special situation of German resettlers from Eastern and Southern Europe as described above,[10] all East German states (except Brandenburg with balanced cumulative net migration) lost a substantial share of their population level due to intra-German migration flows. On the opposite especially Bavaria (Bayern) realized a huge inflow of domestic migration flows.

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[10] The bias in the interregional migration effect of Lower Saxony due to German resettlers may be seen if we compare the migratory performance with the cumulative population change between 1990 and 2006: Here, with a total plus of 8,1% Lower Saxony is among the three German regions with the highest cumulative population growth rates. For details see e.g. BiB (2008).

[Figure 4 about here]

To characterise state level migration patterns over time we finally also plot net migration rates between 1991 and 2006 in figure 5, together with key labour market and macroeconomic time series for German states in figure 6. As figure 5 shows, the general trend sketched for the East–West macro regions with on average positive net migration rates for the West German states and negative rates for the East German counterparts is also reflected by the state level evidence. A clear outlier among the West German states in figure 5 is the net migration rate of Lower Saxony mainly driven by German resettlers from abroad. In the empirical estimation we will explicitly control for the latter administrative induced migration effect, which does not bear much economic interpretation. Taking a closer look at the evolution of state level net migration rates for East Germany, only Brandenburg has a positive migration balance throughout the 1990s benefiting from persistent net out–migration of Berlin. The time series pattern of other East German states is very similar with persistent negative net migration rates over the whole sample period.

Figure 6 presents selected key labour market and macroeconomic indicators at the state level. In the upper left graph regional wage rates between 1991 and 2006 are shown (West German states in solid lines, East German states in dashed lines). The graph shows the initially strong wage gap between the East–West macro regions (except Berlin) in 1991, which was followed by a (politically driven) fast wage convergence until the mid–90s. However, in the following wage convergence significantly slowed down, so that towards the end of the sample in 2006 still significant regional wage differentials can be observed between the Eastern and Western states and with minor magnitude also among the Western states itself. The regional unemployment rates in the upper right graph of figure 6 tell a quite similar story with the Eastern states being on average far above the West German level (except for Bremen), while there is again a considerable degree of heterogeneity both among the West and East German subgroups.

As for the regional wage rates the trend pattern in state level labour productivity shows a fast East-West convergence throughout the 1990s with a slower pace in the second half of the sample period. While the Eastern states (except Berlin) show a very homogeneous development, disparities in labour productivity among West German states increase over the sample period (with Hamburg as positive outlier in figure 6). Finally, figure 6 takes a closer look at the evolution of regional differences in price levels. Such data is typically ignored in empirical analysis given its scare evidence at an intra-country perspective. Here we use data compiled by Roos (2006) based on prices indices for 50 German cities in 1993 and construct a time series of regional price levels by using state level inflations rates for consumer prices between 1991 and 2006.[11] Since differences in regional price levels may offset or even increase regional wage rate differentials, an explicit account for regional (consumer) prices in estimating migration flows seems promising. As the figure 6 shows, the regional price levels for the Eastern states were much below the West German average in 1991, however over the sample this gap gradually declines. Indeed, Roos (2006) finds some evidence for price level convergence among states with an implied half-life until all price levels have converged to a common mean of about 15 years (for data until 2003).

[Figures 5 and 6 about here]

For empirical estimation we make use of all available data for the 16 German states between 1991 and 2006. We model migration patterns both using a bilateral state-to-state approach (with a total of 3840 observations) or aggregated approach, where the latter specifies net migration of region i relative to the rest of the country as sum of all regions minus region i (this leaves us with a total of 256 observations). The latter approach can be interpreted as averaging the effect of all bilateral state-to-state relationships. All economic variables are denoted in real terms. A full description if the data sources (broadly based on officially published regional accounting data, VGRdL) is given in table 5. Since we are dealing with macroeconomic time series the (non)-stationarity of the data and thus spurious regression may be an issue for which we have to account for.

We therefore perform unit panel root tests for the variables in levels using the approach proposed by Im-Pesaran-Shin (1997). For cases where the IPS test casts doubts on the stationarity of the data we also employ the alternative Levin-Lin-Chu (2002) test. While the LLC test assumes that all series are stationary under the alternative hypothesis, the IPS test is consistent under the alternative that only a fraction of the series is stationary. We compute four different setups of the testing procedure: 1.) no lag, no trend; 2.) no lag, trend; 3.) lag(1), no trend; 4.) lag(1), trend.

Turning to the results in table 6 (for variables in levels) and table 7 (for regional differences), in almost all cases we can reject the null hypothesis of non-stationarity based on the IPS test. Only for the average price of building land (*pland*) the IPS test casts some doubt on the stationarity of the data. However, computing additionally the LLC test results, the null hypothesis of non-stationarity is strongly rejected in three of the four test setups. This is broadly in line with our theoretical expectations with respect to

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[11] Computational details and data limitations are discussed in the appendix.

the order of integration of the analysed variables. Migration and labour market variables (unemployment rate, labour participation rate etc.) are typically assumed to be stationary processes, only for labour productivity and building land prices we could theoretically expect the respective variable to be integrated of order 1, which the panel unit root tests simply do not show given the short time dimension T of our sample (indeed, a stylized theoretical labour market model which gives support for the later hypothesis is presented in section 4). We may thus follow Binder et al. (2005) arguing that only because we have a short time dimension in our sample this does not mean that the underlying data could not have arisen from non-stationary processes. Thus to sum up, for the majority of variables the empirical test results and our theoretical expectation support the view of stationary variables. For the candidates that may be potentially integrated variables though the panel unit root tests do not show (labour productivity and building land prices), we compare different empirical alternatives with variables in levels and first differences. Such a modelling strategy gives us a high level of flexibility in estimating different DPD models making us of both levels and first differences as typically proposed in the recent panel econometric literature.

[Table 5 and 6 about here]

3 Interregional Migration: Bits of Theory and Econometric Model Specification

Before we turn to the empirical estimation, we aim at giving a sound theoretical foundation for our migration model. Mainstream economic literature offers different models trying to explain the reasons for people moving from one region to another (see Etzo, 2008, for a recent survey). Still, the neoclassical framework - modelling an individual's lifetime expected income (utility) maximization approach - typically has a prominent role in explaining the individual's migration decision either as in supplying labour or investing in human capital (see e.g. Maza & Villaverde, 2004 for a recent overview of the literature). The idea underlying individual's decision making process with respect to migration is straightforward: Assuming rational behaviour a representative individual will decide to migrate if this improves his welfare position relative to the status-quo of not moving. From this follows that throughout the decision making process the individual needs to compare the expected income he would obtain for the case he stays in his home region

(i) with the expected income we would obtain in the alternative region (j) and further account for 'transportation' costs of moving from region i to j.

Following the seminal paper of Harris & Todaro (1970) this idea can be further elaborated by modelling the expected income from staying in the region of residence (E_{ii}) as a function of the real wage rate in region i (W_i) and the probability of being employed (P_i). The latter in turn is a function of unemployment rate in region i (U_i) and a set of potential variables related both to economic and non-economic factors (S_i). The same set of variables - with different subscripts for region j accordingly - is also used to model the expected income from moving to an alternative region / labour market. Taking also a set of economic (housing prices, transfer payments etc.) and non-economic costs (region specific amenities) of moving from region i to j into account (C_{ij}), the individual's decision will be made in favor of moving to region j if

$$E_{ii} \leq E_{ij} - C_{ij}, \tag{5}$$

with $E_{ii} = f(P_i[U_i, S_i], W_i)$ and $E_{ij} = f(P_j[U_j, S_j], W_j)$. Thus, taken together, at the core of Harris-Todaro model potential migrants weigh the wage level in the home and target regions with the individual probability of finding employment. Using this information we can set up a model for the regional net migration (NM_{ij}) - defined as regional in-migration flows to i from j relative to outmigration flows from i to j - which has the following form

$$NM_{ij} = f(W_i, W_j, U_i, U_j, S_i, S_j, C_{ij}). \tag{6}$$

With respect to the theoretically motivated sign of the explanatory variable parameters we expect that an increase in the home country's real wage rate (or alternatively: income level) *ceteris paribus* leads to higher net migration inflows, while a real wage rate increase in region j results in a decrease of the net migration rate.[12] On the contrary, an increase in the unemployment rate in region i (j) has negative (positive) effects on the bilateral net migration from i to j. Costs of moving from i to j are typically expected to be an impediment to migration and thus are negatively correlated with net migration.

For empirical modelling we also include additional economic variables (S_i, S_j) that may work as pull or push factors for regional migration flows: Giving migration flows a long-run structural rather than business cycle perspective a prominent candidate to be included in the migration model as explanatory variable is labour productivity. As Coulombe (2006)

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[12] Though it is typically difficult to obtain data for regional price level differences, we explicitly derive a proxy based on Roos (2006), to account for the significant differences in the costs of living in the East and West German macro regions.

argues, two cases of structural migration in this setting have to be distinguished: Absolute convergence and conditional convergence. With respect to absolute convergence migration flows are assumed to react to different initial levels of labour productivity in region i and j . Gradually the gap between the two regions will be eliminated in the convergence-growth process and structural migration between i and j will decrease smoothly in a time horizon that goes beyond the business cycle horizon. Differently, conditional convergence is necessarily associated with other structural difference in S_i and S_j so that the gap in labour productivities may not be fully closed. In the (new) economic growth theory an important factor for difference in the long run level of labour productivities among regions is the endowment with human capital in the respective regions.

According to the human capital theory of migration the formal qualification/skill level of the prospect migrant may be an important determinant in the actual migration decision. Recent contributions analysing the relationship between skills and mobility find that higher individual qualification is indeed correlated with higher individual mobility (see e.g. Borjas, 1987, for a theoretical discussion, Wolff (2006) for an overview of empirical studies for Germany). Though this link is found to be more statistically significant at the micro rather than the macro level (see e.g. Bode & Zwing, 2008). Thus, taken these results into account the relative demand for skill intense labour and regional innovative environment may influence net migration. We given the problem of finding appropriate proxies for the regional human capital level (see e.g. Ragnitz, 2007, with a special focus on East West differences) we test different proxies based on the regional human capital potential, the skill level of employee as well as innovative activities such as regional patent intensities. Finally, differences in housing prices and land for building as well as costs of moving from i to j (C_{ij}) should be taken into account. The latter could possibly be proxied by the geographical distance between the home and target region as it is typically done in the gravity model literature though in empirical estimation this variable merely turns out insignificant given measurement problems (see e.g. Bode & Zwing, 1998).[13]

In the empirical literature typically a log-linear form of the migration model in eq.(6) is chosen, additionally either contemporaneous or (one period) lagged values for the explanatory variable are used. Here we follow Puhani (1999) and take one-period lagged values for the explanatory variables so that the model written in panel data notation has the following form (with lower case variables denoting logarithms):

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[13] A full account of the role of distance related migration costs goes beyond the scope of the analysis and is left for future research, see also section 6 on this point. For an application of Lowry-type (1966) gravity models of interregional migration with a distinct role of geographic distance see e.g. Etzo (2007).

$$(inm_{ij,t} - outm_{ij,t}) = \alpha_0 + \alpha_1 w_{i,t-1} + \alpha_2 w_{j,t-1} + \alpha_3 ur_{i,t-1} + \alpha_4 ur_{j,t-1} + \alpha_5' \mathbf{Z} + e_{ij,t}, \quad (7)$$

where $e_{ij,t} = \mu_{ij} + \nu_{ij,t}$ has the typical error component structure. The variable UR is the regional unemployment rate. The motivation for using lagged rather than contemporaneous values for the explanatory variables are as follows: It is likely that differences in regional unemployment and wage rates affect migratory behaviour only with a time delay due to information lags (for a detailed discussion see e.g. Poschner, 1996, as well as Bilger et al., 1991). Taking further into account that migration flows typically adjust with a lag structure, we augment eq.(7) by the lagged value of net migration (with $nm_{ij,t} = inm_{ij,t} - outm_{ij,t}$) as:

$$nm_{ij,t} = \beta_0 + \beta_1 nm_{ij,t-1} + \beta_2 w_{i,t-1} + \beta_3 w_{j,t-1} + \beta_4 ur_{i,t-1}) + \beta_5 ur_{j,t-1} + \beta_6' \mathbf{Z} + e_{ij,t}, \quad (8)$$

The inclusion of the lagged endogenous variable may reflect different channels through which past migration flows may affect current migration e.g. that migrants serve as communication links for friends and relatives left behind. This in turn may influence prospective migrants who want to live in an area where they share cultural and social backgrounds with other residents (see e.g. Chun, 1996, for a detailed discussion).

In applied work one typically finds a restrictive version of eq.(8) where net migration is regressed against regional differences of explanatory variables of the form (see e.g. Puhani, 1999)

$$nm_{ij,t} = \gamma_0 + \gamma_1 nm_{ij,t-1} + \gamma_2 \tilde{w}_{ij,t-1} + \gamma_3 \tilde{ur}_{ij,t-1}) + \gamma_4' \mathbf{Z} + e_{ij,t}, \quad (9)$$

where $\tilde{x}_{ij,t}$ for a variable $x_{ij,t}$ denotes $\tilde{x}_{ij,t} = x_{i,t} - x_{j,t}$. [14]

4 Internal Migration in Germany: A Dynamic Panel Data Analysis

4.1 Single equation results for the migration equation

In this section we will estimate dynamic single and multiple equation specification of the migration model in eq.(8/9) and additional equations for key labour market variables.

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[14] The latter specification implies the following testable restrictions of the unrestricted model in eq.(8): $\beta_2 = -\beta_3$ and $\beta_4 = -\beta_5$.

Thereby, the 1.step single equation estimation mainly serves as a guidance for the latter system approach to choose the most efficient estimator in these settings. To look more detailed at different DPD estimators we may start writing eq.(8/9) generally as the m-th equation of a M–equations system with:[15]

$$y_{i,t} = \alpha_0 + \alpha_1 y_{i,t-1} + \sum_{j=0}^{k} \beta_j' X_{i,t-j} + u_{i,t}, \quad \text{with:} \quad u_{i,t} = \mu_i + \nu_{i,t}, \tag{10}$$

for $i = 1, \ldots, N$ (cross-sectional dimension) and $t = 1, \ldots, T$ (time dimension). $y_{i,t}$ is the endogenous variable and $y_{i,t-1}$ is one period lagged value. X_i a vector of explanatory time-varying and time invariant regressors, $u_{i,t}$ is the combined error term, where $u_{i,t}$ is composed of the two error components μ_i as the unobservable individual effects and ν_i is the remainder error term. Both μ_i and ν_i are assumed to be i.i.d. residuals with standard normality assumptions. In terms of orthogonality conditions these assumptions are given as follows:

$$\begin{aligned} E(\nu_{it}\nu_{js}) &= 0, \quad \text{for either } i \neq j \text{ or } t \neq s, \text{ or both} \\ E(\mu_i \mu_j) &= 0, \quad \text{for } i \neq j \\ E(\mu_i \nu_{jt}) &= 0, \quad \forall i, j, t \end{aligned} \tag{11}$$

The first two assumptions state that the homoscedastic error terms are mutually uncorrelated over time and across cross-sections. Furthermore the unobserved individual heterogeneity is random and uncorrelated between individuals. The third assumptions rules out any correlation between the individual effects and the remainder disturbance term (that is μ_i is exogenous).

There are numerous contributions in the recent literature with respect to the single equation estimation of the dynamic model of the above type, which especially deal with the problem introduced by the inclusion of a lagged dependent variable in the estimation equation and its built-in correlation with the individual effect: That is, since y_{it} is also a function of μ_i, $y_{i,t-1}$ is a function of μ_i and thus $y_{i,t-1}$ as right-hand side regressor in eq.(12) is correlated with the error term. Even in the absence of serial correlation of ν_{it} this renders OLS, FEM and REM models biased and inconsistent (see e.g. Nickel, 1981, Sevestre & Trogon, 1985 or Baltagi, 2005, for an overview).

The most widely applied approaches of dealing with this kind of endogeneity typically

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[15] Restricted to the case of a one period lag for the endogenous variable.

start with first differencing (FD) equation (12) to get rid of μ_i and then estimate the model by instrumental variable (IV) techniques. The advantage of the FD transformation is that this form of data transformation does not invoke the inconsistency problem associated with the standard FEM or REM estimation (see e.g. Baltagi, 2005). Anderson & Hsiao (1981) were among the first to propose an estimator for the transformed FD model of eq.(12):

$$(y_{it} - y_{i,t-1}) = \alpha(y_{i,t-1} - y_{i,t-2}) + \sum_{j=1}^{k} \beta_j (X_{i,t-j} - X_{i,t-j+1}) + (u_{it} - u_{i,t-1}), \qquad (12)$$

where $(u_{it} - u_{i,t-1}) = (\nu_{it} - \nu_{i,t-1})$ since $(\mu_i - \mu_i) = 0$. As a result of first differencing the unobservable individual effect has been eliminated from the model. However, there appears the problem that the error term $(\nu_{it} - \nu_{i,t-1})$ is correlated with $(y_{i,t-1} - y_{i,t-2})$ and thus the latter needs to be estimated by appropriate instruments which are uncorrelated with the error term. Anderson & Hsiao (1981) recommend to use lagged variables, either the lagged observation $y_{i,t-2}$ or the lagged difference $(y_{i,t-2} - y_{i,t-3})$ as instruments for $(y_{i,t-1} - y_{i,t-2})$. These IVs are correlated with the explanatory variable, but not with the error term. Arellano (1989) compares the two alternatives and recommends $y_{i,t-2}$ rather than the lagged differences as instruments since they have shown a superior empirical performance. The respective orthogonality conditions for this approach can be stated as:

$$E(y_{i,t-2}\Delta u_{i,t}) = 0 \quad \text{or alternatively:} \quad E(\Delta y_{i,t-2}\Delta u_{i,t}) = 0, \qquad (13)$$

where Δ is the difference operator defined as $\Delta u_{i,t} = u_{i,t} - u_{i,t-1}$. The AH model can be estimated for $t = 3, \ldots, T$ due to the construction of the instruments. Subsequently, refined instrument sets for the estimation of eq.(10) have been proposed in the literature: Trying to improve the small sample behaviour of the AH estimator Sevestre & Trognon (1995) propose a more efficient FD estimator which is based on a GLS transformation of eq.(10). [16] Searching for additional orthogonality conditions Arellano & Bond (1991) propose an GMM estimator, which makes use of all lagged endogenous variables - rather than just $y_{i,t-2}$ or $\Delta y_{i,t-2}$ - of the form:[17]

$$E(y_{i,t-\rho}\Delta u_{i,t}) = 0 \quad \text{for all} \quad \rho = 2, \ldots, t-1. \qquad (14)$$

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[16] Since this GLS transformation leads to disturbances that are linear combinations of the $u_{i,t}$'s, the only valid instruments for $\Delta y_{i,t-1}$ are current and lagged values of ΔX.

[17] The use of GMM in DPD models was introduced by Holtz-Eakin et al. (1988), who propose a way to use 'uncollapsed' IV sets.

Eq.(14) is also called the 'standard moment condition' and is widely used in empirical estimation. However, one general drawback of dynamic model estimators in first differences is their poor empirical performance especially for a high persistence in the autoregressive component such as growth models (see Munnel, 1992, and Holtz-Eakin, 1994, for poor empirical estimates of a production function in FD, Bond et al. (2001) for growth equation estimates). Bond et al. (2001) argue that first difference IV/GMM estimators can be poorly behaved, since lagged levels of the time series provide only 'weak instruments' for sub-sequent first-differences.

In response to this critique a second generation dynamic panel data models has been developed which also makes use of appropriate orthogonality conditions (in linear form) for the equation in levels (see e.g. Arellano & Bover, 1995, Ahn & Schmidt, 1995, and Blundell & Bond, 1998) as:[18].

$$E(\Delta y_{i,t-1} u_{i,t}) = 0 \quad \text{for t=3,...,T.} \tag{15}$$

.

Thus, rather than using lagged levels of variables for equations in first difference as in the FD estimators, we get an orthogonality condition for the model in level that uses instruments in first differences. Eq. (15) is also called the 'stationarity moment condition'.[19] Blundell & Bond (1998) propose a GMM estimator that uses jointly both the standard and stationarity moment conditions. This latter approach is typically labeled 'system' GMM as a combination of 'level' and 'difference' IV/GMM. Though labeled as 'system' GMM, this estimator treats the data system as a single-equation problem since the same linear functional relationship is believed to apply in both the transformed and untransformed variables (see e.g. Roodman, 2006).

For the migration model of eq.(8/9) with apply different FD, level as well as combined FD & level ('system') estimators and test for the appropriateness of instrument subsets based on standard test criteria such as the 'Difference-in-Sargan' C-Statistic. The estimation results for restricted and unrestricted migration models are shown in table 7.[20]

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[18] The original form in Ahn & Schmidt (1995) is $E(\Delta y_{i,t-1} u_{i,T}) = 0$ for $t = 3, \ldots, T$ derived from a set of non-linear moment conditions. Blundell & Bond (1998) rewrote it as in (17) for convenience. The latter moment condition is also proposed in Arellano & Bover (1995)

[19] That is because for eq.(15) to be valid we need an additional stationarity assumption concerning the initial values $y_{i,1}$. Typically $y_{i,1} = \mu/(1-\alpha) + w_{i,1}$ is considered as an initial condition for making $y_{i,t}$ mean-stationary, with assumptions on the disturbance $w_{i,1}$ as $E(\mu_i w_{i,1}) = 0$ and $E(w_{i,1}\nu_{i,t}) = 0$.

[20] Here we only present regression results for the 'disaggregated' bilateral model, , which has the advantage of additional degrees of freedom for empirical testing. The estimated parameters of the smaller model using a 'rest of the country' aggregate are of similar size and can be obtained from the authors upon request. For empirical estimation we use the Stata routines *xtabond2* (Roodman, 2006) and *ivreg2* (Baum et al., 2003).

[Table 7 about here]

We start with the fairly simple Anderson-Hsiao (1981) estimator for the core migration model using instruments for the autoregressive migration component according to the orthogonality condition in eq.(13). The other explanatory variables in this single equation approach are assumed to be strictly exogenous (this assumption will relaxed later on in the simultaneous equation modelling of migration and labour market variables). As specified in eq.(9) real wage and unemployment rates enter as regional differences. The real wage rate is computed as nominal wage level adjusted for regional consumer prices derived from Roos (2006). The results show that the unemployment rates differentials $(ur_{ij,t-1})$ between region i and j have a significant impact on bilateral net migration and with a–priori expected coefficient sign, that is rising differences in the unemployment rate between i and j lead to decreasing net in-migration flows to region i from j. The estimated coefficients for wage rates differences $((\widetilde{w - pcpi})_{ij,t-1})$ are however tested to be statistically insignificant and with false coefficient sign (according to our theoretical ex–ante expectations). Finally, not reported in table 8:[21] The coefficient restriction of using regional differences (i minus j) rather than unrestricted variable for region i and j cannot be rejected on basis of a linear Wald test (this accounts for almost all specification in table 8).

We then augment the core migration model by further including variables measuring regional differences in labour productivity $(\widetilde{ylr}_{ij,t-1})$, a human capital index $(\widetilde{hc}_{ij,t})$ and prices for building land $(\widetilde{pland}_{ij,t})$.[22] While the former variable may serve as a proxy for the general economic performance in region i and j not fully reflected in the regional wage level, human capital may act as a pull/push factor for skill intensive labour movements given the hypothesis that a high stock of human capital in the region (both as part of the work force as well as from education) attracts additional potential migrants with a high qualification. On the contrary, a high regional endowments with human capital may lead to tighter labour markets resulting in a negative correlation between migration flows and human capital endowments, so that the final effect is a–priori not that clear cut. The same accounts for regional differences in the price for building land: That is, according to the neoclassical paradigm increasing land prices between i and j should have a negative impact on net in–migration in region i since this reflects higher costs of living in i relative to j. However, on the opposite land prices may also reflect the regional attractiveness

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[21] Results upon request.

[22] In the final specification we used labour productivity in terms of growth rates, which gave more reasonable results.

as a destination to work and live, which in turn is clearly positively linked to migratory movements.

The results of the augmented model including labour productivity, human capital and building land prices based on the Anderson–Hsiao (AH) estimator are displayed in column 2 of table 7. Now, in the augmented migration model real wage differences have a significant role in explaining migration rate, while the unemployment rate turns out insignificant. The inclusion of lagged labour productivity (growth) differences between i and j turns out to have a highly significant impact on net inmigration with coefficient sign in line with our theoretical expectations, that is regions with a relatively high productivity growth performance in the past attract more migrants. The proxy for human capital turns out to be negative. This result may have two reasons: 1.) As argued above a high regional stock of human capital may lead to tighter labour market for highly qualified workers leading to reduced in–migration rates, 2.) our derived index for human capital (see appendix for details) may be a poor proxy, given the high formal qualification level in East German states which does not necessarily reflect the effective regional use of human capital (see Ragnitz, 2007, on that point). The proxy for land prices turns out to be insignificant in the Anderson–Hsiao (AH) specification

Turning from simple IV–type estimators to the Arellano–Bond GMM approach, the results in table 8 show that the use of more instruments in the AB model does not improve the model in terms of the root mean square erroer (RMSE) as a general measure for the appropriateness of the estimation much.[23]. Both AB specifications are in line with the augmented AH IV–approach with the solely exception that the AB model identifies a clear transmission channel for regional unemployment differentials in determining migration flows, while the coefficient for real wages is of reversed sign. The other parameter estimates are much in line for the AH and AB model – both from a qualitative and quantitative point of view. Given the large number of instruments in the AB2 case we also perform an overidentification test based on the Hansen J-Statistic to check for instrument validit and relevance. As table 8 shows the AB2 specification passes the overidentification test.

Given the results of the panel unit root tests and the fact that labour productivity only enters in 1. differences, we may also apply estimators that make use of variables in levels rather than just 1. differences as in the AH and AB specification. Here we perform both pure level GMM as well Blundell-Bond (1998) type 'system' GMM estimations. All GMM estimators are based on a two-step approach, where initial 2SLS residuals are used

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[23] The difference between the AB1 and AB2 model is that the former uses GMM style instruments employing all available lags according to eq.(14) solely for the lagged endogenous variable, while AB2 employs these type of instrumentation also for the strictly exogenous variables

to compute the 2 step weighting matrix. The results of the level and combined FD & level estimators are given in table 8. The level GMM estimation output shows for all variables statistically significant results with coefficient signs broadly in line with our a priori theoretical expectations. This is especially striking for the core labour market variables (regional wage and unemployment rate differentials) where empirical evidence in line with the neoclassical model predictions was mixed in the AH and AB case. Both types of IV–sets in level GMM estimation (either using only lagged differences of the endogenous variable, LEV1, or additionally transformed instruments from the strictly exogenous variables, LEV2) show similar results. For the estimated equations in levels we also add a dummy variable for Lower Saxony to control for the strong negative net migration trends caused by German resettlers. As expected the dummy turns out to be negative and statistically highly significant.

Finally, the BB1 and BB2 estimators combine data in levels and first differences. Again, most labour market variables turn out statistically significant and of correct sign, only the human capital index enters insignificantly in both specifications.[24] Next to Hansen J-Statistic we also compute the C-Statistic based on Eichenbaum et al. (1988) as difference of two J-Stats. to test whether the additional instruments for the level equation adds substantial information to the IV list in the 1.difference equation. Table 8 shows that the IVs in the level equation contribute significantly in instrumenting the lagged migration variables as right hand side regressor in the model according to the C-Statistic. To compare the predictive performance of the various estimators we compute the root mean squared error (rmse) statistics for all estimators as a general evaluation criteria. The results show that the system GMM models (BB1 and BB2) perform best, followed by the level GMM estimators. These results are in line with recent findings concerning the relative efficiency of different GMM estimators. Finally, we compute an Arellano–Bond (2001) type test for 1. and 2. order serial correlation in the residuals ($m_1-, m_2 - statistics$, see e.g. Arellano, 2003, for details) giving some weak evidence for a possible serial correlation in the model as an indicator for remaining endogeneity of some of the included lagged instruments.

Based on the Blundell–Bond specification in table 8 we also test for the effect of sectorally disaggregated real wage rates. The results show that regional wage rates differences for the industrial sector are highly significant in explaining migration flows while regional wage differences in the service sector do not have any explanatory power. Moreover, the share of the industrial sector in region j is negatively correlated with net in–migration in i, which may indicate that the rather small industrial base in the East German states

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[24] The IV selection for the model is in line with the AB1 and AB2 specification augmented by the equation in levels.

may be one explanation for the persistent outmigration of its workforce. Finally, we also test for the significance of regional difference in the labour participation rate in explaining state level migration flows. The latter can act as a proxy for the flexibility in the labour market. The empirical results for the Blundell–Bond estimator are statistically significant and the positive impact of labour participation on migration is of expected sign. We may thus takes these findings as a promising starting point to model migration and labour market dynamics in a simultaneous equation approach.

4.2 System approach for modelling migration and labour market interactions

Up to this point we have assumed that the causal direction between migration and key labour market and/or macroeconomic indicators is of one–directional nature that runs from the the r.h.s. variables to migration without feedback effects from migration flows to regional differences wages, employment and further labour market variables. Accounting more carefully for the endogeneity of regressors to get a more complete picture of migration and regional labour market interdependencies, we may relax the assumption of one–way causality. Taking up the likely linkages between migration and (un)employment as an example there is in fact a huge theoretical and empirical literature questioning whether 'people follow jobs' or 'jobs follow people'. According to the 'people follow jobs' argumentation (e.g. Lowry, 1966) employment is seen indeed exogenous w.r.t. migration feedback effects within a demand driven framework for regional growth (the so called export-base theory). As Chun (1996) points out, for regional employment being exogenous one must assume that either the labour demand elasticity with respect to wages is zero or the labour supply elasticity with respect to wages is infinite. Contrary to Lowry (1966), the Borts-Stein (1964) hypothesis contrary points out that employment may react to migratory movements assuming that the regional demand for labour is perfectly elastic and any increase in labour supply that results from migration must also lead to increased employment. Similar to two-way effects may also be discussed for human capital and innovative activity and are very prominent in the huge literature relating migration and economic growth (see Etzo, 2008, for a survey).

Earlier contribution to the joint analysis of migration and labour market variables can be found in Blanchard & Katz (1992) for the United States and Decressin & Fatas (1995) for Europe. Here we follow and extend the stylized theoretical model worked out in Möller (1995), which draws on the Blanchard–Katz framework but with the clear distinction that it explicitly models net migration rather than determines it residually as in Blanchard–Katz. Centering around the neoclassical migration equation with regional differences in the unemployment and real wage rate as explanatory variables the model adds further behavioural equations of the form[25]

$$
\begin{aligned}
nm_{ij,t} &= f(\tilde{nm}_{ij,t-1}, \sum_{i=0}^{n} \tilde{w}_{ij,t-i}, \sum_{i=0}^{n} \tilde{ur}_{ij,t-i}), && (16)\\
\tilde{q}_{ij,t} &= f(\tilde{q}_{ij,t-1}, \sum_{i=0}^{n} \tilde{w}_{ij,t-i}, \sum_{i=0}^{n} \tilde{ur}_{ij,t-i}), && (17)\\
\tilde{w}_{ij,t} &= f(\tilde{w}_{ij,t-i}, \sum_{i=0}^{n} \tilde{u}_{ij,t-i}, \sum_{i=0}^{n} \tilde{yl}_{ij,t-i}), && (18)\\
\tilde{yl}_{ij,t} &= f(\tilde{yl}_{ij,t-1}, \sum_{i=0}^{n} \tilde{w}_{ij,t-i}, \sum_{i=0}^{n} \tilde{nm}_{ij,t-i}, \sum_{i=0}^{n} \tilde{q}_{ij,t-i}, \sum_{i=0}^{n} \tilde{ur}_{ij,t-i}), && (19)\\
\tilde{ur}_{ij,t} &= f(\tilde{ur}_{ij,t-1}, \sum_{i=0}^{n} \tilde{w}_{ij,t-i}, \sum_{i=0}^{n} \tilde{yl}_{ij,t-i}, \sum_{i=0}^{n} \tilde{q}_{ij,t-i}, \sum_{i=0}^{n} \tilde{nm}_{ij,t-i}). && (20)
\end{aligned}
$$

Eq.(16) is the neoclassical core migration equation as derived in the above section. Eq.(17) specifies regional differences in the participation rate (with q_{it} defined as $q_{it} = emp_{i,t} - pop_{i,t}$, where *emp* is total employment and *pop* denotes population) is specified as a function of its own lagged value, wage rate and unemployment differences. Labour participation may be seen as a proxy for the flexibility in the regional labour market and may act as an alternative to the migration mechanism resolving regional labour market disparities. Given the assumption that the substitution effect typically outweighs the income effect in the labour supply decision a relative wage rate increase in region i is expected to positively affect the regional participation rate, while an increase in the unemployment rate should yield the opposite effect. The wage equation in the model assumes a negative relationship with respect to unemployment, which is typically found in the literature concerning the wage curve. On contrary, labour productivity is supposed to be positively correlated with the real wage. The wage equation thus may thus be seen as a regionalised version of its standard form as e.g. used in Franz & Gordon (1993).

In modelling labour productivity ($yl_{i,t}$) Möller (1995) chooses a dynamic production function specification, where the two factor inputs capital and labour depend on the location attractiveness of region i. Eq.(19) specifies labour productivity to be negatively correlated with the wage rate since higher wages lower location attractiveness, the coefficient signs of the further variables is a–priori not clear. The model is closed by an equation for labour demand in eq.(20), which is solved for the unemployment rate as dependent variable. In deriving the steady-state solution of the model under different parameter

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[25] The model is originally specified in growth rates, in the following we rewrite the model in its more general level–form. We also allow for a more general lag structure. In Möller (1995) region j is defined as rest of the country aggregate.

assumptions Möller (1995) analysis the long-run impacts and the dynamic adjustment patterns to the variables' equilibrium values after shocking the model. For the most general case the authors finds that wage and labour productivity shocks have equilibrium effects on all variables except for the unemployment rate. Given the assumption that the productivity level has no significant influence on the regional inflow of capital, only regional output differences are found to be subject to long-term hysteresis effects in response to model shocks while for the other variables regional differences are found to diminish over time. This suggests that migration and labour market variables are stationary processes (in line with our empirical findings), while labour productivity is an integrated variable.

Having shown that it seems very reasonable from a theoretical perspective to account for bi-directional relationships among migration and labour market variables we aim at extending the core–migration equation estimated in the above section to a system approach in the spirit of the stylized theoretical model in eq.(16) to eq.(20) treating all variables as endogenous.[26] Extending on Möller (1995) we also add an human capital equation to the model accounting for regional differences in the skill–level of the work force as an explicit factor input in production and an important driving force in labour market dynamics including migratory behaviour. Oppenländer (1995) proposes to extend the framework in Moëller (1995) in such a way that it goes beyond the analysis of the standard neoclassical production function by explicitly controlling for the regional human capital endowment and innovative activity, which may give helpful insights for the policy making process e.g. with respect to explaining persistent regional labour market differences in East and West Germany. As Schneider (2005) shows, the recently observed net out–migration of highly qualified workers may indeed be seen as a severe threat to the East German labour market and economic development and an analysis of the relationships between the regional skill composition and migratory tendencies ranks top on the policy agenda. Searching for determinants that attract human capital Arntz (2006) finds for German micro data, that regional income differences strongly influence the regional skill composition indicating the high–skilled job movers are much more responsive to interregional variation in the wage level than their less–skilled counterparts. Beside the wage rate we would expect from a (new growth) theory perspective that human capital level is also positively correlated with regional productivity. We thus may also conclude that net–inmigration flows are positively correlated with the regional level of human capital given the above arguments together with recent findings of the human capital theory of migration that highly qualified migrants generally have a higher propensity to move in response to labour market

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[26] This allows us to more properly account for the issue of variable endogeneity and also exploit likely efficiency gains in estimation, if the residuals of different models for the variables in focus are correlated.

incentives. Regional differences in human capital may thus be modelled as

$$\tilde{hc}_{ij,t} = \tilde{hc}_{ij,t-1}, \sum_{i=0}^{1} \tilde{w}_{ij,t-i}, \sum_{i=0}^{1} \tilde{yl}_{ij,t-i}, \sum_{i=0}^{1} \tilde{nm}_{ij,t-i}) \tag{21}$$

Additionally, we also allow regional human capital differences to affect the endogenous variables in the model's remaining equations according to eq.(16) to (20).

In empirical implementation the simultaneous analysis of migration and its causal relation to key economic and labour market variables has been conducted in a variety of approaches - either from a structural (see e.g. Okun, 1968, Muth, 1971, Salvatore, 1980, Bilger et al., 1991 and the large literature in the Carlino-Mills, 1987, tradition) or time–series perspective (see Blanchard & Katz, 1992, Decressin & Fatas, 1995, Möller, 1995, Lu, 2001, Mäki-Arvela, 2003, or Partridge & Rickman, 2006). The latter approach typically applies Vector Autoregressive (VAR) models, which provide a valuable tool for analysing the dynamics among geographic and economic processes.[27] The Panel VAR technique combines the traditional VAR approach treating all variables in the system as endogenous with panel data and was first employed by Holtz-Eakin et al. (1988). VAR models generally specify a multivariate equation system, where each variable under study is regressed on a finite number of lags of all variables jointly considered (for details see e.g. Lütkepohl, 2005). A discussion of different estimators for Panel VAR models together with Monte Carlo simulation results for standard small T, large N settings is given by Binder et al. (2005). As Mäki-Arvela (2003) argues, the unrestricted VAR methodology is ideally suited for examine interrelated time series variables and their dynamics in a labour market setting, where a particular focus is to explore the strengths of different adjustment mechanisms in response to various macroeconomic shocks.

The general presentation of a m-variable first-order PVAR(1) can be written as:[28]

$$z_{i,t} = \Gamma_0 + \Gamma_1 z_{i,t-1} + e_{i,t} \tag{22}$$

where $z_{i,t}$ is an $m \times 1$ variable vector, Γ_1 is an $m \times m$ matrix of slope coefficients, $e_{i,t}$ is an $m \times 1$ vector of the composed error term as discussed above, including unobserved individual effects and a remainder component. The PVAR(1) model is thus a straightforward generalization of the univariate dynamic panel data model as a restricted system of m-equations according to eq.(10).

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[27] Though the VAR model closely resembles the form of a simultaneous equation model (SEM), it imposes fewer and weaker restrictions in specifying a model compared to the SEM.

[28] For the sake of simplicity we restrict our presentation to the PVAR(1) case. As Binder et al. (2005) note, higher-order models can for most parts be treated in conceptually the same manner as first-order models.

For the empirical estimation of a Panel VAR model we employ multiple-equation GMM (as e.g. outlined in Hayashi, 2000). We therefore basically stack our migration model from above together with equations for regional wage rate and employment differences as well as differences in labour productivity (growth), labour participation and a regional human capital index in the typical system way (3SLS or SUR) and apply IV estimation using the Blundell-Bond type instruments, which has been shown to be the most efficient model in the context of single equation estimation (table 7).[29] The resulting set of orthogonality conditions W_i^S for a system of m equations (with $m = 1, \ldots, M$) are the combined individual equations' orthogonality conditions stacked in the following way:

$$W_i^S = \begin{bmatrix} W_1 & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & W_M \end{bmatrix} \tag{23}$$

The IVs in W_m in turn are derived from the standard and stationarity moment conditions according to eq.(14)/eq.(15) and as in Ahn & Schmidt (1999) we assume that each instrument is valid in every equation of the system.

Stacking the equations for joint GMM estimation may lead to further efficiency gains if the residuals of m-equations are correlated. We therefore apply a two-step approach which explicitly accounts for cross-equation residual correlation, where the weighting matrix V_N^S in 2–step GMM estimation is defined as

$$V_N^S = N^{-1} \sum_{i=1}^{N} W_i^{S\prime} \hat{e}_i \hat{e}_i^{\prime} W_i^S. \tag{24}$$

In empirical application the 1.step error terms are derived from a consistent 2SLS estimation. The results of PVAR(1) model are shown in table 9.

[Table 9 about here]

Starting with the migration equation, the results are much in line with the estimated single equation parameters taking the Blundell-Bond approach as point of reference (last column in table 8). Only the participation rate and human capital are tested insignificant in the PVAR setting. With respect to the other equations of the PVAR we see that migration has a significant effect on the unemployment rate and wage rate as well

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[29] Ben-Jedida (1994) was one of the first to apply GMM based DPD models to the system case. A detailed description of GMM based estimation techniques for Panel VAR is given by Binder et al. (2005).

as human capital, which generally support the view of two-way interdependences among the variables. Taking a closer look at the equations for the core labour market variables employment (rate) and wage level, we see that migration has indeed an equilibrating effect on regional labour markets in line with the neoclassical view: That is, a high level of inmigration in region i increases the region's unemployment rates relative to region j, while at the same the net inmigration lowers regional wage rate differences (the wage in region i decreases relative to j) and thus works towards a cross-regional wage equalization as outlined above. Contrary to the stylized theoretical labour market model our empirical results do not favor the existence of a wage curve la Blanchflower & Oswald (1994, 2005) since unemployment is tested insignificantly in the real wage equation. However, as expected labour productivity (growth) has a positive impact on the wage rate. In the equation for labour productivity the wage rate itself has the theoretically expected negative effect, indicating that higher wages reduces location attractiveness. Also for labour participation equation wage und unemployment rate have the theoretically expected coefficient signs, that is a higher wage rate positively influences labour market participation, while unemployment has the opposite effect. The equation for human capital mainly gives result in line with Arntz (2006) with a positive impact of wage rates and labour productivity on regional human capital endowments, while higher unemployment rates are negatively correlated with our human capital index.

From the Panel VAR results we can additionally compute impulse-response functions, which describe the reaction of one variable in the system to the innovations in another variable in the system, while holding all other shocks equal to zero. Since the actual variance-covariance matrix is the model is not diagonal, in order to isolate shocks to one of the VAR errors it is necessary to decompose the residuals in such a way that they become orthogonal.[30]

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[30] Following Love & Zicchino (2006) the orthogonalized impulse response function can be derived as follows: We start withe the moving average representation of the PVAR system as

$$z_t = \xi + \sum_{i=0}^{\infty} \Gamma_1^i e_{t-i} \tag{25}$$

where ξ is a function of parameters of the model and Γ_1^i is the i-th power of matrix Γ_1 in eq.(25). Since e_t tend to co–move in studying the effects of changes in the error terms on the endogenous variables, eq.(25) can be re-written as

$$z_t = \xi + \sum_{i=0}^{\infty} \kappa_i \epsilon_{t-i}. \tag{26}$$

The coefficients κ_i are the impulse response functions. The elements of κ_i represent the impact of a unit shock in ϵ_{t-i}. In order to quantify the cumulative response of an endogenous variable to an unpredicted innovation in some components of ϵ_t the latter have to be orthogonal. Assuming that $\Omega = E(\epsilon_t \epsilon_t')$ is positive definite we can define $u_t = K^{-1}\epsilon_t$, where K is a lower triangular matrix with one along the principle diagonal. In terms of u_t we can finally write eq.(26) as a moving average representation of z_t

Figure 7 plots the impulse-response functions together with 5% errors bands generated through Monte Carlo simulations with 500 repetitions.[31] Additionally, table 10 finally reports variance decompositions based upon the orthogonalised impulse response coefficient matrices. Different from impulse-response techniques, variance decomposition displays the proportion of movements in the dependent variables that are due to their own shocks versus shocks to the other variables, which is done by determining how much of an s-step ahead forecast error variance for each variable is explained by innovations to each explanatory variable (we report s = 10,20). Thus, the variance decomposition gives information about the relative importance of each shock to the variables in the PVAR.

[Figure 7 and table 10 about here]

The impulse response functions are suitable to consider the dynamic properties of the model as a whole. Here we are particularly interested in interpreting the responses of migration to shocks in the labour market variables of the PVAR. As the figure shows all responses have the theoretically expected sign: That is, the response of net migration to a unit (one standard deviation) shock of the unemployment rate turns out to persistently negative (for similar West German results see Möller, 1995). The response to a shock in the wage rate differential among region i and j has the expected positive dynamics and fades out after after some periods. The response of migration to shock in labour productivity and the participation rate is positive and only fades out gradually. Finally, the negative effect of migration in response to a shock in human capital differences fades out rapidly. Thus, the impulse responses and also variance decomposition give the general impression that it takes considerable time (around 10 years or more) until most labour market and macroeconomic shocks have been absorbed by migratory behaviour or even may have permanent effects possibly reflecting some type of hysteresis. Taken together the results

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$$z_t = \xi + \sum_{i=0}^{\infty} K \kappa_i \epsilon_{t-i}. \tag{27}$$

For any shock in $u_{x,t-s}$ of variable x we can then write the effect on variable y as

$$\frac{\delta y_t}{\delta u_{x,t-s}} = \kappa_s K_x, \tag{28}$$

where K_x is the first column of matrix K. The plot of eq.(28) as a function of $s > 0$ is then an orthogonalized impulse response function. As Love & Zicchino (2006) point out, the orthogonalization of the residuals needs a particular ordering and allocate any correlation between the residuals of any two elements to the variables that come first in the ordering. We therefore tried out different ways of ordering, however, the results seemed to be rather insensitive with respect to the chosen ordering. This result is in line with findings in Möller (1995) for related data and model settings.

[31] We kindly acknowledge the provision of Stata routines for impuls-response function in a Panel VAR setting by Inessa Love from the World Bank.

of the PVAR estimation we may conclude that the main transmission channels identified by the neoclassical migration model are working in balancing regional disparities. A final challenging question is in how far our neoclassical migration model is able to track back the specific East-West migration pattern since unification. We turn to this final aspect in the next section.

5 East-West migration flows: Still an ”empirical puzzle”?

In this section, the explanatory power of the specified migration and labour market model in explaining the overriding East-West migration trend since reunification will be examined. Net outmigration of the East German states directly started after opening out the intra-German border: While more than 742.000 people (net) directly emigrated in the first 15 months after opening up the Berlin Wall, the net migration from the new states in 1991 already fell to an annual amount 170.000 people. While this declining trend could be observed until 1997, the late 1990s have shown a second wave in East-West net outmigration with a distinct peak in 2001 (see also figure 2). The latter tendency may provide a good reason to carefully check, whether the specific path of East–West migration can be explained within the above specified migration migration model in its functional PVAR form. We are especially interesting in answering the following question: Can this rise in East-West migration be explained on grounds of regional disparities in wage level and unemployment between Eastern and Western Germany? Or does this second wave in East-West migration is due to - unmodelled - mobility enhancing factors among Eastern German workers?

The question of East-West migration is also of special interests since earlier findings (e.g. Alecke & Untiedt, 2000) gave rise to a German ”empirical puzzle” (in line with similar striking evidence found for the Italian case), where macroeconomic Harris-Todaro inspired models were only found helpful in predicting changes in migration trends, but not in their absolute levels. Both for German East-West and Italian South-North migration flows a high degree of ”immobility” was found to coexist with large regional disparities.[32] To find an appropriate answer to this ”empirical puzzle” of insufficient migration to equilibrate regional disparities is of special importance e.g. for determining the role of migration in the process of income convergence. To check the performance of our PVAR(1) model with respect to migration flows, figures 8 to 13 therefor plot the actual and predicted net migration rates on a bilateral basis for each of the East-West pair using the Panel VAR

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[32] For a discussion of the Italian case see e.g. Fachin (2007) or Etzo (2007).

results from table 8.

[Figure 8 to figure 13 about here]

As the figures show there is a rather high concordance of actual and fitted values over time for most bilateral pairs indicating that the estimated elasticities in conjunction with the temporal variation in the explanatory variables are in a position to explain the trends in the East-West migration since 1994. However, for a variety of state pairs there is also evidence for a constant difference between actual and predicted net migration over time which may require a closer examination of specific regional effects. According to the regional economic literature, one line of argumentation is that differences in the regional (expected) wage levels will even be persistent in the long-term equilibrium between the regional labor markets, since they are subject to regional amenities (for example specific climatic or ecological conditions in a region). Hence, regional differences in the expected wages exhibit an effect on migration only after a critical value has been passed. Greenwood et al. (1991) argue that the extent of regionally amenities can easily be tested by the inclusion of regional dummy variables in the empirical migration model. In this case, amenity-rich regions would have coefficients greater than zero for the specific regional dummy variables and poor regions would have a negative value. This means that amenity-rich regions exhibit lower than average outmigration as would be expected on basis of our migration model after controlling for regional economic differences.

To do so, we augment the Panel VAR by a dummy variables for East Germany that takes a value of 1 for all bilateral East-West state pairs and 0 otherwise. Additionally, we also specify a dummy for the East-West border regions. Table 11 and table 12 present the empirical results: The main finding with respect to the migration equation is that the East–Dummy turns out to be insignificant for the whole sample period. However, if we construct the dummy variable in such a way that it takes values of 1 only for a specific subsample period, the dummy variables shows a positive and (the most) significant variable coefficient for the period up to 1997. Similar results are found for the border–dummy, where the latter is tested to have a quantitatively bigger impact on migration. The interpretation for the positive coefficient sign of the dummy variables is as follows: After controlling for regional labour market and macroeconomic differences as explanatory factors for migratory movements, the net in–migration for the East German states (Eastern border regions) is above the average of all German regions included in the sample. Thus, East–West movements in terms of less than expected net out–migration for the period up to 1997 may to some extend be rooted in determinants outside of the labour market and general economic conditions.

[Table 11 and table 12 about here]

Nevertheless, it does not seem reasonable to interpret the positive dummy variable coefficients in favor of regional amenities in the East German states that keep people living there (not only because these are typically time-fixed). The most substantial critique to the amenities interpretations of the dummy variable is that the latter can only be interpreted as amenities under the premise that the influence of other latent variables on the regional net migration indicate a negligible variable order. However, this is more than doubtful with respect to the Eastern states when we also consider the determinants of individual migration decisions (as worked out in microeconomic migration theories), like the age structure of the work force potential, the relative wage structure, network effects, or the option value of waiting. The net influence of these variables on the East-West migration is undetermined. Thus it can be argued that based on low wage-pricing in the new states and under the premise that higher qualified employees have a greater tendency for mobility than their less qualified colleagues, the net outward migration in the new states should be higher than in the original ones. Accordingly, it can be expected that the higher employment figures of women in Eastern Germany is a limiting factor since households with double earning members tend to be less mobile. Even the option value of waiting would allow a low level of net migration in the new states.

Moreover, the analysis so far neglects the high level of commuter flows between East and West which may be seen as a substitute to migration and which in particular may be a reasonable explanation for the high dummy variable coefficient value of the Eastern border regions. Finally, politically induced distortions to regional labour market performance and general economic development may be the source for an impediment to sufficient high migration rates as balancing factor for regional labour markets. The latter comprise for instance a politically driven fast wage adjustment in the East (see Burda & Hunt, 2001, for details on this point), as well as massive West-East financial transfers which kept people away from leaving the Eastern states. Only recently these transfers have been reduced in volume as shown in figure 14. Figure 15 plots the increasing importance of East–West commuter flows between 1990 and 2006.

[Figure 14 about here]

Thus summing up, whereas earlier East-West migration patterns could possibly be the result of an interplay of (non)-economic factors kept unmodelled in our macroeconomic migration PVAR, recent tendencies seem to be much better explained by regional differences in key macro-variables. This is also seen in the bilateral migration predictions out of figure 6 to 11, which are generally match closer the actual net migration level for the end of the sample. This may support the hypothesis that although net migration flows have been distorted by various reason throughout the 1990s, towards the end of the sample period they respond much better to underlying regional labour market and economic differences in key economic variables and work itself in a way of reducing regional disparities - especially for the second wave of huge East-West migration flows around 2001, which comes along with a gradual fading out of labour market and macroeconomic distortions.

6 Conclusion

The paper has analysed the effects of regional differences in labour market dynamics and interregional migration flows among German states since re–unification. Our motivation for conducting this type of analysis was threefold: 1.) As the short literature review revealed, there is less consensus among empirical contributions analysing intra-German migration flows with respect to which (set of) explanatory variables may be best suited to explain actual interregional migration flows, 2.) fore the German case there is also a clear gap between the sample period employed in recent empirical work (predominantly only until the mid/late 1990s) and available data. Finally, 3.) recent methodological advances in the analysis of (dynamic) panel data models have only rarely been applied to the analysis of regional migration flows (for Germany). We respect to the latter we have put an explicit focus on estimating Vector autoregressive (VAR) models for panel data using efficient GMM methods such as the 'system' GMM instrumental variable estimator recently proposed by Blundell & Bond (1998). One advantage of this approach is that it allows more appropriately handle the issue of simultaneity and multi-way feedback relationships among variables in focus. Also, by the computation of impulse-response functions we are able check the dynamic properties of our estimated Panel VAR system and evaluate the responses of regional net migration with respect to different shocks.

With respect to our emprirical results we are able to identify a clear role of regional differences in key labour market variables such as wage and unemployment rates as driving force of interstate migration. In modelling wage rate differences we explicitly accounted for difference in regional (consumer) price levels among German states. Also general economic indicators including labour productivity, labour market participation rates and human capital among other factors were included in the analysis. While labour productivity was found to be a robust determinant of migratory movements across different model specification, the role of human capital, labour market participation and prices for building land was tested to be empirically much weaker. We finally also disaggregated regional wage rate differentials across sectors finding that interregional migration flows were particularly driven by wage differences in the industry sector, while service sector wage differences did not add any additional information in explaining migratory movements. Moving to a simultaneous analysis of migration and labour market dynamics our PVAR results show that feedback effects from migratory movements also have an equilibrating effect on regional labour markets in line with the neoclassical view: That is, a high level of inmigration in region i increases the region's unemployment rates relative to region j, while at the same the net inmigration lowers regional wage rate differences (the wage in region i decreases relative to j) and thus works towards a cross-regional wage equalization as outlined above.

We also used the model to predict the evolution of the special East-West migration patterns in Germany. One of our main results is that throughout the 1990s the East-West migration pattern was indeed to some extent biased and driven by other factors outside those variables according to the neoclassical migration model included in the PVAR. To come to this conclusion we tested for the significance of a common dummy variable for all East German states as well as Eastern border regions in the PVAR framework – a result which supports earlier empirical findings for Germany and similar evidence for regional South–North migration in Italy. In this sense the size of the East-West migratory movement in Germany was insufficient for contributing decisively for balancing the regional disparities and gave rise to the East German "empirical puzzle". Likely explanations for this result may be seen in huge income transfers and the possibility of high East-West commuting. However, taking the whole estimation period up to 2006 as point of reference, both the East German and Border dummy turn out to be insignificant, which in turn supports the hypothesis that recent migration flows are much better explained by standard (neoclassical) macroeconomic migration models with a prominent role given to regional differences in key labour market variables such as wage and unemployment difference in a Harris-Todaro (1970) fashion. Thus, migration may indeed be seen as a balancing factor for regional disparities – especially for the second wave of huge East-West migration flows around 2001, which came along with a gradual fading out of macroeconomic distortions.

Further research effort should in particular focus on model extensions which explicitly account for further relevant effects in determining migration flows such as geographic distance, network effects (see e.g. Uhlig, 2007) and a more rigorous testing of sectoral effects (see e.g. Kubis, 2005). From a methodological point of view a natural extension to the PVAR model presented here would also include to test for spatial effects (see e.g. Mutl, 2002, Di Giacinto, 2003, Beenstock & Felsenstein, 2007, for different Spatial (Panel) VAR presentations as well as Gebremariam, 2007, for a more general treatment of (structural) system estimation with spatial effects) as well as distangling overall migration and labour market interrelations into short-term asymmetric regional business cycle and long-run structural components (see e.g. Coulombe, 2006).

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Table 1: List of abbreviations used for German states (NUTS1)

BW	**Baden-Württemberg**
BAY	**Bavaria (Bayern)**
BER	**Berlin**
BRA	**Brandenburg**
BRE	**Bremen**
HH	**Hamburg**
HES	**Hessen**
MV	**Mecklenburg-Vorpommern**
NIE	**Lower Saxony (Niedersachsen)**
NRW	**Nord Rhine Westphalia (Nordrhein-Westfalen)**
RHP	**Rhineland-Palatinate (Rheinland-Pfalz)**
SAAR	**Saarland**
SACH	**Saxony (Sachsen)**
ST	**Saxony-Anhalt (Sachsen-Anhalt)**
SH	**Schleswig-Holstein**
TH	**Thuringia (Thüringen)**

Figure 1: In- and outmigration rates for the German East-West macro-regions together with state level heterogeneity, 1991-2006

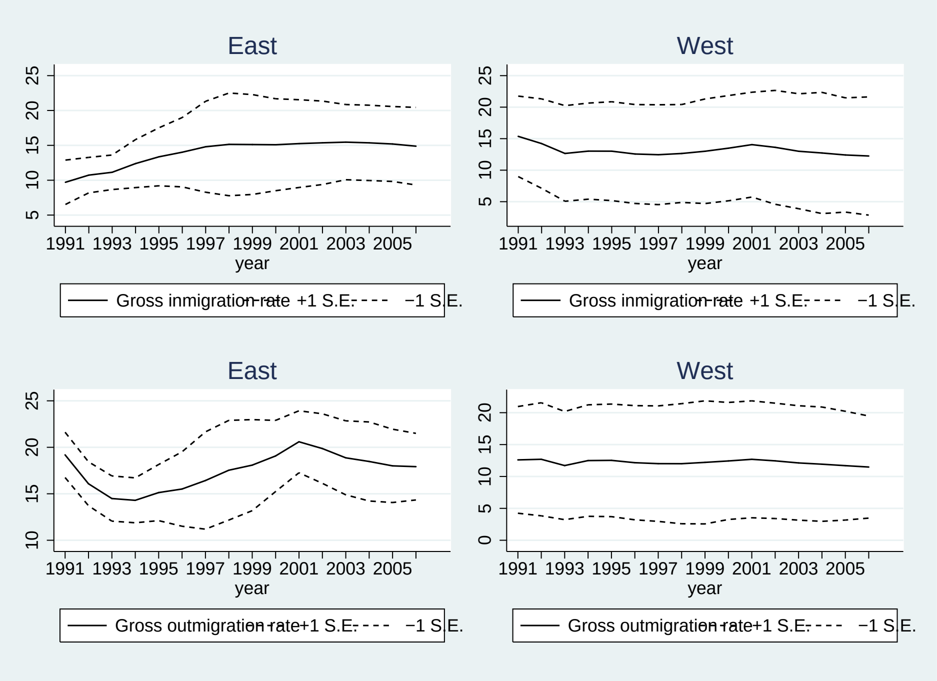


Figure 2: Net migration rate and total migration intensity for the German East-West macro-regions together with state level heterogeneity, 1991-2006

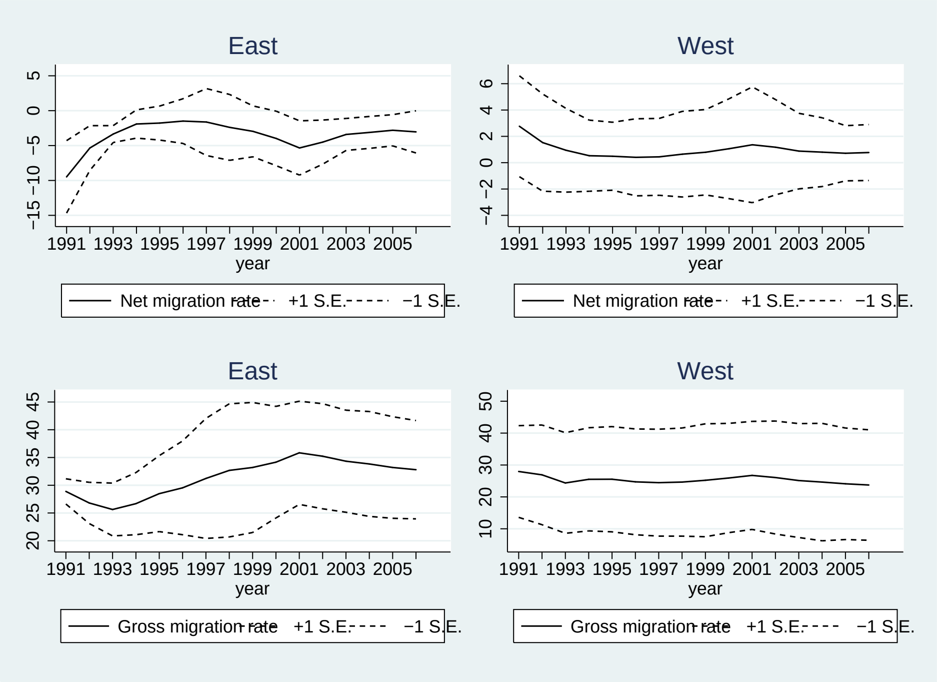


Table 1: In-migration rates ($w_{i,t}^{inm}$) at the German state level (NUTS1) for 1991-2006

	BW	**BAY**	**BER**	**BRA**	**BRE**	**HH**	**HES**	**MV**
1991	26.21	21.32	31.39	31.92	58.11	53.54	31.73	29.88
1992	24.49	20.58	31.35	31.39	62.40	53.44	31.45	27.95
1993	22.72	18.39	31.50	31.58	59.10	57.43	29.00	27.30
1994	23.26	18.41	33.63	34.11	61.44	58.17	29.70	26.75
1995	23.32	18.69	36.42	38.19	62.86	58.36	29.59	28.20
1996	22.55	17.91	38.49	42.14	63.89	59.18	28.84	29.45
1997	22.17	17.65	43.20	47.13	63.19	60.35	28.96	29.47
1998	22.60	18.34	47.41	48.79	63.12	62.25	29.20	30.87
1999	22.64	18.97	47.30	49.09	65.63	64.51	29.52	32.05
2000	23.28	19.66	47.00	46.73	63.86	63.74	29.80	33.62
2001	24.22	20.85	47.16	47.84	64.53	63.67	30.41	35.82
2002	23.21	19.61	47.33	46.50	66.53	64.14	29.70	36.47
2003	22.05	18.76	46.32	45.04	66.27	63.57	28.81	35.28
2004	21.50	17.97	45.92	45.05	65.79	66.24	28.73	35.09
2005	21.44	18.05	45.20	43.92	63.89	63.61	29.01	33.58
2006	21.54	18.78	45.09	42.24	64.14	62.68	28.62	33.41
	NIE	**NRW**	**RHP**	**SAAR**	**SACH**	**ST**	**SH**	**TH**
1991	39.10	18.23	35.83	26.49	25.95	28.28	53.89	27.90
1992	36.48	17.06	36.05	24.72	22.66	23.70	53.86	26.29
1993	30.28	15.29	33.88	22.42	20.35	22.91	46.95	23.03
1994	35.66	15.93	34.89	23.09	20.65	24.31	48.11	23.20
1995	36.09	15.89	33.84	22.33	21.49	25.53	47.90	23.93
1996	35.68	15.49	32.51	22.73	21.32	25.80	41.33	23.37
1997	35.09	15.29	31.85	22.18	21.69	25.06	41.29	23.67
1998	34.23	15.43	31.75	22.06	21.90	25.94	41.00	23.81
1999	35.50	16.06	31.82	22.01	22.36	26.87	40.89	24.40
2000	38.34	16.65	31.99	21.09	24.59	29.48	40.53	25.83
2001	40.29	16.99	32.41	22.15	26.91	31.77	40.60	27.83
2002	39.18	16.60	32.23	21.71	25.66	30.76	41.11	27.30
2003	36.99	16.24	30.95	20.58	24.49	30.35	40.32	27.13
2004	35.11	15.88	30.97	20.89	23.87	29.23	40.94	26.51
2005	31.94	15.60	31.70	21.03	23.48	28.63	39.28	26.48
2006	28.82	15.33	31.59	21.60	23.47	27.55	38.58	26.67

Note: Data from Destatis & VGRdL, formula see text.

Table 2: Outmigration rates ($w_{i,t}^{outm}$) at the German state level (NUTS1) for 1991-2006

	BW	**BAY**	**BER**	**BRA**	**BRE**	**HH**	**HES**	**MV**
1991	11.18	8.44	15.55	21.89	29.45	25.35	13.93	21.96
1992	11.60	8.81	16.00	20.44	32.01	26.59	14.59	18.03
1993	11.58	8.39	16.75	17.69	32.30	27.60	14.35	16.48
1994	12.03	8.19	18.02	16.06	33.02	29.16	14.32	15.25
1995	12.01	7.90	19.97	17.55	32.54	29.34	13.79	15.27
1996	11.64	7.65	21.95	18.97	33.59	30.35	13.60	14.73
1997	11.38	7.45	25.37	19.97	33.84	30.50	13.70	15.37
1998	11.21	7.53	26.77	20.85	35.10	31.45	13.83	16.84
1999	10.91	7.50	25.60	22.43	35.67	32.01	13.95	17.95
2000	10.38	7.69	24.36	22.32	33.83	30.28	14.04	20.25
2001	10.00	7.91	23.70	24.78	33.51	29.93	14.46	21.93
2002	9.76	8.13	23.82	24.20	32.37	30.58	14.10	21.95
2003	9.76	8.00	24.20	22.62	32.62	30.25	14.04	20.42
2004	9.72	7.95	24.31	22.38	32.04	31.19	13.94	20.11
2005	10.00	7.85	23.24	22.06	31.33	30.47	14.39	19.12
2006	10.51	8.02	22.26	21.72	31.04	28.80	14.08	19.57
	NIE	**NRW**	**RHP**	**SAAR**	**SACH**	**ST**	**SH**	**TH**
1991	19.59	7.74	14.44	13.44	18.40	20.58	30.32	19.20
1992	17.70	7.89	14.61	12.95	14.04	15.32	30.70	14.99
1993	13.00	7.68	14.34	12.14	11.80	13.23	24.61	13.02
1994	18.21	7.88	14.53	12.18	11.31	13.70	24.81	12.79
1995	19.77	7.71	14.45	11.80	11.56	14.18	24.98	13.46
1996	20.24	7.48	14.59	11.45	11.33	13.85	18.42	13.08
1997	19.75	7.40	14.53	11.54	11.37	14.11	18.56	12.90
1998	18.67	7.66	14.53	11.62	12.35	15.46	18.68	13.54
1999	19.94	7.99	14.47	11.58	12.99	16.69	18.54	13.98
2000	22.90	7.89	14.79	11.13	14.64	19.23	18.14	15.29
2001	24.85	7.90	14.97	11.55	16.87	21.14	18.00	16.99
2002	23.66	7.75	14.58	10.80	15.51	19.63	18.25	16.27
2003	21.68	7.63	14.42	10.29	13.82	18.34	18.25	15.84
2004	20.24	7.51	14.48	10.43	13.08	17.64	18.53	15.42
2005	17.92	7.52	14.74	11.04	12.75	17.05	18.11	15.80
2006	14.89	7.81	15.16	11.93	12.83	17.20	17.88	16.30

Note: Data from Destatis & VGRdL, formula see text.

Table 3: **Net migration rates ($w_{i,t}^{nmr}$) at the German state level (NUTS1) for 1991-2006**

	BW	**BAY**	**BER**	**BRA**	**BRE**	**HH**	**HES**	**MV**
1991	3.86	4.44	0.28	-11.85	-0.79	2.85	3.88	-14.04
1992	1.30	2.95	-0.65	-9.49	-1.62	0.27	2.27	-8.10
1993	-0.45	1.62	-2.01	-3.79	-5.51	2.23	0.30	-5.66
1994	-0.80	2.04	-2.42	1.99	-4.60	-0.15	1.06	-3.76
1995	-0.70	2.88	-3.52	3.10	-2.21	-0.32	2.00	-2.33
1996	-0.73	2.61	-5.40	4.20	-3.29	-1.52	1.63	-0.02
1997	-0.60	2.76	-7.54	7.19	-4.50	-0.64	1.57	-1.27
1998	0.18	3.28	-6.13	7.09	-7.08	-0.65	1.54	-2.80
1999	0.82	3.98	-3.90	4.22	-5.72	0.50	1.62	-3.85
2000	2.53	4.28	-1.72	2.09	-3.81	3.19	1.72	-6.88
2001	4.21	5.03	-0.24	-1.72	-2.50	3.81	1.48	-8.03
2002	3.69	3.35	-0.31	-1.89	1.79	2.98	1.51	-7.43
2003	2.52	2.76	-2.08	-0.19	1.03	3.06	0.73	-5.56
2004	2.06	2.07	-2.70	0.29	1.70	3.86	0.85	-5.13
2005	1.43	2.36	-1.28	-0.20	1.22	2.67	0.23	-4.66
2006	0.53	2.74	0.57	-1.19	2.06	5.07	0.45	-5.73
	NIE	**NRW**	**RHP**	**SAAR**	**SACH**	**ST**	**SH**	**TH**
1991	-0.09	2.75	6.95	-0.38	-10.86	-12.88	-6.76	-10.51
1992	1.08	1.28	6.83	-1.18	-5.41	-6.93	-7.54	-3.69
1993	4.28	-0.07	5.21	-1.86	-3.25	-3.55	-2.26	-3.01
1994	-0.76	0.17	5.83	-1.27	-1.96	-3.09	-1.51	-2.38
1995	-3.44	0.46	4.93	-1.27	-1.62	-2.84	-2.06	-3.00
1996	-4.79	0.53	3.32	-0.18	-1.33	-1.90	4.49	-2.79
1997	-4.41	0.50	2.80	-0.90	-1.05	-3.16	4.17	-2.14
1998	-3.12	0.10	2.69	-1.19	-2.81	-4.98	3.64	-3.27
1999	-4.37	0.08	2.87	-1.15	-3.63	-6.50	3.81	-3.56
2000	-7.46	0.86	2.41	-1.18	-4.70	-8.97	4.26	-4.75
2001	-9.41	1.19	2.47	-0.96	-6.83	-10.51	4.60	-6.15
2002	-8.14	1.11	3.07	0.10	-5.36	-8.51	4.61	-5.23
2003	-6.36	0.98	2.10	0.00	-3.14	-6.32	3.82	-4.55
2004	-5.37	0.86	2.00	0.04	-2.29	-6.04	3.88	-4.34
2005	-3.91	0.56	2.22	-1.04	-2.02	-5.47	3.06	-5.12
2006	-0.96	-0.29	1.28	-2.26	-2.18	-6.84	2.81	-5.93

Note: Data from Destatis & VGRdL, formula see text.

Table 4: Gross migration intensity ($w_{i,t}^{gmv}$) at the German state level (NUTS1) for 1991-2006

	BW	**BAY**	**BER**	**BRA**	**BRE**	**HH**	**HES**	**MV**
1991	26.21	21.32	31.39	31.92	58.11	53.54	31.73	29.88
1992	24.49	20.58	31.35	31.39	62.40	53.44	31.45	27.95
1993	22.72	18.39	31.50	31.58	59.10	57.43	29.00	27.30
1994	23.26	18.41	33.63	34.11	61.44	58.17	29.70	26.75
1995	23.32	18.69	36.42	38.19	62.86	58.36	29.59	28.20
1996	22.55	17.91	38.49	42.14	63.89	59.18	28.84	29.45
1997	22.17	17.65	43.20	47.13	63.19	60.35	28.96	29.47
1998	22.60	18.34	47.41	48.79	63.12	62.25	29.20	30.87
1999	22.64	18.97	47.30	49.09	65.63	64.51	29.52	32.05
2000	23.28	19.66	47.00	46.73	63.86	63.74	29.80	33.62
2001	24.22	20.85	47.16	47.84	64.53	63.67	30.41	35.82
2002	23.21	19.61	47.33	46.50	66.53	64.14	29.70	36.47
2003	22.05	18.76	46.32	45.04	66.27	63.57	28.81	35.28
2004	21.50	17.97	45.92	45.05	65.79	66.24	28.73	35.09
2005	21.44	18.05	45.20	43.92	63.89	63.61	29.01	33.58
2006	21.54	18.78	45.09	42.24	64.14	62.68	28.62	33.41
	NIE	**NRW**	**RHP**	**SAAR**	**SACH**	**ST**	**SH**	**TH**
1991	39.10	18.23	35.83	26.49	25.95	28.28	53.89	27.90
1992	36.48	17.06	36.05	24.72	22.66	23.70	53.86	26.29
1993	30.28	15.29	33.88	22.42	20.35	22.91	46.95	23.03
1994	35.66	15.93	34.89	23.09	20.65	24.31	48.11	23.20
1995	36.09	15.89	33.84	22.33	21.49	25.53	47.90	23.93
1996	35.68	15.49	32.51	22.73	21.32	25.80	41.33	23.37
1997	35.09	15.29	31.85	22.18	21.69	25.06	41.29	23.67
1998	34.23	15.43	31.75	22.06	21.90	25.94	41.00	23.81
1999	35.50	16.06	31.82	22.01	22.36	26.87	40.89	24.40
2000	38.34	16.65	31.99	21.09	24.59	29.48	40.53	25.83
2001	40.29	16.99	32.41	22.15	26.91	31.77	40.60	27.83
2002	39.18	16.60	32.23	21.71	25.66	30.76	41.11	27.30
2003	36.99	16.24	30.95	20.58	24.49	30.35	40.32	27.13
2004	35.11	15.88	30.97	20.89	23.87	29.23	40.94	26.51
2005	31.94	15.60	31.70	21.03	23.48	28.63	39.28	26.48
2006	28.82	15.33	31.59	21.60	23.47	27.55	38.58	26.67

Note: Data from Destatis & VGRdL, formula see text.

Figure 3: Weighted scatter plots for state level in- and outmigration

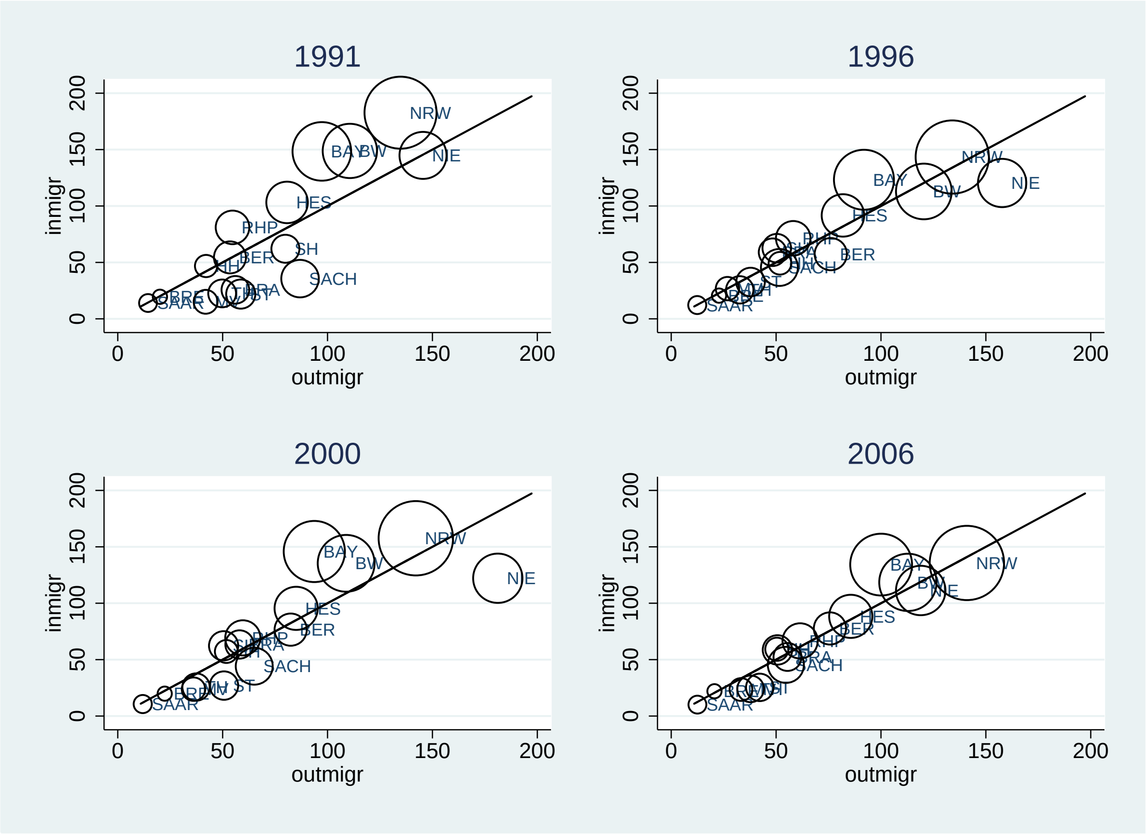
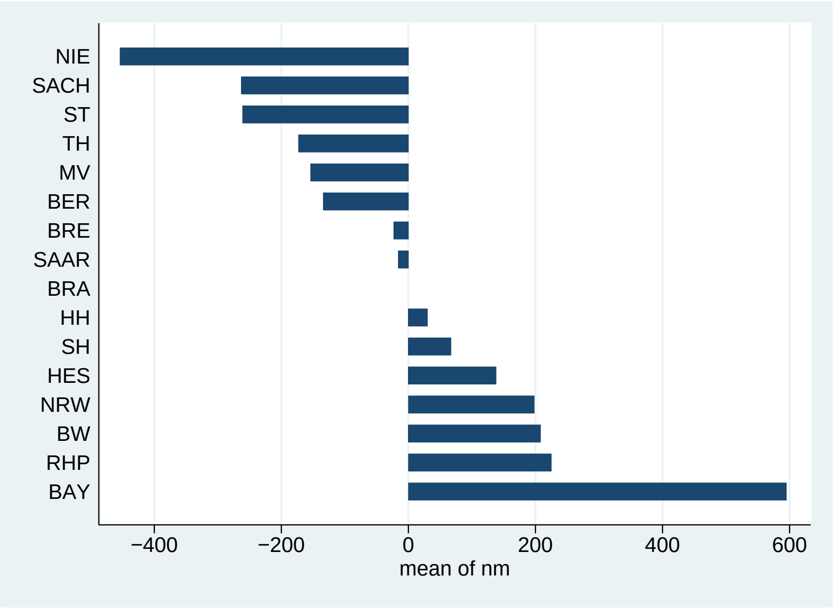
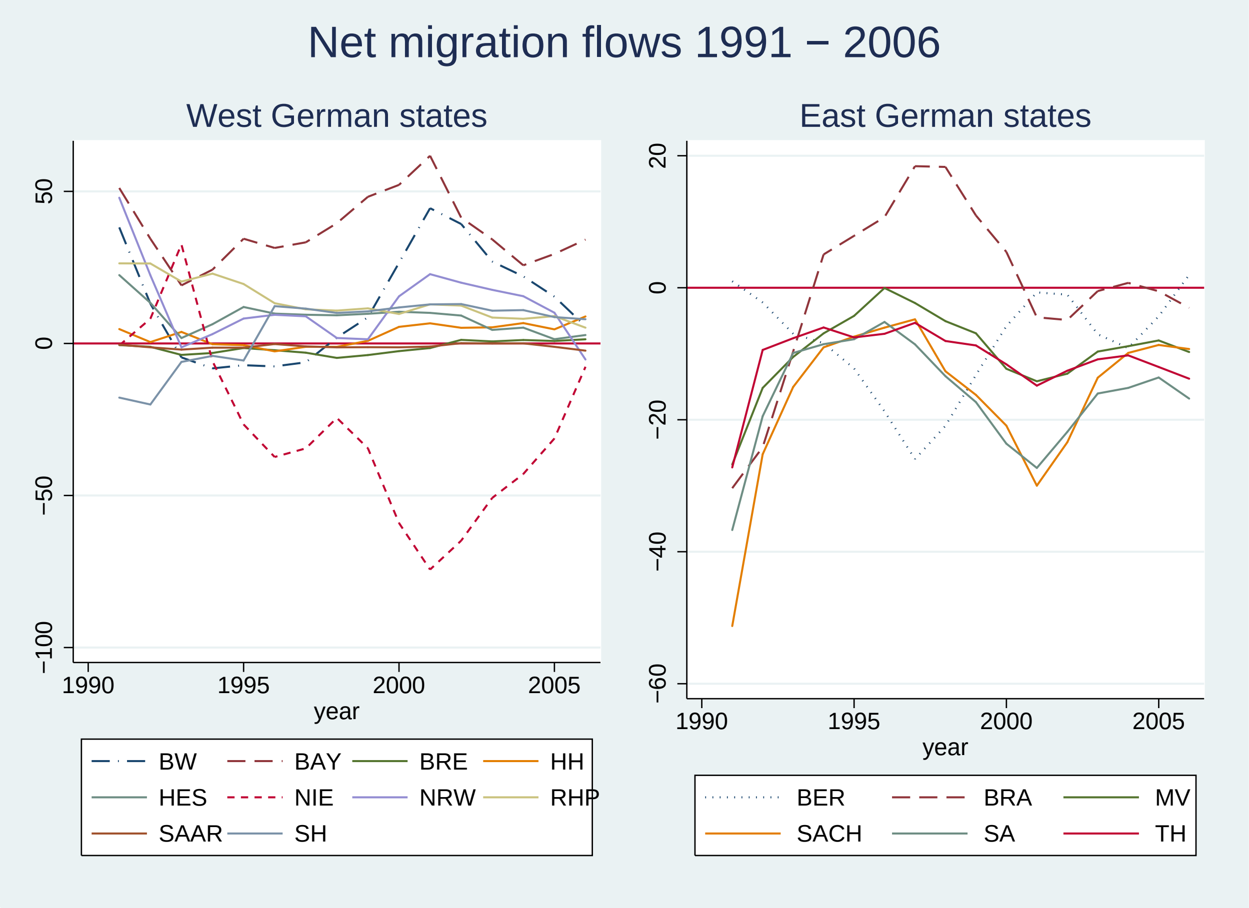


Figure 4: Cumulative net migration for German states (NUTS1) between 1990 and 2006



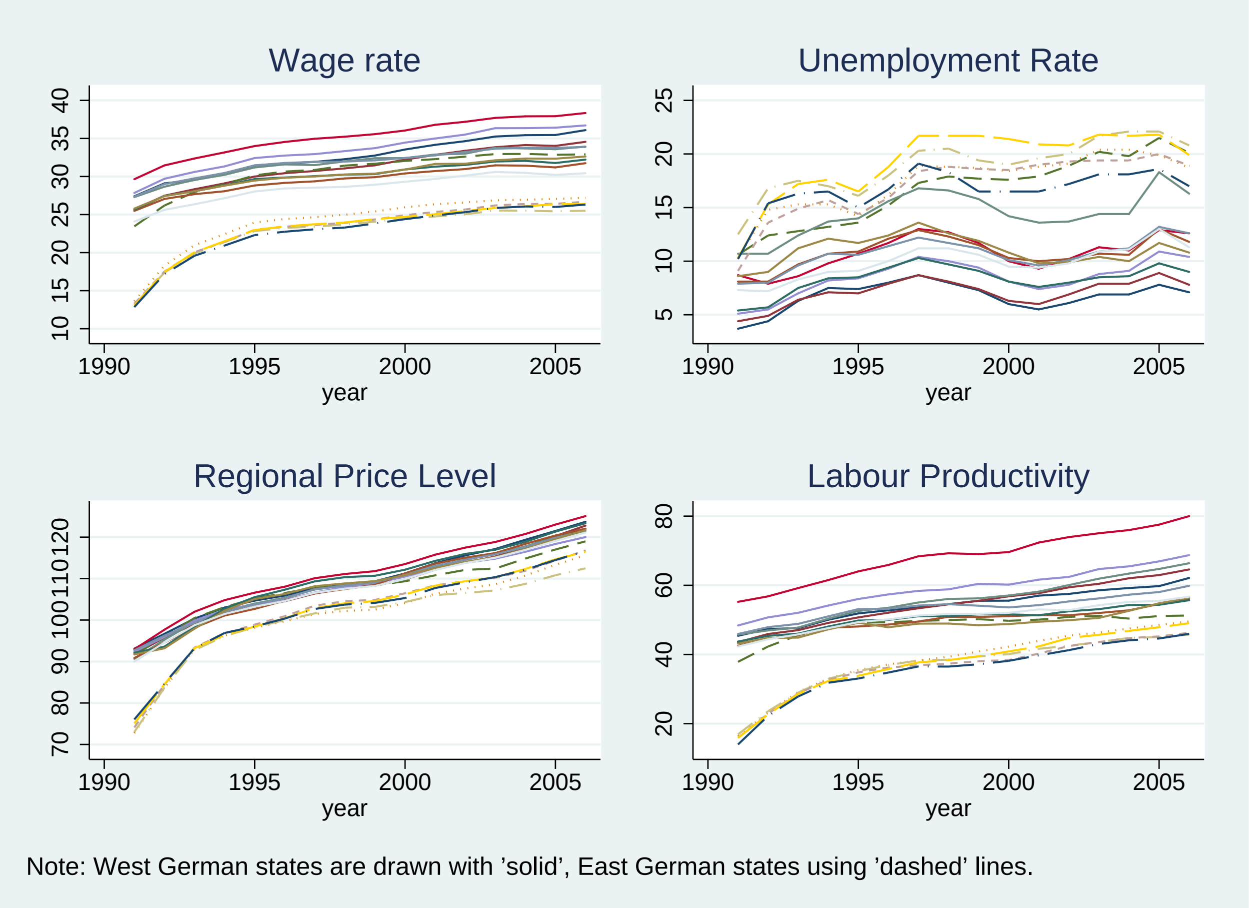
Source: Based on data from BiB (2008).

Figure 5: Time series plots for German state level net migration between 1991 and 2006



Source: Data from Destatis (2008).

Figure 6: Time series plots for German state level labour market and marcoeconomic variables between 1991 and 2006



Source: Data from Destatis (2008).

Table 5: Data description and source

Variable name	**Description**	**Source**
$outm_{ijt}$	Total number of outmigration from region i to j, in 1000	Destatis (2008)
inm_{ijt}	Total number of in-migration from region i to j, in 1000	Destatis (2008)
y_{it}	Gross domestic product in region i, 1000 EUR	VGRdL (2008)
y_{jt}	Gross domestic product in region j, 1000 EUR	VGRdL (2008)
py_{it}	GDP deflator in region i	VGRdL (2008)
py_{jt}	GDP deflator in region j	VGRdL (2008)
ylr_{it}	Labour productivity in region i, 1000 EUR, in real terms	VGRdL (2008)
ylr_{jt}	Labour productivity in region j, 1000 EUR, in real terms	VGRdL (2008)
pop_{it}	Population in region i, in 1000	VGRdL (2008)
pop_{jt}	Population in region j, in 1000	VGRdL (2008)
emp_{it}	Total employment in region i, in 1000	VGRdL (2008)
emp_{jt}	Total employment in region ij, in 1000	VGRdL (2008)
$unemp_{it}$	Total unemployment in region i, in 1000	VGRdL (2008)
$unemp_{jt}$	Total unemployment in region j, in 1000	VGRdL (2008)
ur_{it}	Unemployment rate in region i defined as $\left(\frac{unemp_{i,t}}{emp_{i,t}}\right)$	VGRdL (2008)
ur_{jt}	Unemployment rate in region j defined as $\left(\frac{unemp_{j,t}}{emp_{j,t}}\right)$	VGRdL (2008)
$wage_{it}$	Wage rate in region i defined as wage compensation per employee	VGRdL (2008)
$wage_{jt}$	Wage rate in region j defined as wage compensation per employee	VGRdL (2008)
$pcpi_{it}$	Consumer price index in region i based on Roos (2006) and regional CPI inflation rates	Roos (2006), RWI (2007)
$pcpi_{jt}$	Consumer price index in region j based on Roos (2006) and regional CPI inflation rates	Roos (2006), RWI (2007)
q_{it}	Labour market participation rate in region i defined as $\left(\frac{emp_{i,t}}{pop_{i,t}}\right)$	VGRdL (2008)
q_{jt}	Labour market participation rate in region j defined as $\left(\frac{emp_{i,t}}{pop_{i,t}}\right)$	VGRdL (2008)
hc_{it}	Human capital measure computed as a weighted composite indicator built up on the following ratios: 1.) high school graduates with university qualification per total population between 18-20 years (*hcschool*), 2.) number of university degrees per total population between 25-30 years (*hcuni*), 3.) share of employed persons with a university degree relative to total employment (*hcsvh*), 4.) number of patents per populations (*hcpat*); the following composite indicators have been tested: hc1 = 0,50*hcsvh + 0,30*hcschool + 0,15*hcuni + 0,05*hcpat hc4 = 0,30*hcsvh + 0,30*hcschool + 0,30*hcuni + 0,10*hcpat hc6 = 0,25*hcsvh + 0,25*hcschool + 0,25*hcuni + 0,25*hcpat	Destatis (2008) (hc6=default)
$pland_{it}$	Averages price for building land per qm in region i, in Euro	Destatis (2008)
$pland_{jt}$	Averages price for building land per qm in region j, in Euro	Destatis (2008)

Note: For BRE, HH and SH no consumer price inflation rates are available. We took the West German aggregate for these states, this also account for RHP, SAAR until 1995. In order tp construct time series for the price of building land (*pland*) no state level data before 1995 was available. Here we used the 1995-1999 average growth rate for each state to derive the values for 1991-1994. For Hamburg and Berlin only few data points were available. Here we took the price per qm in 2006 and used national growth rates to contruct artificial time series.

Table 6: **P-values of Panel unit root tests for variables in levels**

	IPS t-bar test N,T=(256,16)			
Specification	1	2	3	4
$nmr_{i,t}$	0.00	0.00	0.00	0.00
$ur_{i,t}$	0.00	0.00	0.00	0.00
$ur_{j,t}$	0.00	0.00	0.02	0.00
$(w-pcpi)_{i,t}$	0.00	0.00	0.00	0.00
$(w-pcpi)_{j,t}$	0.00	0.00	0.00	0.00
$\Delta ylr_{i,t}$	0.00	0.00	0.00	0.00
$\Delta ylr_{j,t}$	0.00	0.00	0.00	0.00
$hc_{i,t}$	0.00	0.00	0.00	0.00
$hc_{j,t}$	0.00	0.00	0.00	0.00
$pland_{i,t}$	0.00	0.00	0.00	0.00
$pland_{j,t}$	0.99	0.93	0.99	0.99
	LLC pooled ADF test N,T=(256,16)			
$pland_{i,t}$	0.00	0.00	0.00	0.00
$pland_{j,t}$	0.02	0.00	0.56	0.00

Note: Variant 1 = lag(0), no trend; variant 2 = lag(0), trend; variant 3 = lag(1), no trend; variant 4 = lag(1), trend. The tests have been performed using the *levinlin* and *ipshin* Stata-routines written by Bornhorst & Baum (2006, 2007).

Table 7: P-values of Panel unit root tests for variables as regional differences

	IPS t-bar test N,T=(256,16)			
Specification	1	2	3	4
$\widetilde{nmr}_{i,t}$	0.00	0.00	0.00	0.00
$\widetilde{ur}_{ij,t}$	0.00	0.00	0.02	0.00
$\widetilde{(w-pcpi)}_{ij,t}$	0.00	0.00	0.00	0.00
$\Delta\widetilde{ylr}_{ij,t}$	0.00	0.00	0.00	0.00
$\widetilde{hc}_{ij,t}$	0.00	0.00	0.00	0.00
$\widetilde{pland}_{ij,t}$	0.00	0.00	0.00	0.00

Note: Variant 1 = lag(0), no trend; variant 2 = lag(0), trend; variant 3 = lag(1), no trend; variant 4 = lag(1), trend. The tests have been performed using the *levinlin* and *ipshin* Stata-routines written by Bornhorst & Baum (2006, 2007).

Table 8: Estimation Results - Single equation DPD model for net migration

	First Difference				**Level**		**First Diff. & Level**			
Dep. Var.: $nm_{ij,t}$	**AH**	**AH**	**AB1**	**AB2**	**LEV1**	**LEV2**	**BB1**	**BB2**	**BB2**	**BB2**
$nm_{ij,t-1}$	0.54*** (0.058)	0.42*** (0.062)	0.52*** (0.031)	0.55*** (0.025)	0.50*** (0.047)	0.51*** (0.040)	0.73*** (0.024)	0.75*** (0.018)	0.71*** (0.019)	0.56*** (0.033)
$\tilde{ur}_{ij,t-1}$	-0.10** (0.047)	0.05 (0.053)	-0.15*** (0.041)	-0.12*** (0.030)	-0.17*** (0.020)	-0.17*** (0.017)	-0.07*** (0.018)	-0.08*** (0.014)	-0.06*** (0.016)	-0.07** (0.038)
$\widetilde{(w-pcpi)}_{ij,t-1}$	-0.14 (0.104)	0.54*** (0.145)	-0.13 (0.132)	-0.24** (0.045)	0.37*** (0.039)	0.36*** (0.036)	0.27*** (0.043)	0.24*** (0.034)		0.46*** (0.092)
$\widetilde{(w-pcpi)}^{industry}_{ij,t-1}$									0.23*** (0.043)	
$\widetilde{(w-pcpi)}^{services}_{ij,t-1}$									0.005 (0.073)	
Industry share$_{j,t-1}$									-0.01* (0.003)	
$\Delta\tilde{ylr}_{ij,t-1}$		0.22*** (0.063)	0.46*** (0.056)	0.40*** (0.045)	0.62*** (0.052)	0.62*** (0.051)	0.57*** (0.042)	0.52*** (0.040)	0.51*** (0.043)	0.72*** (0.058)
$\tilde{q}_{ij,t-1}$										0.38* (0.238)
$\tilde{hc}_{ij,t-1}$		-0.02* (0.012)	-0.03* (0.015)	-0.02* (0.014)	-0.01 (0.009)	-0.014* (0.009)	-0.004 (0.011)	-0.01 (0.010)	-0.01 (0.011)	-0.04** (0.017)
$\tilde{pland}_{ij,t-1}$		0.003 (0.004)	0.002 (0.006)	0.002 (0.002)	0.01*** (0.004)	0.01*** (0.003)	0.01 (0.004)	0.005** (0.002)	0.005** (0.002)	0.001 (0.004)
$Dummy_{NIE}$					-0.18*** (0.021)	-0.18*** (0.019)	-0.10*** (0.028)	-0.07*** (0.018)	-0.16*** (0.031)	-0.11** (0.059)
No. of obs.	3360	3120	3120	3120	3120	3120	3120	3120	3120	3120
No. of groups	240	240	240	240	240	240	240	240	240	240
No. of IVs	3	6	109	449	6	11	123	493	324	105
m_1	-9.15	-7.64	-6.78	-6.91	8.37	8.07	-7.20	-7.27	-7.24	-6.90
m_2	2.87	2.60	2.30	2.34			2.21	2.25	2.26	2.24
J-Statistic (Hansen Overid. test)				$\chi^2(443) = 239.5$ passed				$\chi^2(486) = 238.9$ passed		
C-Statistic (Exogeneity test)							$\chi^2(13) = 6.91$ passed	$\chi^2(57) = 0.03$ passed		
RMSE	0.229	0.255	0.227	0.244	0.188	0.187	0.168	0.166		

Note: ***, **, * = denote significance levels at the 1%, 5% and 10% level respectively. For one-step Anderson-Hsiao IV (AH) and two-step Arellano–Bond GMM (AB), Level GMM (LEV) and Blundell-Bond system GMM (BB) estimators robust standard errors are computed. The latter are based on Windmeijer's (2005) finite-sample correction.

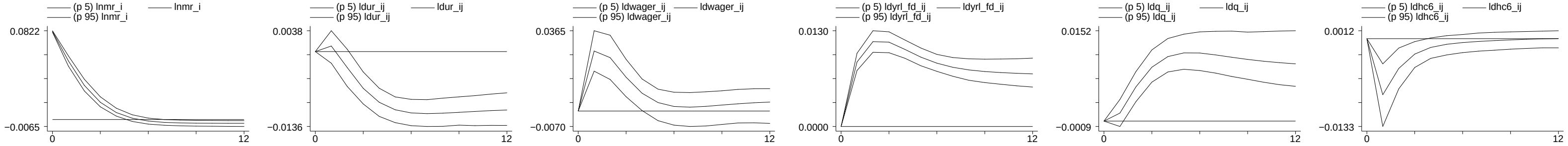
Table 9: Estimation Results - Panel VAR with lag(1) for $[nm_{ij,t}, \tilde{eq}_{ij,}, \tilde{w}_{ij,t}, \Delta\tilde{y}_{ij,t}, \widetilde{patint}_{ij,t}]$

Dep. Var.	**r.h.s. var.**	**coef**	**Corr. S.E.**	**z**	$P > \lvert z \rvert$
$nm_{ij,t}$	$nm_{ij,t-1}$	0.57***	0.034	16.59	(0.00)
$nm_{ij,t}$	$\tilde{u}r_{ij,t-1}$	-0.08*	0.042	-1.85	(0.06)
$nm_{ij,t}$	$\widetilde{(w-pcpi)}_{ij,t-1}$	0.42***	0.099	4.24	(0.00)
$nm_{ij,t}$	$\Delta\widetilde{ylr}_{ij,t-1}$	0.71***	0.058	12.20	(0.00)
$nm_{ij,t}$	$\tilde{q}_{ij,t-1}$	0.39	0.262	1.51	(0.14)
$nm_{ij,t}$	$\widetilde{hc}_{ij,t-1}$	-0.05	0.018***	-2.94	(0.00)
$\tilde{u}r_{ij,t}$	$nm_{ij,t-1}$	0.06***	0.009	6.58	(0.00)
$\tilde{u}r_{ij,t}$	$\tilde{u}r_{ij,t-1}$	0.90***	0.014	60.36	(0.00)
$\tilde{u}r_{ij,t}$	$\widetilde{(w-pcpi)}_{ij,t-1}$	-0.54***	0.032	-16.50	(0.00)
$\tilde{u}r_{ij,t}$	$\Delta\widetilde{ylr}_{ij,t-1}$	-0.67***	0.023	-28.75	(0.00)
$\tilde{u}r_{ij,t}$	$\tilde{q}_{ij,t-1}$	0.28***	0.096	2.86	(0.00)
$\tilde{u}r_{ij,t}$	$\widetilde{hc}_{ij,t-1}$	0.01**	0.005	1.97	(0.05)
$\widetilde{(w-pcpi)}_{ij,t}$	$nm_{ij,t-1}$	-0.02***	0.004	-5.15	(0.00)
$\widetilde{(w-pcpi)}_{ij,t}$	$\tilde{u}r_{ij,t-1}$	0.01	0.011	0.77	(0.44)
$\widetilde{(w-pcpi)}_{ij,t}$	$\widetilde{(w-pcpi)}_{ij,t-1}$	0.81***	0.017	45.55	(0.00)
$\widetilde{(w-pcpi)}_{ij,t}$	$\Delta\widetilde{ylr}_{ij,t-1}$	0.21***	0.006	31.17	(0.00)
$\widetilde{(w-pcpi)}_{ij,t}$	$\tilde{q}_{ij,t-1}$	0.46***	0.061	7.48	(0.00)
$\widetilde{(w-pcpi)}_{ij,t}$	$\widetilde{hc}_{ij,t-1}$	0.01***	0.002	3.01	(0.00)
$\Delta\widetilde{ylr}_{ij,t}$	$nm_{ij,t-1}$	-0.05	0.01***	-6.94	(0.00)
$\Delta\widetilde{ylr}_{ij,t}$	$\tilde{u}r_{ij,t-1}$	0.02	0.016	1.45	(0.15)
$\Delta\widetilde{ylr}_{ij,t}$	$\widetilde{(w-pcpi)}_{ij,t-1}$	-0.28***	0.025	-11.13	(0.00)
$\Delta\widetilde{ylr}_{ij,t}$	$\Delta\widetilde{ylr}_{ij,t-1}$	0.52***	0.014	36.57	(0.00)
$\Delta\widetilde{ylr}_{ij,t}$	$\tilde{q}_{ij,t-1}$	0.72***	0.091	7.87	(0.00)
$\Delta\widetilde{ylr}_{ij,t}$	$\widetilde{hc}_{ij,t-1}$	0.01**	0.003	1.97	(0.04)
$\tilde{q}_{ij,t}$	$nm_{ij,t-1}$	0.001	0.003	0.38	(0.71)
$\tilde{q}_{ij,t}$	$\tilde{u}r_{ij,t-1}$	-0.02***	0.007	-2.76	(0.00)
$\tilde{q}_{ij,t}$	$\widetilde{(w-pcpi)}_{ij,t-1}$	0.11***	0.011	(9.86)	(0.00)
$\tilde{q}_{ij,t}$	$\Delta\widetilde{ylr}_{ij,t-1}$	0.10***	0.005	17.49	(0.00)
$\tilde{q}_{ij,t}$	$\tilde{q}_{ij,t-1}$	0.70***	0.039	17.65	(0.00)
$\tilde{q}_{ij,t}$	$\widetilde{hc}_{ij,t-1}$	-0.005***	0.001	-4.44	(0.00)
$\tilde{q}_{ij,t}$	$nm_{ij,t-1}$	-0.08**	0.036	-2.06	(0.04)
$\tilde{q}_{ij,t}$	$\tilde{u}r_{ij,t-1}$	-0.52***	0.080	-6.45	(0.00)
$\tilde{q}_{ij,t}$	$\widetilde{(w-pcpi)}_{ij,t-1}$	0.62***	0.145	4.31	(0.00)
$\tilde{q}_{ij,t}$	$\Delta\widetilde{ylr}_{ij,t-1}$	0.29***	0.066	4.36	(0.00)
$\tilde{q}_{ij,t}$	$\tilde{q}_{ij,t-1}$	-0.35	0.451	-0.77	(0.44)
$\tilde{q}_{ij,t}$	$\widetilde{hc}_{ij,t-1}$	0.04***	0.012	3.28	(0.00)

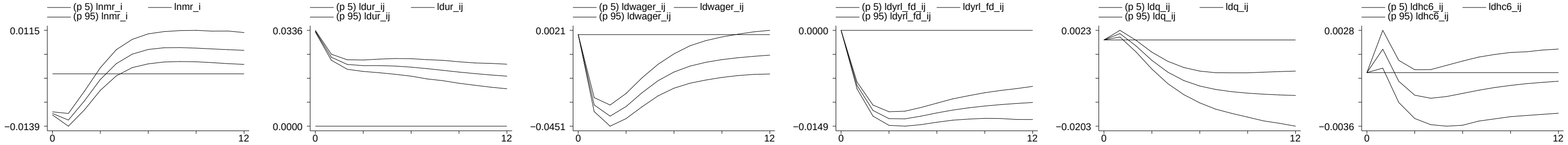
No. of obs. per eq.	3120
No. of system obs.	18720
No. of instruments	504
C-Statistic ('diff-in-Sargan')	$\chi^2(36) = 19.21$ (0.98)
RMSE_{system}	0.185

Note: ***, **, * = denote significance levels at the 1%, 5% and 10% level respectively. Standard errors are computed based on Windmeijer's (2005) finite-sample correction.

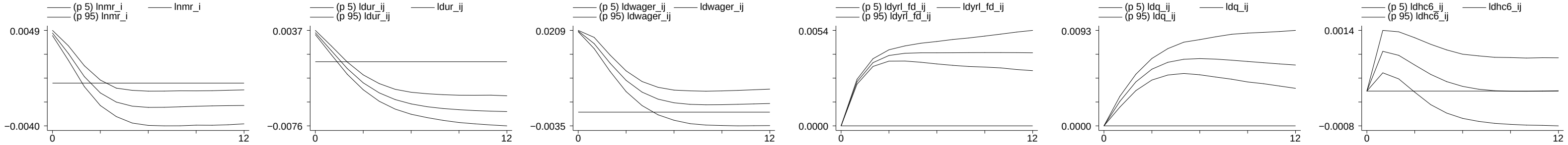
Figure 7: Impulse-Responses for PVAR with lag(1) incl. $[nm_{ij,t}, \tilde{eq}_{ij,t}, \tilde{w}_{ij,t}, \Delta\tilde{y}_{ij,t}, \widetilde{patint}_{ij,t}]$



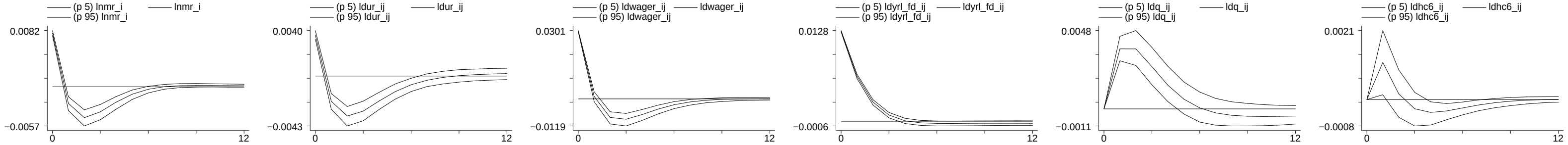
response of lnmr_i to lnmr_i shock | response of lnmr_i to ldur_ij shock | response of lnmr_i to ldwager_ij shock | response of lnmr_i to ldyrl_fd_ij shock | response of lnmr_i to ldq_ij shock | response of lnmr_i to ldhc6_ij shock



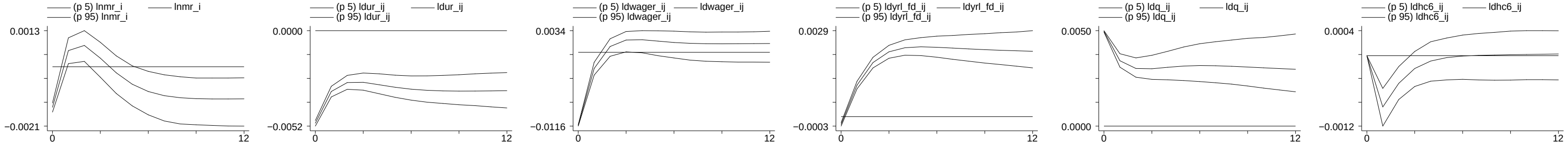
response of ldur_ij to lnmr_i shock | response of ldur_ij to ldur_ij shock | response of ldur_ij to ldwager_ij shock | response of ldur_ij to ldyrl_fd_ij shock | response of ldur_ij to ldq_ij shock | response of ldur_ij to ldhc6_ij shock



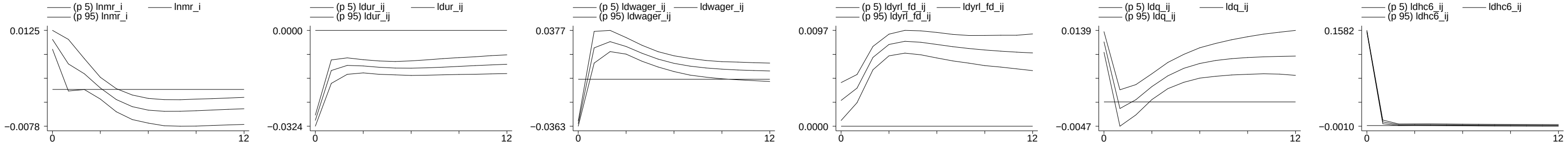
response of ldwager_ij to lnmr_i shock | response of ldwager_ij to ldur_ij shock | response of ldwager_ij to ldwager_ij shock | response of ldwager_ij to ldyrl_fd_ij shock | response of ldwager_ij to ldq_ij shock | response of ldwager_ij to ldhc6_ij shock



response of ldyrl_fd_ij to lnmr_i shock | response of ldyrl_fd_ij to ldur_ij shock | response of ldyrl_fd_ij to ldwager_ij shock | response of ldyrl_fd_ij to ldyrl_fd_ij shock | response of ldyrl_fd_ij to ldq_ij shock | response of ldyrl_fd_ij to ldhc6_ij shock



response of ldq_ij to lnmr_i shock | response of ldq_ij to ldur_ij shock | response of ldq_ij to ldwager_ij shock | response of ldq_ij to ldyrl_fd_ij shock | response of ldq_ij to ldq_ij shock | response of ldq_ij to ldhc6_ij shock



response of ldhc6_ij to lnmr_i shock | response of ldhc6_ij to ldur_ij shock | response of ldhc6_ij to ldwager_ij shock | response of ldhc6_ij to ldyrl_fd_ij shock | response of ldhc6_ij to ldq_ij shock | response of ldhc6_ij to ldhc6_ij shock

Table 10: Variance decomposition for PVAR(1) of
$[nm_{ij,t}, \tilde{ur}_{ij,}, \widetilde{(w-pcpi)}_{ij,t}, \Delta\tilde{ylr}_{ij,t}, \tilde{q}_{ij,t}, \tilde{hc}_{ij,t}]$

	s	nm$_{ij,t}$	$\tilde{ur}_{ij,}$	$\widetilde{(w-pcpi)}_{ij,t}$	$\Delta\tilde{ylr}_{ij,t}$	$\tilde{q}_{ij,t}$	$\tilde{hc}_{ij,t}$
$\tilde{nm}_{ij,t}$	10	0.724	0.050	0.111	0.053	0.056	0.007
$\tilde{ur}_{ij,t}$	10	0.038	0.362	0.449	0.098	0.052	0.001
$\widetilde{(w-pcpi)}_{ij,t}$	10	0.034	0.101	0.602	0.083	0.179	0.001
$\Delta\tilde{ylr}_{ij,t}$	10	0.071	0.030	0.735	0.138	0.024	0.001
$\tilde{q}_{ij,t}$	10	0.017	0.258	0.362	0.097	0.264	0.002
$\tilde{hc}_{ij,t}$	10	0.008	0.072	0.132	0.017	0.015	0.757
$\tilde{nm}_{ij,t}$	20	0.619	0.103	0.104	0.072	0.096	0.006
$\tilde{ur}_{ij,t}$	20	0.042	0.377	0.341	0.122	0.117	0.001
$\widetilde{(w-pcpi)}_{ij,t}$	20	0.038	0.197	0.407	0.118	0.239	0.001
$\Delta\tilde{ylr}_{ij,t}$	20	0.071	0.031	0.733	0.138	0.026	0.001
$\tilde{q}_{ij,t}$	20	0.028	0.306	0.252	0.128	0.284	0.002
$\tilde{hc}_{ij,t}$	20	0.011	0.100	0.130	0.030	0.036	0.693

Note: Based on the orthogonalized impluse-responses, see text.

Figure 8: Bilateral net migration between Berlin and the West German states - actual and PVAR fitted values

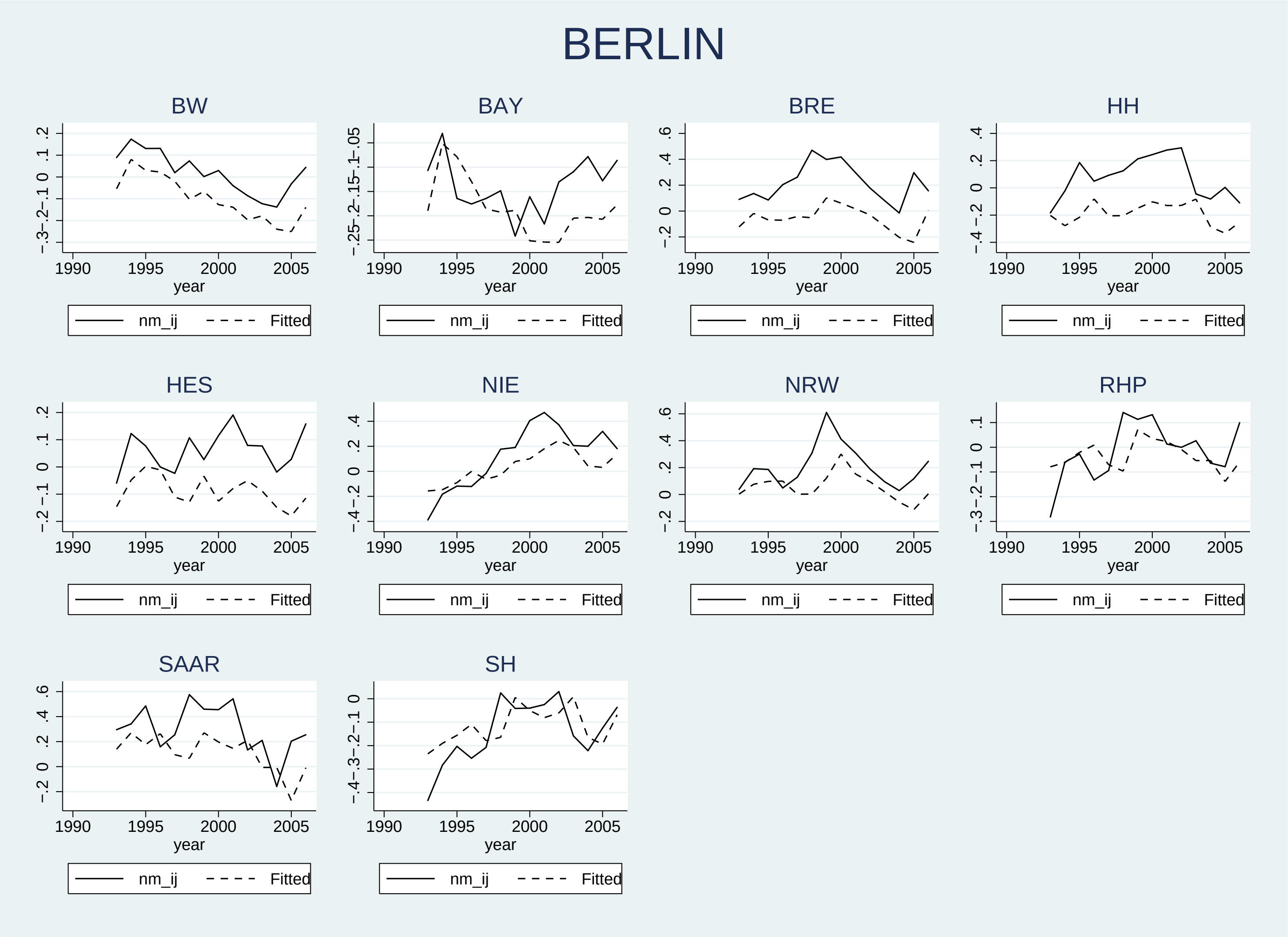


Figure 9: Bilateral net migration between Brandenburg and the West German states - actual and PVAR fitted values

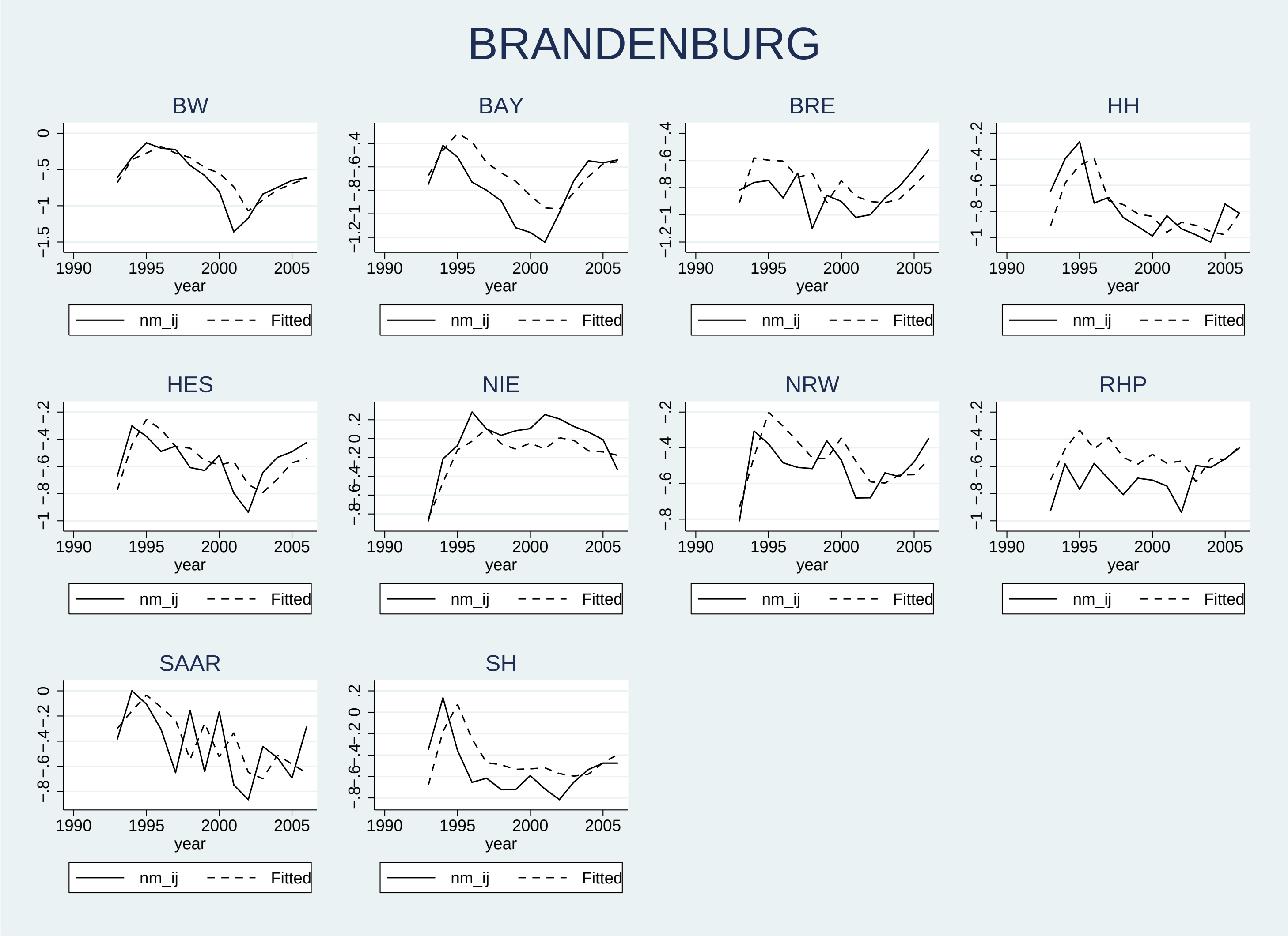


Figure 10: Bilateral net migration between Mecklenburg-Vorpommern and the West German states - actual and PVAR fitted values

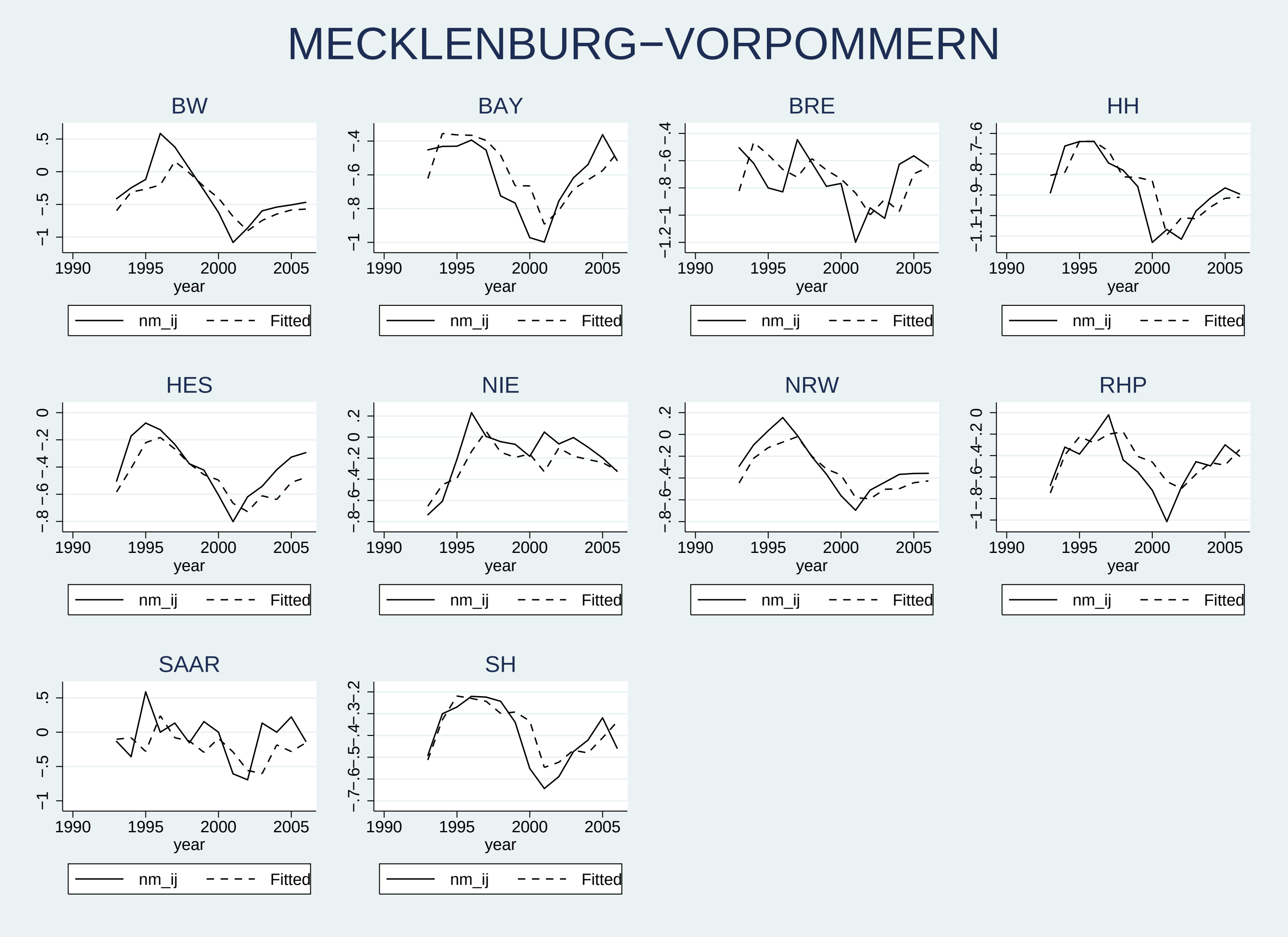


Figure 11: Bilateral net migration between Saxony and the West German states - actual and PVAR fitted values

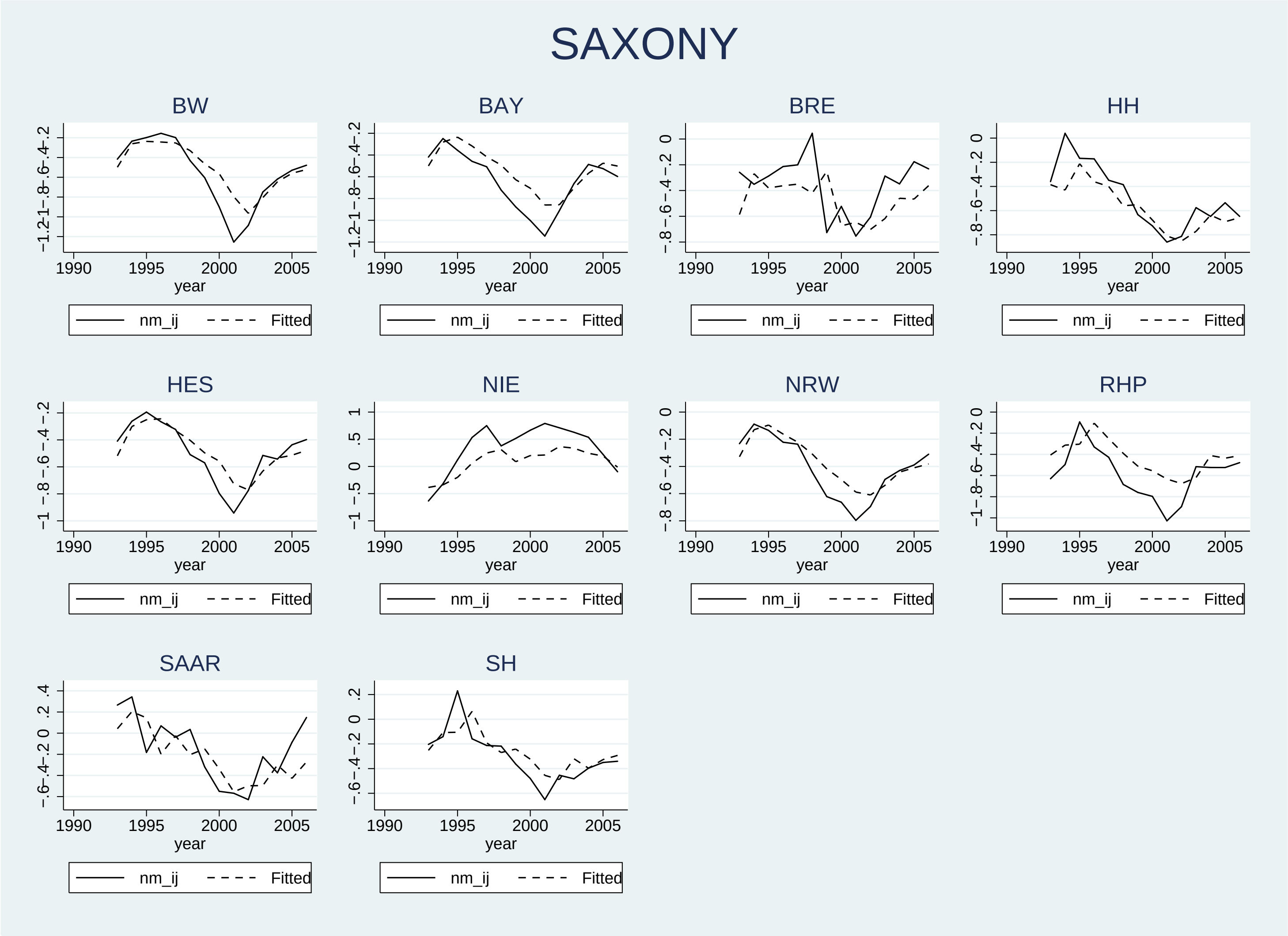


Figure 12: Bilateral net migration between Saxony-Anhalt and the West German states - actual and PVAR fitted values

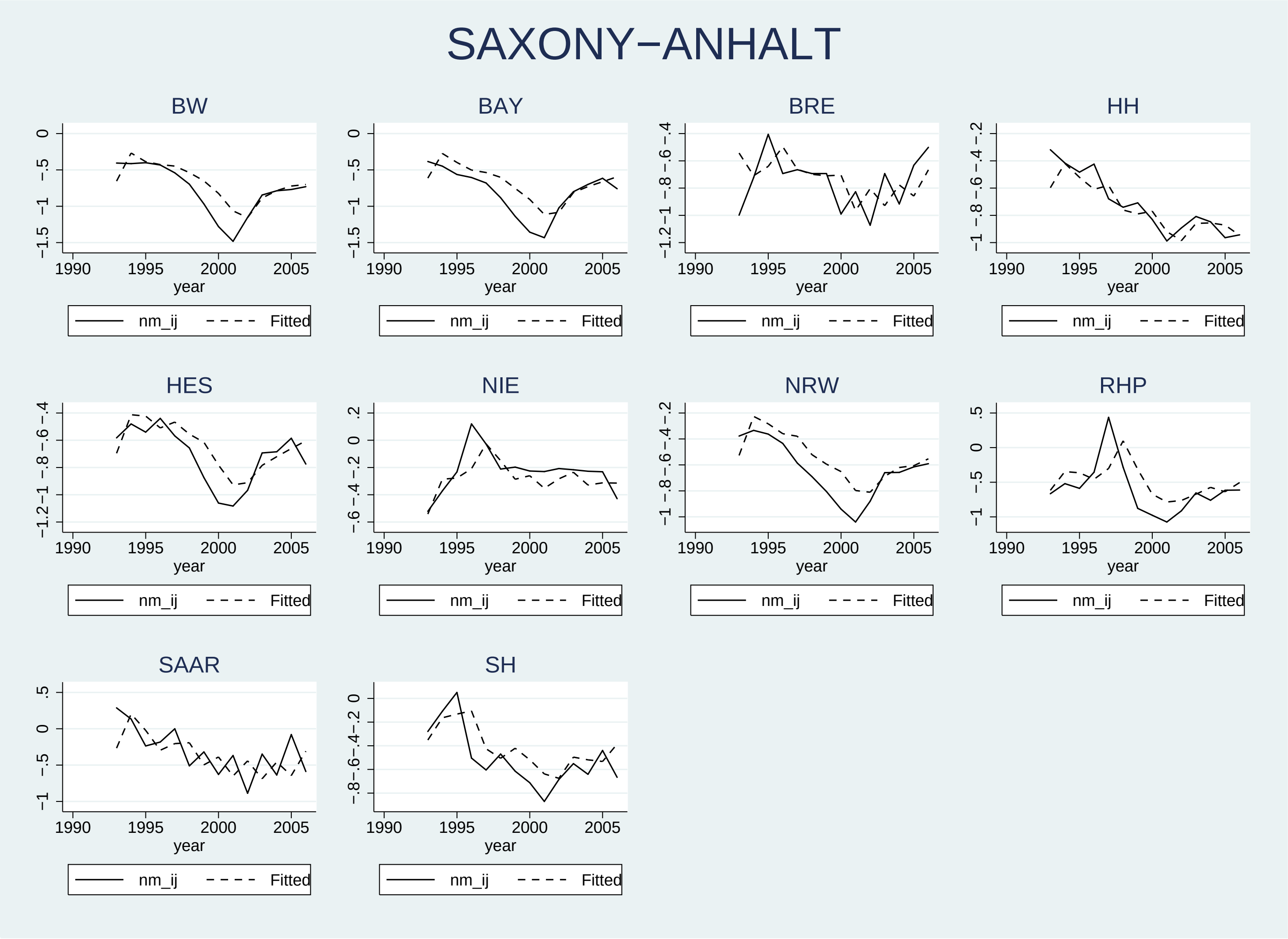


Figure 13: Bilateral net migration between Thuringia and the West German states - actual and PVAR fitted values

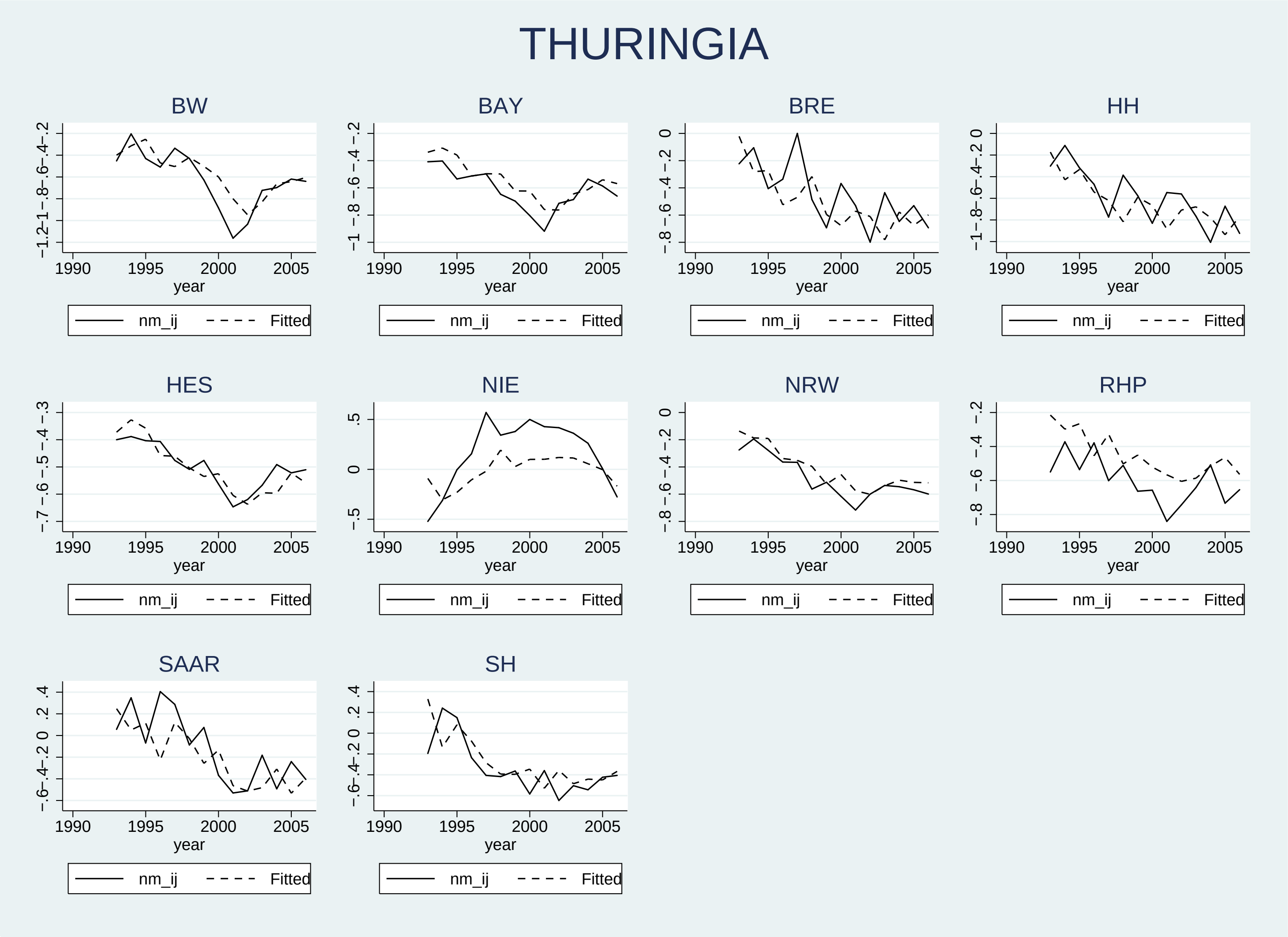
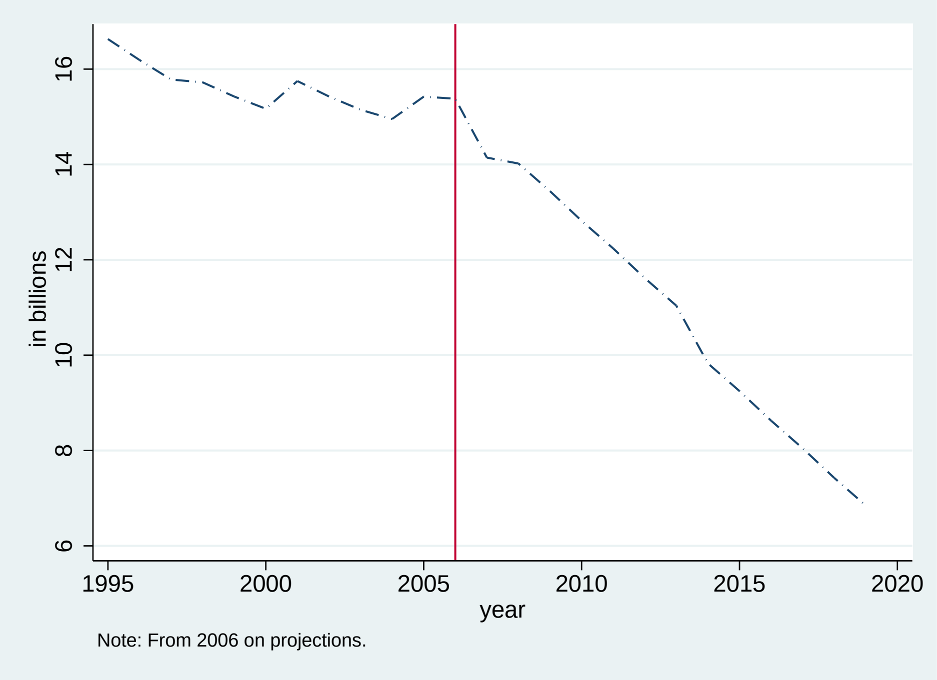
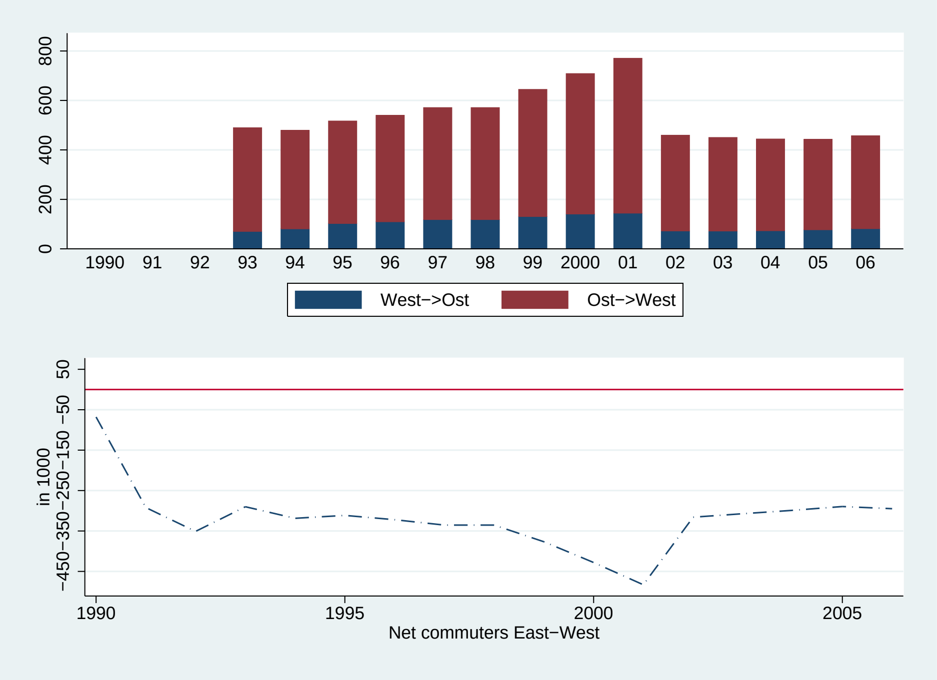


Figure 14: West-East Transfers (excl. Berlin) for 1995–2019 as share of East German GDP



Source: Data from BMF, BMWi, BMBF, Ragnitz et al. (2000), SVR (2004), GEFRA et al. (2003).
Note: For details of calculation see Bradley et al. (2006).

Figure 15: East–West commuter flows for the period 1991–2006



Source: Data from Bach et al. (1992), Bundesagentur für Arbeit.

Table 11: Estimation Results for East-Dummy augmented PVAR(1) with $[nm_{ij,t}, \tilde{ur}_{ij,}, \widetilde{(w-pcpi)}_{ij,t}, \Delta \tilde{ylr}_{ij,t}, \tilde{q}_{ij,t}, \tilde{hc}_{ij,t}]$

Time Period		East-Dummy until 2006			East-Dummy until 1997		
Dep. Var.	**r.h.s. var.**	**coef**	**S.E.**	$P > \lvert z \rvert$	**coef**	**S.E.**	$P > \lvert z \rvert$
$nm_{ij,t}$	$nm_{ij,t-1}$	0.58***	0.035	(0.00)	0.46***	0.068	(0.00)
$nm_{ij,t}$	$\tilde{ur}_{ij,t-1}$	-0.08*	0.045	(0.07)	-0.13**	0.055	(0.02)
$nm_{ij,t}$	$\widetilde{(w-pcpi)}_{ij,t-1}$	0.45***	0.104	(0.00)	0.21	0.176	(0.24)
$nm_{ij,t}$	$\Delta \tilde{ylr}_{ij,t-1}$	0.73***	0.059	(0.00)	0.54***	0.113	(0.00)
$nm_{ij,t}$	$\tilde{q}_{ij,t-1}$	0.37	0.260	(0.15)	0.82**	0.322	(0.01)
$nm_{ij,t}$	$\tilde{hc}_{ij,t-1}$	-0.05***	0.018	(0.00)	-0.04**	0.020	(0.04)
$nm_{ij,t}$	$East-Dummy$	0.02	0.033	(0.50)	0.06**	0.026	(0.01)
$\tilde{ur}_{ij,t}$	$nm_{ij,t-1}$	0.05***	0.010	(0.00)	-0.03	0.029	(0.25)
$\tilde{ur}_{ij,t}$	$\tilde{ur}_{ij,t-1}$	0.86***	0.017	(0.00)	0.77***	0.067	(0.00)
$\tilde{ur}_{ij,t}$	$\widetilde{(w-pcpi)}_{ij,t-1}$	-0.53***	0.035	(0.00)	-0.27**	0.109	(0.01)
$\tilde{ur}_{ij,t}$	$\Delta \tilde{ylr}_{ij,t-1}$	-0.65***	0.025	(0.00)	-0.69***	0.071	(0.00)
$\tilde{ur}_{ij,t}$	$\tilde{q}_{ij,t-1}$	0.25**	0.098	(0.01)	-1.10***	0.335	(0.00)
$\tilde{ur}_{ij,t}$	$\tilde{hc}_{ij,t-1}$	0.01	0.005	(0.17)	0.07***	0.015	(0.00)
$\tilde{ur}_{ij,t}$	$East-Dummy$	0.05***	0.013	(0.00)	0.01	0.022	(0.63)
$\widetilde{(w-pcpi)}_{ij,t}$	$nm_{ij,t-1}$	-0.02***	0.005	(0.00)	0.01*	0.005	(0.06)
$\widetilde{(w-pcpi)}_{ij,t}$	$\tilde{ur}_{ij,t-1}$	0.02*	0.011	(0.10)	0.13***	0.019	(0.00)
$\widetilde{(w-pcpi)}_{ij,t}$	$\widetilde{(w-pcpi)}_{ij,t-1}$	0.82***	0.020	(0.00)	0.59***	0.030	(0.00)
$\widetilde{(w-pcpi)}_{ij,t}$	$\Delta \tilde{ylr}_{ij,t-1}$	0.21***	0.008	(0.00)	0.18***	0.014	(0.00)
$\widetilde{(w-pcpi)}_{ij,t}$	$\tilde{q}_{ij,t-1}$	0.46***	0.062	(0.00)	1.37***	0.092	(0.00)
$\widetilde{(w-pcpi)}_{ij,t}$	$\tilde{hc}_{ij,t-1}$	0.01***	0.002	(0.00)	0.001***	0.002	(0.00)
$\widetilde{(w-pcpi)}_{ij,t}$	$East-Dummy$	-0.01	0.009	(0.37)	-0.06***	0.010	(0.00)
$\Delta \tilde{ylr}_{ij,t}$	$nm_{ij,t-1}$	-0.04***	0.007	(0.00)	0.00	0.009	(0.84)
$\Delta \tilde{ylr}_{ij,t}$	$\tilde{ur}_{ij,t-1}$	0.05***	0.017	(0.00)	0.23***	0.031	(0.00)
$\Delta \tilde{ylr}_{ij,t}$	$\widetilde{(w-pcpi)}_{ij,t-1}$	-0.28***	0.029	(0.00)	-0.47***	0.043	(0.00)
$\Delta \tilde{ylr}_{ij,t}$	$\Delta \tilde{ylr}_{ij,t-1}$	0.51***	0.016	(0.00)	0.51***	0.024	(0.00)
$\Delta \tilde{ylr}_{ij,t}$	$\tilde{q}_{ij,t-1}$	0.74***	0.092	(0.00)	1.98***	0.153	(0.00)
$\Delta \tilde{ylr}_{ij,t}$	$\tilde{hc}_{ij,t-1}$	0.01**	0.003	(0.01)	-0.01*	0.003	(0.10)
$\Delta \tilde{ylr}_{ij,t}$	$East-Dummy$	-0.03*	0.016	(0.08)	-0.09***	0.014	(0.00)
$\tilde{q}_{ij,t}$	$nm_{ij,t-1}$	0.00	0.003	(0.98)	0.00	0.004	(0.55)
$\tilde{q}_{ij,t}$	$\tilde{ur}_{ij,t-1}$	-0.02***	0.008	(0.00)	-0.05***	0.013	(0.00)
$\tilde{q}_{ij,t}$	$\widetilde{(w-pcpi)}_{ij,t-1}$	0.11***	0.012	(0.00)	0.10***	0.018	(0.00)
$\tilde{q}_{ij,t}$	$\Delta \tilde{ylr}_{ij,t-1}$	0.10***	0.006	(0.00)	0.07***	0.013	(0.00)
$\tilde{q}_{ij,t}$	$\tilde{q}_{ij,t-1}$	0.70***	0.041	(0.00)	0.55***	0.080	(0.00)
$\tilde{q}_{ij,t}$	$\tilde{hc}_{ij,t-1}$	-0.01***	0.001	(0.00)	-0.01***	0.002	(0.00)
$\tilde{q}_{ij,t}$	$East-Dummy$	0.00	0.005	(0.70)	0.02***	0.008	(0.00)
$\tilde{hc}_{ij,t}$	$nm_{ij,t-1}$	-0.07**	0.035	(0.05)	0.13**	0.061	(0.04)
$\tilde{hc}_{ij,t}$	$\tilde{ur}_{ij,t-1}$	-0.52***	0.078	(0.00)	-0.24***	0.063	(0.00)
$\tilde{hc}_{ij,t}$	$\widetilde{(w-pcpi)}_{ij,t-1}$	0.83***	0.143	(0.00)	-0.09	0.342	(0.80)
$\tilde{hc}_{ij,t}$	$\Delta \tilde{ylr}_{ij,t-1}$	0.36***	0.067	(0.00)	0.11	0.155	(0.48)
$\tilde{hc}_{ij,t}$	$\tilde{q}_{ij,t-1}$	-0.50	0.446	(0.26)	0.87	0.680	(0.20)
$\tilde{hc}_{ij,t}$	$\tilde{hc}_{ij,t-1}$	0.05***	0.013	(0.00)	0.35***	0.013	(0.00)
$\tilde{hc}_{ij,t}$	$East-Dummy$	0.11*	0.059	(0.07)	-0.01	0.050	(0.78)

No. of obs. per eq.	3120
No. of system obs.	18720
No. of system IVs	510
System RMSE	0.182
C-Statistic (P-value)	$\chi^2(36) = 15.89$ for East-Dummies: $\chi^2(6) = 2.16$] (0.98) for East-Dummies: (0.90)

Note: ***, **, * = denote significance levels at the 1%, 5% and 10% level respectively. Standard errors are computed based on Windmeijer's (2005) finite-sample correction.

Table 12: Estimation Results for Border-Dummy augmented PVAR(1) with $[nm_{ij,t}, \tilde{ur}_{ij,}, \widetilde{(w-pcpi)}_{ij,t}, \Delta\tilde{ylr}_{ij,t}, \tilde{q}_{ij,t}, \tilde{hc}_{ij,t}]$

Time Period		**Border-Dummy until 2006**			**Border Dummy until 1997**		
Dep. Var.	**r.h.s. var.**	**coef**	**S.E.**	$P>\|z\|$	**coef**	**S.E.**	$P>\|z\|$
$nm_{ij,t}$	$nm_{ij,t-1}$	0.58^{***}	0.035	(0.00)	0.57^{***}	0.034	(0.00)
$nm_{ij,t}$	$\tilde{ur}_{ij,t-1}$	-0.08^{**}	0.043	(0.05)	-0.07^{*}	0.043	(0.08)
$nm_{ij,t}$	$\widetilde{(w-pcpi)}_{ij,t-1}$	0.44^{***}	0.102	(0.00)	0.45^{***}	0.100	(0.00)
$nm_{ij,t}$	$\Delta\tilde{ylr}_{ij,t-1}$	0.72^{***}	0.059	(0.00)	0.69^{***}	0.060	(0.00)
$nm_{ij,t}$	$\tilde{q}_{ij,t-1}$	0.41	0.263	(0.12)	0.39	0.263	(0.14)
$nm_{ij,t}$	$\tilde{hc}_{ij,t-1}$	-0.05^{***}	0.018	(0.00)	-0.05^{***}	0.018	(0.00)
$nm_{ij,t}$	$Border-Dummy$	0.09	0.059	(0.14)	0.12^{**}	0.060	(0.05)
$\tilde{ur}_{ij,t}$	$nm_{ij,t-1}$	0.06^{***}	0.010	(0.00)	0.06^{***}	0.010	(0.00)
$\tilde{ur}_{ij,t}$	$\tilde{ur}_{ij,t-1}$	0.90^{***}	0.015	(0.00)	0.90^{***}	0.015	(0.00)
$\tilde{ur}_{ij,t}$	$\widetilde{(w-pcpi)}_{ij,t-1}$	-0.54^{***}	0.033	(0.00)	-0.53^{***}	0.033	(0.00)
$\tilde{ur}_{ij,t}$	$\Delta\tilde{ylr}_{ij,t-1}$	-0.67^{***}	0.023	(0.00)	-0.67^{***}	0.024	(0.00)
$\tilde{ur}_{ij,t}$	$\tilde{q}_{ij,t-1}$	0.28^{***}	0.096	(0.00)	0.27^{**}	0.096	(0.01)
$\tilde{ur}_{ij,t}$	$\tilde{hc}_{ij,t-1}$	0.01^{*}	0.005	(0.06)	0.01^{**}	0.005	(0.05)
$\tilde{ur}_{ij,t}$	$Border-Dummy$	0.01	0.029	(0.76)	0.01	0.016	(0.51)
$\widetilde{(w-pcpi)}_{ij,t}$	$nm_{ij,t-1}$	-0.02^{***}	0.005	(0.00)	-0.02^{***}	0.005	(0.00)
$\widetilde{(w-pcpi)}_{ij,t}$	$\tilde{ur}_{ij,t-1}$	0.01	0.011	(0.43)	0.01	0.011	(0.43)
$\widetilde{(w-pcpi)}_{ij,t}$	$\widetilde{(w-pcpi)}_{ij,t-1}$	0.81^{***}	0.018	(0.00)	0.82^{***}	0.018	(0.00)
$\widetilde{(w-pcpi)}_{ij,t}$	$\Delta\tilde{ylr}_{ij,t-1}$	0.21^{***}	0.007	(0.00)	0.21^{***}	0.007	(0.00)
$\widetilde{(w-pcpi)}_{ij,t}$	$\tilde{q}_{ij,t-1}$	0.46^{***}	0.062	(0.00)	0.46^{***}	0.061	(0.00)
$\widetilde{(w-pcpi)}_{ij,t}$	$\tilde{hc}_{ij,t-1}$	0.01^{***}	0.002	(0.00)	0.01^{***}	0.002	(0.00)
$\widetilde{(w-pcpi)}_{ij,t}$	$Border-Dummy$	0.00	0.021	(0.90)	0.01	0.017	(0.67)
$\Delta\tilde{ylr}_{ij,t}$	$nm_{ij,t-1}$	-0.05^{***}	0.007	(0.00)	-0.05^{***}	0.007	(0.00)
$\Delta\tilde{ylr}_{ij,t}$	$\tilde{ur}_{ij,t-1}$	0.02	0.016	(0.13)	0.02	0.016	(0.14)
$\Delta\tilde{ylr}_{ij,t}$	$\widetilde{(w-pcpi)}_{ij,t-1}$	-0.28^{***}	0.026	(0.00)	-0.27^{***}	0.025	(0.00)
$\Delta\tilde{ylr}_{ij,t}$	$\Delta\tilde{ylr}_{ij,t-1}$	0.52^{***}	0.015	(0.00)	0.52^{***}	0.014	(0.00)
$\Delta\tilde{ylr}_{ij,t}$	$\tilde{q}_{ij,t-1}$	0.72^{***}	0.091	(0.00)	0.71^{***}	0.090	(0.00)
$\Delta\tilde{ylr}_{ij,t}$	$\tilde{hc}_{ij,t-1}$	0.01^{**}	0.004	(0.04)	0.01^{**}	0.004	(0.05)
$\Delta\tilde{ylr}_{ij,t}$	$Border-Dummy$	-0.01	0.028	(0.80)	0.00	0.022	(0.97)
$\tilde{q}_{ij,t}$	$nm_{ij,t-1}$	0.00	0.003	(0.78)	0.00	0.003	(0.75)
$\tilde{q}_{ij,t}$	$\tilde{ur}_{ij,t-1}$	-0.02^{**}	0.008	(0.01)	-0.02^{**}	0.007	(0.01)
$\tilde{q}_{ij,t}$	$\widetilde{(w-pcpi)}_{ij,t-1}$	0.11^{***}	0.011	(0.00)	0.11^{***}	0.011	(0.00)
$\tilde{q}_{ij,t}$	$\Delta\tilde{ylr}_{ij,t-1}$	0.10^{***}	0.006	(0.00)	0.10^{***}	0.006	(0.00)
$\tilde{q}_{ij,t}$	$\tilde{q}_{ij,t-1}$	0.70^{***}	0.040	(0.00)	0.71^{***}	0.039	(0.00)
$\tilde{q}_{ij,t}$	$\tilde{hc}_{ij,t-1}$	-0.01^{***}	0.001	(0.00)	-0.01^{***}	0.001	(0.00)
$\tilde{q}_{ij,t}$	$Border-Dummy$	0.00	0.013	(0.91)	0.00	0.008	(0.78)
$\tilde{hc}_{ij,t}$	$nm_{ij,t-1}$	-0.07^{**}	0.036	(0.05)	-0.07^{**}	0.036	(0.04)
$\tilde{hc}_{ij,t}$	$\tilde{ur}_{ij,t-1}$	-0.52^{***}	0.080	(0.00)	-0.52^{***}	0.080	(0.00)
$\tilde{hc}_{ij,t}$	$\widetilde{(w-pcpi)}_{ij,t-1}$	0.64^{***}	0.147	(0.00)	0.64^{***}	0.147	(0.00)
$\tilde{hc}_{ij,t}$	$\Delta\tilde{ylr}_{ij,t-1}$	0.29^{***}	0.066	(0.00)	0.29^{***}	0.067	(0.00)
$\tilde{hc}_{ij,t}$	$\tilde{q}_{ij,t-1}$	-0.38	0.447	(0.40)	-0.39	0.451	(0.39)
$\tilde{hc}_{ij,t}$	$\tilde{hc}_{ij,t-1}$	0.04	0.012	(0.00)	0.04^{***}	0.012	(0.00)
$\tilde{hc}_{ij,t}$	$Border-Dummy$	0.00	0.136	(0.98)	0.00	0.082	(0.99)

No. of obs. per eq.	3120
No. of system obs.	18720
No. of instruments	510
System RMSE	0.185
C-Statistic (P-value)	$\chi^2(36) = 17.87$ for Border-Dummies: $\chi^2(6) = 3.12$ (0.99) for Border-Dummies: (0.79)

Note: ***, **, * = denote significance levels at the 1%, 5% and 10% level respectively. Standard errors are computed based on Windmeijer's (2005) finite-sample correction.