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Björn Alecke, Timo Mitze, and Gerhard Untiedt

Internal Migration, Regional Labour Market Dynamics and Implications for German East-West Disparities

Results from a Panel VAR

#96

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Björn Alecke, Timo Mitze, and Gerhard Untiedt*

Internal Migration, Regional Labour Market Dynamics and Implications for German East-West Disparities – Results from a Panel VAR

Abstract

This paper analyses the causal linkages between regional labour market variables and internal migration flows among German states between 1991–2006. We adopt a Panel VAR approach to identify the feedback effects among the variables and analyse the dynamic properties of the system through impulse-response functions. We also use the model to track the evolution of the particular East-West migration since re-unification aiming to shed more light on the East German "empirical puzzle", characterized by lower migration responses than expected from the regional labour market position relative to the West. We indeed get evidence for such a puzzle throughout the mid-1990s, which is likely to be caused by huge West-East income transfers, a fast exogenously driven wage convergence and the possibility of East-West commuting. However, we also observe an inversion of this relationship for later periods: That is, along with a second wave of East-West movements around 2001 net flows out of East Germany were much higher than expected after controlling for its weak labour market and macroeconomic performance. Since this second wave is also accompanied by a gradual fading out of economic distortions, this supports the view of "repressed" migration flows for that period.

JEL Classification: C33, J61, R23

Keywords: Internal migration, Panel VAR, System GMM

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1 Introduction

As the Lisbon agenda shows, the extent to which regional differences in real wages, income and unemployment (e.g. as response to asymmetric demand shocks) can be balanced through labour migration is a subject of obvious interest for economic policy given the rather low (external but also internal) mobility rates for EU member states compared to the US and Australia (for details see e.g. Bonin et al., 2008). According to neoclassical theory the link between migration and regional labour market variables is assumed to work as follows: Regions with relatively high unemployment and low wage levels should experience net out-migration 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 then ensure that the regional labour market disparities will disappear over time. In a long-run cross-regional labor market equilibrium unemployment differences can then only be explained with differences in regional wage levels as a compensation for the higher unemployment risks, while otherwise factor prices are assumed to equalize across regions.[1]

Taking up this research question we aim at analysing whether and by what magnitude regional differences in wage levels, unemployment among other economic (push and pull) factors significantly influence the internal migratory behaviour within Germany. We put a particular emphasis on the analysis integration of the West and East German labour market integration since re–unification and analyse the likely two–way interdependences among migration and labour market variables. For empirical estimation we use internal migration flows between the German federal states (NUTS1 level) between 1991–2006 and apply dynamic panel data methods in a VAR context. The remainder of the paper is organised as follows: In the next section we present a short literature review. Section 3 sketches the underlying theoretical model that will serve as a starting point in specifying testable empirical specifications for estimation. Section 4 gives a short overview of the data used for the empirical analysis including a discussion of the time series properties. Section 5 describes the Panel VAR (PVAR) approach, section 6 the estimation results. In section 7, we test the explanatory power of the PVAR for predicting interregional East-West migration flows since re–unification and take a look at the East German "empirical puzzle". Section 8 finally concludes.

[1]See Siebert (1994) for a similar line of argumentation for regional labour market dynamics in Germany. A critical view of this concept of compensating differentials is given by Blanchflower & Oswald (1994, 2005), who introduce a 'wage curve' linking low wage levels and high unemployment rates for a particular region. Recent empirical studies by Wagner (1994), Baltagi & Blien (1998) and Baltagi et al. (2007) indeed give evidence for a 'wage curve' relationship in Germany.

2 Literature Review

This literature review mainly serves two purposes: First, from a partial equilibrium perspective we look at recent empirical contributions in specifying a stable long-run (neoclassical) migration equation. Second, using this long-run migration equation as an important building block for a more profound labour market analysis we then augment the scope of the literature review to multiple equation approaches, which account more carefully for likely dynamic feedback effects among migration and labour market variables.

Given the huge body of literature on the neoclassical migration model, it is not surprising that the empirical results in terms of a stable long-run migration equation are somewhat mixed and country specific: Taking a European perspective, one large bulk of empirical contributions finds regional disparities in (un-)employment rates as significant and important determinant of migration flows, while regional wage or income effects are found to be less evident from a data perspective. Examples are Pissarides & McMaster (1990) and Jackman & Savouri (1992) for British regions, Westerlund (1997) for the case of Sweden, as well as Bentolila & Dolado (1991) and Devillanova & Garcia-Fontes (2004) for Spanish regions. Only for Italian data Daveri & Faini (1998) point at a more prominent role given to regional wage levels in explaining gross out-migration from southern to northern regions. Similar evidence is also reported in Fachin (2007) for long-run trends of Italian South–North migration. The author finds that income growth in the origin region is a significant driving force of migration, while unemployment rates have only weak effects. A possible explanation for the rather weak empirical support for wage rate differentials at the European level may be the lack of an appropriate account of regional price level differences, which may significantly alter the results compared to variables in nominal or in some standard (e.g. output price) deflated form (see Roos, 2006).

Taking a closer look at German internal migration flows, among the earlier contributions Decressin (1994) examines gross migration flows for the 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 are considered.[2] Difficulties in proving a significant influ-

[2]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 does not check for regional price level differences.

ence 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 West Germany, as well as Schwarze & Wagner (1992), Wagner (1992), Burda (1993) and Büchel & Schwarze (1994) for the East German states.[3]

Opposed to the earlier evidence, recent macroeconomic studies assign a more prominent role to regional wage rate differentials in predicting German internal migration flows (see e.g. Parikh & Van Leuvensteijn, 2003, Alecke & Untiedt, 2000, 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 for 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 a significant non-linear relationship between disaggregated regional wage rate differences and East-West migration, while unemployment differences are tested be insignificant. 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.[4]

So far we have looked at single equation (partial equilibrium) approaches to estimate a stable long-run neoclassical migration equations. Building on this literature there is also a bulk of studies extending the scope of the analysis to a multiple equation setting in order to account more carefully on likely feedback effects of migratory movements on labour market variables and their joint responses to shocks. Aiming to control for two-way effects has been resulted in a variety of empirical specifications - either from a structural (see e.g. Okun, 1968, Muth, 1971, Salvatore, 1980, Bilger et al., 1991, and the large literature following Carlino-Mills, 1987) or time–series perspective (see Blanchard & Katz, 1992, Decressin &

[3]Subsequent micro studies mainly focused on qualifying the theoretically unsatisfactory result with respect to wage rates: Schwarze (1996) for example shows that by using the expected rather than actual wage rate the results turn significant. The latter is also confirmed in Brücker & Trübswetter (2004) focusing on the role of self-selection in East-West migration. In a continuation of Burda (1993), Burda et al. (1998) also indicates a significant, however non-linear influence of household income.

[4]When interpreting these findings one however has to bear in mind that the above cited studies exclusively use data until the mid/late-1990s, which in fact may bias the results w.r.t. to the wage component given the fast (politically driven) East-West wage convergence as one overriding trend in the overall pattern of East German macroeconomic development. In the second half of the 1990s wage convergence substantially lost pace, so that the estimated link may become less stable when extending the sample period beyond the mid-1990s.

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. In particular the VAR approach is well suited to analyse regional adjustment processes in reaction to exogenous (macroeconomic) shocks. A general discussion of labour market analysis with VAR models is for instance given in Summers (2000).

Up to the knowledge of the authors the only empirical application of a system approach of migration and labour market dynamics for German regions is given by Möller (1995). Using a VAR model for seven West German regions between 1960 and 1993 the author mainly finds the theoretically expected negative response of net in-migration to a unit shock in unemployment with a time-lag of about 2 to 3 years. The analysis of the impulse-response functions also shows that the unemployment shock on migration is likely to have a negative long-run impact on regional population levels, which in turn bring back the unemployment rate to its old steady state level. Contrary to the predictions of the neoclassical migration model Möller (1995) finds that migration is negatively affected by a regional wage rate increase. The author explains this latter result in terms of reduced factor demand for labour given the change in the relative price for capital and labour input, which then overcompensates the positive initial signal of a wage rate increase to the internal and external labour market force.

The feedback effects of labour market variables to migration shocks largely shows a negative mid- to long-run impact for wages, labour productivity and labour participation. Möller (1995) takes the VAR findings that shocks are on average only gradually absorbed with full adjustment being achieved in decades rather than years in support for the existence of regional hysteresis effects. Finding appropriate answers on the latter point has already inspired empirical research since the seminal contribution of Blanchard & Katz (1992): In a similar VAR setup for Finish regions Mäki-Arvela (2003) gets empirical results closely related to those obtained in Möller (1995). In his analysis Mäki-Arvela (2003) reveals that a positive employment shock may indeed have a significant (hysteretic) long-run effect on net-migration, especially in the absence of counteracting regional policies. Moreover, the author also finds similar long-run responses for income levels and the labour participation rate. With respect to the latter variable Mäki-Arvela (2003) finds that for Finish regions the change in the labour participation rate is the dominant adaption mechanism to shocks in employment, while migratory responses – contrary to the US as found in Blanchard & Katz (1992) – are less important. The latter result is also given in Decressin & Fatas (1995) for European wide data. However, updating on the latter study Lomo & Morgan (2004) find a more dominant role of the migration response to a labour demand shock for a panel of European regions, which has been estimated to be particularly present (both in the short and mid-run) for France and German data in an individual country regression setup.

3 Modelling Migration in a System of Regional Labour Market Dynamics and Economic Development

In this section we briefly describe the neoclassical migration model and integrate the specification into a stylized framework of labour market dynamics and regional evolutions in the spirit of the Blanchard & Katz (1992) approach. One important distinction from the latter is that we explicitly include a long-run migration equation in our model rather than capturing it residually.[5] Mainstream economic literature offers different theories trying to explain the reasons for people moving from one region to another, which can broadly be classified as either being micro or macro oriented (see Stillwell, 2005, and Etzo, 2008, for recent surveys). Within the latter category the neoclassical framework - modelling an individual's lifetime expected income (utility) maximization approach - clearly takes an outstanding role (see e.g. Maza & Villaverde, 2004). In the neoclassical approach the basic idea underlying the individual's decision making process with respect to migration is straightforward: Under rational behaviour a representative agent will decide to migrate if this action improves his welfare position relative to the status-quo of not moving. Relevant factors in the underlying decision making process are the expected income the agent would obtain for the case of staying in the home (origin) region (i) and the expected income obtained in the alternative (destination) region (j) net off '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 ($PROB_i$). The latter in turn is a function of unemployment rate in region i (UR_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 the alternative (destination) region. Taking also a set of economic (house prices, transfer payments etc.) and non-economic costs (such

[5]Blanchard & Katz (1992) set up a three equation model including employment minus unemployment changes, the employment to labour force ratio as well as the labour force to population ratio as endogenous variables. From the behaviour of these variables over time the authors are able compute the effect on the unemployment and the participation rate as well as the implied effect on net out–migration e.g. as response to a reduction in employment.

as region specific amenities) as well as costs 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

$$E_{ii} \leq E_{ij} - C_{ij}, \tag{1}$$

with $E_{ii} = f(PROB_i[UR_i, S_i], W_i)$ and $E_{ij} = f(PROB_j[UR_j, S_j], W_j)$. This shows that at the core of Harris-Todaro model the agent weighs the wage level in the home (origin) and target (destination) region with the individual probability of finding employment. We are then able to set up a model for the regional net migration (NM_{ij}) - defined as regional gross in–migration flows to i from j net of outflows from i to j - as

$$NM_{ij} = f(W_i, W_j, UR_i, UR_j, S_i, S_j, C_{ij}). \tag{2}$$

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.[6] 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 purposes we operationalize the set of additional variables (S_i, S_j) that may work as pull or push factors for regional migration flows in the following way: Given that migration flows have a long-run structural rather than just business cycle perspective one likely determinant of migration flows is real labour productivity growth. As Coulombe (2006) argues, the transmission channel from labour productivity to migration is closely linked to the convergence-concept of the (new) growth literature: Under the assumption of absolute convergence migration flows are assumed to react to different initial levels of labour productivity in two regions i and j. Gradually the gap between the two regions will be eliminated in the catching-up process and structural migration between i and j will decrease smoothly in a time horizon that however goes well beyond the business cycle horizon. Conditional convergence is necessarily associated with other structural differences captured in S_i and S_j so that the initial gap in labour productivities may not be fully closed, however the basic correlation between changes in labour productivity and net in–migration should hold as well until the regions have not

[6] 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.

fully converged to their respective long run steady state levels.[7]

From the macro viewpoint of the conditional convergence assumption of the new growth theory one key factor driving differences in the long run steady state labour productivity level is the regional endowment with human capital. Though in the context of migration research typically analysed from a microeconomic perspective, also from the macro view the link between migration and regional human capital may be of great importance – e.g. in analysing the causes and consequences for a regional 'brain drain' associated with a sharp decline in the regional skill composition due to net out-migration. From a micro view the link between the formal skill level of the prospect migrant and the actual migration decision is well documented, where recent contributions typically establish a positive correlation between individual qualification and mobility (see e.g. Borjas, 1987, for a theoretical discussion, Wolff (2006) as well as Bode & Zwing (2008) for an overview of empirical studies for Germany).[8] In operationalizing eq.(2) finally costs of moving from i to j (C_{ij}) apply: At the empirical level the latter may possibly be proxied by geographical distance between home and target region as it is typically done in the gravity model literature. In this logic transport cost rise with increasing distance between the origin and destination region. However, for estimation purposes such proxy variables often turn out insignificant given the huge potential of measurement errors (see e.g. Bode & Zwing, 1998, for a detailed discussion).[9]

At the empirical level typically a log-linear form of the stylized migration equation in eq.(2) is chosen, which may either include contemporaneous and/or lagged values for the explanatory and also endogenous variable. As suggested by Puhani (2001) the latter lag structure accounts for likely time delays in the transmission process of labour market signals to migration flows. The inclusion of lagged terms for the endogenous variable reflects different channels through which past flows may affect current migration such as communication links between migrants and friends and relatives left behind. The latter linkage in turn may influence prospective migrants who want to live in an area where they share cultural and social backgrounds with other residents (see Chun, 1996, for a detailed discussion). Finally, we restrict the explanatory variables to enter as inter–

[7]However, as McCann (2001) argues regional economic growth is a complex process and may for instance be strongly influenced by the location decision of firms, which in turn gives rise to potential regional scale effects e.g. via agglomeration forces. Such forces then may act as a pull factor for migration so that also a positive correlation between productivity growth and net in–migration could be in order rather than the expected negative one from the standard growth model.

[8]One pitfall at the empirical level is to find an appropriate proxy for the regional human capital endowment (see e.g. Dreger et al., 2008, as well as Ragnitz, 2007, for a special focus on East West differences). We therefore test different proxies in form of a composite indicator based on the regional human capital potential (high school and university graduates), the skill level of employee as well as innovative activities such as regional patent intensities.

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

regional differences yielding a triple–indexed model specification (ij, t), where ij denote the difference between region i and region j and t is the time index. Allowing for a general lag structure the migration equation may be written as:

$$\begin{aligned} nm_{ij,t} &= \gamma_{10} + \gamma_{11}(L)nm_{ij,t-1} + \gamma_{12}(L)\widetilde{wr}_{ij,t-1} + \gamma_{13}(L)\widetilde{ur}_{ij,t-1} \\ &+\gamma_{14}(L)\widetilde{ylr}_{ij,t-1} + \gamma_{15}(L)\tilde{q}_{ij,t-1} + \gamma_{16}(L)\widetilde{hc}_{ij,t-1} + e_{ij,t}, \end{aligned} \tag{3}$$

where $\tilde{x}_{ij,t}$ for any variable $x_{ij,t}$ is defined as $\tilde{x}_{ij,t} = (x_{i,t} - x_{j,t})$ and (L) is the lag operator. The error term $e_{ij,t} = \mu_{ij} + \nu_{ij,t}$ is assumed to have the typical one-way error component structure including time-fixed unobservable individual effects and a remainder error term. Next to the core labour market variables in terms of real wages $(\widetilde{wr})$ and unemployment rate $((\widetilde{ur})$ we include changes in real labour productivity (Δylr), the labour participation (q) rate and a human capital index (hc) as explicit control variables in S_{ij}.

Eq.(3) is frequently used in a partial equilibrium framework in order to estimate the elasticity of migratory movements w.r.t labour market and further (macro)economic variables. However, as Gallin (1999) points out, this type of analysis can be misleading because migration and labour market conditions are usually jointly determined. To do so, we set up a small-scale model for regional labour market and economic development, which closely follows the specification in Möller (1995). Centering around the neoclassical migration equation with regional differences in the unemployment and real wage rate as explanatory variables the author includes a set of behavioural equations derived from an eclectic model of regional evolutions first proposed by Blanchard & Katz (1992):[10]

$$\begin{aligned} \tilde{wr}_{ij,t} &= \gamma_{20} + \gamma_{21}(L)nm_{ij,t-1} + \gamma_{22}(L)\tilde{wr}_{ij,t-1} + \gamma_{23}(L)\widetilde{ur}_{ij,t-1} \\ &+\gamma_{24}(L)\Delta\widetilde{ylr}_{ij,t-1} + \gamma_{25}(L)\tilde{q}_{ij,t-1} + \gamma_{26}(L)\widetilde{hc}_{ij,t-1} + e_{ij,t}, \end{aligned} \tag{4}$$

$$\begin{aligned} \widetilde{ur}_{ij,t} &= \gamma_{30} + \gamma_{31}(L)nm_{ij,t-1} + \gamma_{32}(L)\tilde{wr}_{ij,t-1} + \gamma_{33}(L)\widetilde{ur}_{ij,t-1} \\ &+\gamma_{34}(L)\Delta\widetilde{ylr}_{ij,t-1} + \gamma_{35}(L)\tilde{q}_{ij,t-1} + \gamma_{36}(L)\widetilde{hc}_{ij,t-1} + e_{ij,t}, \end{aligned} \tag{5}$$

$$\begin{aligned} \Delta\widetilde{ylr}_{ij,t} &= \gamma_{40} + \gamma_{41}(L)nm_{ij,t-1} + \gamma_{42}(L)\tilde{wr}_{ij,t-1} + \gamma_{43}(L)\widetilde{ur}_{ij,t-1} \\ &+\gamma_{44}(L)\Delta\widetilde{ylr}_{ij,t-1} + \gamma_{45}(L)\tilde{q}_{ij,t-1} + \gamma_{46}(L)\widetilde{hc}_{ij,t-1} + e_{ij,t}, \end{aligned} \tag{6}$$

[10] The approach in Möller (1995) defines regional differences for region i relative to the rest of the country aggregate j.

$$\tilde{q}_{ij,t} = \gamma_{50} + \gamma_{51}(L) nm_{ij,t-1} + \gamma_{52}(L)\tilde{wr}_{ij,t-1} + \gamma_{53}(L)\widetilde{ur}_{ij,t-1} + \gamma_{54}(L)\Delta\widetilde{ylr}_{ij,t-1} + \gamma_{55}(L)\tilde{q}_{ij,t-1} + \gamma_{56}(L)\widetilde{hc}_{ij,t-1} + e_{ij,t}, \quad (7)$$

$$\widetilde{hc}_{ij,t} = \gamma_{60} + \gamma_{61}(L) nm_{ij,t-1} + \gamma_{62}(L)\tilde{wr}_{ij,t-1} + \gamma_{63}(L)\widetilde{ur}_{ij,t-1} + \gamma_{64}(L)\Delta\widetilde{ylr}_{ij,t-1} + \gamma_{65}(L)\tilde{q}_{ij,t-1} + \gamma_{66}(L)\widetilde{hc}_{ij,t-1} + e_{ij,t}, \quad (8)$$

There are different ways to put theoretically motived sign restrictions on the variable coefficients of the system in eq.(4) to eq.(8). In the following we will highlight some prominent interpretations for the case of the wage equation, however we will also show that labour economics and macroeconomics are far away from building on a consensus model even in key parameters, which thus advocates the use of a rather unrestrictive panel time series approach that lets the data decide about the coefficient sign/size.

The general specification of eq.(4) nests a set of standard wage equations, which put a special emphasis on the correlation of wages and unemployment: In his approach Möller (1995) assumes a negative relationship between the wage level and regional unemployment ($\gamma_{23} < 0$) in line with recent evidence on the German wage curve. However, taking up the argumentation from above, a Harris–Torado inspired line of argumentation would argue the other way around under the assumption that in a high regional unemployment environment the worker needs to be paid a higher wage to compensate the higher risk of being unemployed. Finally, $\gamma_{23} > 0$ would also be true for a Phillips curve specification of wages and unemployment (though the latter concept is originally related to wage changes rather than levels). A detailed discussion of conflicting views on the theoretical foundation of the wage equation is e.g. given in Blanchflower & Oswald (2005). Given that wages and unemployment are typically simultaneously determined, a likewise controversy discussion centers around the theoretically expected correlation between unemployment on wages in eq.(5).

In modelling labour productivity growth ($\Delta\widetilde{ylr}_{i,t}$) Möller (1995) proposes to build upon a neoclassical production function with two factor inputs (capital and labour) with a special reference to location attractiveness: Thus, labour productivity growth in eq.(6) should be negatively correlated with the wage rate ($\gamma_{42} < 0$) since higher wages lower location attractiveness. The coefficient signs of the further variables is a–priori not that clear. Eq.(7) relates the evolution of the regional labour participation rate (defined as $q_{it} = [emp_{i,t} - pop_{i,t}]$, where emp is total employment and pop denotes population) mainly to regional differences in the wage and unemployment rate.[11] If we assume that substitution effects typically outweigh the income effect in the labour supply decision, relative wage rate increase in region i should positively affect the regional participation rate ($\gamma_{52} > 0$) , while an increase in the unemployment rate should yield the opposite effect ($\gamma_{53} < 0$). Labour participation thereby may be seen as an alternative labour market adjustment mechanism compared to the migration channel as e.g. reported in Decressin & Fatas (1995) and Mäki-Arvela (2003).

Eq.(8) finally extends the system by an equation for the regional human capital endowment. This allows to properly account for the causes and consequences of migration induced changes in the regional skill–level of the work force.[12] Eq.(8) can thus be interpreted in terms of a stylized factor demand equation for human capital as explicit argument in the production function (see e.g. Gort & Lee, 2001, for a related microfounded modelling approach as well as Beine et al., 2005, for an explicit inclusion of migration flows in a human capital convergence equation).

As sketched above, the analysis of the interplay of human capital, migration and labour market variables at the macro regional level has important policy implications. Questions that frequently arise under the headings of regional 'brain drain' are: Does structural net out–migration lead to a loss in the regional human capital stock or is it skill neutral? As Schneider (2005) shows, the recently observed trend of significant net out–migration of highly qualified workers may indeed be seen as a severe threat to the East German labour market and economic development. In analysing likely determinants that attract human capital Arntz (2006) finds for German micro data that regional income differences strongly influence the regional skill composition with high–skilled job movers being much more responsive to an interregional variation in the wage level than their less–skilled counterparts. Beside regional wage rate differentials (as well as changes in the wage dispersion) we would expect from a (new growth) theory perspective that human capital level is positively correlated with regional productivity and vice versa. However, it will remain the empirical task to analyse whether the response of migration to regional human capital differences is equilibrating or disequilibrating in nature after controlling for the above identified factors and to work out the direct and indirect effects.

To sum up, the above analysis has already shown that the analysis of migration and labour market dynamics is a complex issue, which can hardly be addressed within one

[11] One has to note that q in the definition typically used in Blanchard-Katz type analysis also captures demographic and – at the regional level – also commuting effects.

[12] Oppenländer (1995) was among the first to propose such an extension to the standard neoclassical growth framework of Möeller (1995) e.g. in order carefully explain the persistent regional labour market differences in East and West Germany resulting from a much slower than initially expected income and labour productivity convergence.

single theoretical context. Our empirical strategy deliberately rests on an eclectic model to select theoretical motivated variables and thereafter uses a flexible VAR approach for estimation. This strategy relaxes (arbitrary) theoretical restrictions put on right hand side variables and lets the data determine whether migration has equilibration or disequilibrating effects on the labour market and whether a 'Wage' or 'Phillips' curve may be in order for our German case study. We will give a discussion of the specification and estimations issues of the Panel VAR (PVAR) approach in the following. However, before that we first briefly describe the data base used for estimation and discuss the time series properties of the variables in the next section. The latter in fact may have important implications for the selection of appropriate estimation techniques in the context of dynamic panel data models.

4 Data and Stylized Facts of Intra-German Migration Patterns

For empirical estimation we use data for the 16 German states between 1991 and 2006. We model migration based on inter-regional flow data (with a total of 3840 observations) rather than aggregating state level net migration relative to the rest of the country (that is, summed over all regions minus region i). The former strategy gives us more degrees of freedom for estimation and avoids an artificial 'averaging' of migration flows. All economic variables are denoted in real terms. A full description of the data sources is given in table 1. Since we are dealing with macroeconomic time series the (non)-stationarity of the data and thus spurious regression may be an issue. We therefore perform unit panel root tests for the variables in levels using the approach proposed by Im-Pesaran-Shin (1997). 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.

We report results for variables in levels as well as regional differences in table 2. In all cases the IPS test rejects the null hypothesis of non-stationarity. These results are broadly in line with our theoretical expectations concerning the order of integration of the variables: Migration and labour market variables (unemployment rate, labour participation rate etc.) are typically assumed to be stationary processes, the same accounts for growth in labour productivity, which implies an I(1) process for the variable in levels. Human capital is likewise expect to change only gradually over time. These results give us a high level of flexibility in terms of employing different dynamic panel data (DPD) estimators both in levels and first differences as typically proposed in the recent literature.

<< Table 1 and Table 2 about here >>

Looking at selected stylized facts – in particular the evolution of East–West migration flows since re-unification – figure 1 plots state level net in-migration rates between 1991 and 2006. Additionally, figure 2 reports aggregated migration flows for the two East-West macro regions, which allows to identify distinct waves in macro regional migration over time.[13] As figure 1 shows, West German states benefit on average from the net out-migration trend of Eastern states. The only strongly negative outlier among the West German states is Lower Saxony, however the latter trend is largely exogenously driven by German resettlers from abroad.[14] In the empirical estimation we will explicitly control for the latter exogenously 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 its geographical proximity to Berlin. The time series pattern of other East German states is persistently negative over the whole sample period. If we aggregate the inter-regional state level flows to gross and net out–migration among the two macro regions West and East (incl. Berlin), figure 2 allows to identify the two waves of East-West net outflows with peaks in the early 1990s and around 2001. Compared to this West to East migratory flows have been rather stable (and much lower) over time.

Finally, figure 3 presents selected key labour market and macroeconomic indicators at the state level. With respect to wages the figures shows the initially strong gap between the East–West macro regions (except Berlin), 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. A similar convergence pattern could also be observed for the case of labour productivity. With respect to regional unemployment rates figure 3 shows that the Eastern states are on average far above the West German level (except for Bremen) together with a considerable degree of heterogeneity both among the West and East German subgroups.

We also account for 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. Since differences in regional

[13] East Germany including Berlin.

[14] The explanation is that these resettlers are legally obliged to first move to the central base 'Friesland' in Lower Saxony and then only subsequently can freely migrate to other states within Germany.

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 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). While the labour participation rate in the East German states is much below the Western average, the (formal) human capital endowment – except for patent distribution – is spread rather equally among the East and Western states.

<< Figure 1 to Figure 3 about here >>

5 Dynamic Panel Data Estimators in a VAR Framework

The Panel VAR (PVAR) technique combines the traditional VAR approach treating all variables of the system as endogenous with estimation techniques for panel data and was first employed by Holtz-Eakin et al. (1988).[15] While the use of VAR models in time series analysis is a common standard, the use in a panel data context is less common. However, a recent comparison of different PVAR estimators together with a Monte Carlo simulation experiments for standard small T, large N data 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 economic shocks. Throughout the analysis we restrict our estimation approach to a first-order PVAR(1) written in matrix form as:[16]

$$z_{i,t} = \Gamma_0 + \Gamma_1 z_{i,t-1} + e_{i,t} \tag{9}$$

where $z_{i,t}$ is an $m \times 1$ vector in our case $z_{i,t} = [nm_{ij,t}, \widetilde{wr}_{ij,t}, \widetilde{ur}_{ij,t}, \Delta\widetilde{ylr}_{ij,t}, \tilde{q}_{ij,t}, \widetilde{hc}_{ij,t}]$, 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 a univariate dynamic panel data model. To look more carefully at the recently proposed DPD estimators, we may write the m-th equation of our M–equation system as:

[15] For a recent textbook treatment see e.g. Arellano (2003).

[16] As Binder et al. (2005) note, higher-order models can be treated in conceptually the same manner as the first-order representation. For ease of presentation we denote the cross section dimension by i rather than ij.

$$y_{i,t} = \alpha_0 + \alpha_1 y_{i,t-1} + \beta_1' X_{i,t-1} + u_{i,t}, \quad \text{with:} \quad u_{i,t} = \mu_i + \nu_{i,t}, \tag{10}$$

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.

There are numerous contributions in the recent literature for a dynamic single equation model of the above type, which especially deal with the problem introduced by the inclusion of the lagged dependent variable on the right hand side of the estimation equation and its built-in correlation with the combined error term: 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.(10) is correlated with the error term. A widely applied approach to deal with this kind of endogeneity typically starts from first differencing eq.(10) to get rid of μ_i and then estimates the model by instrumental variable (IV) techniques:

$$(y_{it} - y_{i,t-1}) = \alpha_1 (y_{i,t-1} - y_{i,t-2}) + \beta_1 (X_{i,t-1} - X_{i,t-2}) + (u_{it} - u_{i,t-1}), \tag{11}$$

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 IVs which are uncorrelated with the error term. If we assume that the vector of exogenous variables X_{it} is strictly exogenous, one first option is derive a set of valid instruments using valid orthogonality conditions for X_{it-1} – either in levels or first differences (see e.g. Harris et al., 2008) – as:

$$E(X_{i,t} \Delta u_{i,t}) = 0 \quad \text{and/or} \quad E(\Delta X_{i,t} \Delta u_{i,t}) = 0, \tag{12}$$

Anderson & Hsiao (1981) were among the first to propose an estimator for the transformed 1.diff. model in eq.(11) that additionally employs valid instruments based on the past values of the lagged endogenous variable either in levels $y_{i,t-2}$ or lagged differences $(y_{i,t-2} - y_{i,t-3})$, which are correlated with the instrumented variable but not with the error term.[17] The underlying orthogonality conditions for this approach can be stated as:

[17] 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.

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

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.(11) have been proposed in the literature: Trying to improve the small sample behaviour of the AH estimator Sevestre & Trognon (1995) propose a more efficient first difference estimator which is based on a GLS transformation of eq.(11).[18] 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:[19]

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

Eq.(14) is also called the 'standard moment condition' and is widely used in empirical estimation. The resulting instrument matrix for past values of the endogenous variable can then be written as:

$$Z_i^{\Delta,(y)} = \begin{pmatrix} y_{i0} & 0 & \ldots & \ldots & 0 & \ldots & 0 \\ 0 & y_{i0} & y_{i1} & 0 & 0 & \ldots & 0 \\ 0 & \ldots & & \vdots & \vdots & \ldots & 0 \\ 0 & \ldots & 0 & 0 & y_{i0} & \ldots & y_{iT-2} \end{pmatrix} \tag{15}$$

and analogously for the set of strictly exogenous explanatory variables (X_{it-1}):

$$Z_i^{\Delta,(x)} = \begin{pmatrix} x'_{i0} & \ldots & x'_{iT-1} & 0 & \ldots & \ldots & 0 & \ldots & 0 \\ 0 & \ldots & 0 & x'_{i0} & \ldots & x'_{iT} & 0 & \ldots & 0 \\ 0 & \ldots & & & \ldots & 0 & \ldots & & 0 \\ 0 & \ldots & \ldots & & \ldots & 0 & x'_{i0} & \ldots & x'_{iT-1} \end{pmatrix} \tag{16}$$

and the full IV set for the 1.diff. transformed model (Z_i^{Δ}) is given by

$$Z_i^{\Delta} = (Z_i^{\Delta,(y)}, Z_i^{\Delta,(X)}) \tag{17}$$

One general drawback of dynamic model estimators in 1.diff. is their on average weak empirical performance: As Bond et al. (2001) argue, IV/GMM estimators in first diffe-

[18] 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.

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

rences 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 DPD 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:[20].

$$E(\Delta y_{i,t-1}u_{i,t}) = 0 \quad \text{for t=3,...,T.} \tag{18}$$

Rather than using lagged levels of variables for equations in first difference as in the 1.diff. estimators, we get an orthogonality condition for the model in level that uses instruments in first differences. Eq. (18) is also called the 'stationarity moment condition'.[21] Blundell & Bond (1998) propose a GMM estimator that uses jointly both the standard and stationarity moment conditions. This latter approach is typically known as 'system' GMM (SYSGMM) combining 'level' and 'difference' GMM. Though labeled '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 as:

$$\begin{pmatrix} \Delta y \\ y \end{pmatrix} = \alpha \begin{pmatrix} \Delta y_{-1} \\ y_{-1} \end{pmatrix} + \beta \begin{pmatrix} \Delta X_{-1} \\ X_{-1} \end{pmatrix} + \begin{pmatrix} \Delta u \\ u \end{pmatrix} \tag{19}$$

and the overall instrument set in the case of system GMM is $Z_i = (Z_i^{\Delta}, Z_i^{L})$, where the latter is instrument set for the equation in levels based on valid orthogonality conditions for $y_{i,t-1}$ and $X_{i,t-1}$. For the empirical estimation of our PVAR model we employ multiple-equation GMM (as e.g. outlined in Hayashi, 2000), which basically involves stacking our migration and labour market model in the typical system way (3SLS or SUR) and apply IV estimation using the SYS-GMM estimation strategy. The resulting IV set Z_i^S for a system of m equations (with $m = 1, \ldots, M$) is a combination of the individual equations' IV sets, where we allow the instruments to differ among the equations of the system as

$$Z_i^S = \begin{bmatrix} Z_{i1} & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & Z_{iM} \end{bmatrix} \tag{20}$$

[20]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)

[21]That is because for eq.(18) to hold 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 $E(w_{i,1}\nu_{i,t}) = 0$.

Stacking the equations for multiple-equation GMM estimation may lead to further efficiency gains if the residuals of the M-equations are correlated. We therefore apply a two-step approach which explicitly accounts for cross-equation residual correlation. The weighting matrix V^S in 2–step efficient GMM estimation is defined as:

$$V^S = N^{-1} \sum_{i=1}^{N} Z_i^{S\prime} \hat{e}_i \hat{e}_i' Z_i^S \tag{21}$$

and the vector of 1.step error terms $\hat{e}_i = (\hat{e}_{i1}, \ldots, \hat{e}_{iM})'$ is derived from a consistent (equation by equation) 2SLS estimation. The system GMM estimator in the context of the PVAR(1) can then be written as:

$$\hat{\Phi}_{GMM} = \left(S_{ZX}' (V^S)^{-1} S_{ZX} \right)^{-1} S_{ZX}' (V^S)^{-1} S_{Zy}, \tag{22}$$

with

$$S_{ZX} = \begin{bmatrix} \frac{1}{N}\sum_{i=1}^{N} z_{i1}' x_{i1} & & \\ & \ddots & \\ & & \frac{1}{N}\sum_{i=1}^{N} z_{iM}' x_{iM} \end{bmatrix} \text{ and } S_{Zy} = \begin{bmatrix} \frac{1}{N}\sum_{i=1}^{N} Z_{i1}' y_{i1} \\ \vdots \\ \frac{1}{N}\sum_{i=1}^{N} Z_{iM}' y_{im} \end{bmatrix}. \tag{23}$$

6 Empirical Results

In this section we present the empirical results of the PVAR(1) model. We first look at the estimation output and post estimation tests and then analyse the dynamic adjustment processes in terms of impulse response functions. One major concern in our modelling approach is to carefully check for the consistency and efficiency of the chosen estimation approach. Since the system GMM approach relies on IV estimation we basically guide instrument selection based on the Sargan (1958) / Hansen (1982) overidentification test. Especially in a multiple equation context appropriate IV selection is of vital importance since the full IV candidate set may become large.One has to note that the power of the Hansen J-Statistic shrinks with increasing instrument number (see e.g. Bowsher, 2002, and Roodman, 2007). The standard Sargan statistic is however robust to this problem. We thus use a procedure to reduce the number of orthogonality conditions employed for estimation – both by using 'collapsed' IV sets as well as by sorting out correlated variables with the help of the C-Statistic (or 'Diff-in-Sargan/Hansen') as numerical difference of two overidentification tests isolating IVs under suspicion (see Eichenbaum et al., 1988, for details). Additionally, we check the likely efficiency gains of the system SYS-GMM estimation approach in terms of testing for cross-equation correlations for the 1.step residuals.

The estimation results for the PVAR(1) model based on the efficient two-step system SYS-GMM approach are reported in table 3, the IV downward testing approach using the long-run migration equation as an example is shown in table 4. In the first column of the table we apply the full set of available instruments according to eq.(14) and eq.(18). Among lagged net migration ($nm_{ij,t-1}$) as right hand side regressor we include regional differences in real wages ($\widetilde{wr}_{ij,t-1}$), unemployment rates ($\widetilde{ur}_{ij,t-1}$), labour productivity growth ($(\widetilde{\Delta ylr})_{ij,t-1}$), labour participation ($\tilde{q}_{ij,t-1}$) and human capital ($\widetilde{hc}_{ij,t-1}$). We also control for the distortion in the migration pattern for Lower Saxony due to German resettlers by the inclusion of a dummy variable (D_{NIE}).

The estimation results for the migration equation show that the core labour market variables (both real wage and unemployment differentials as well as labour productivity growth) turn out statistically significant and of expected signs. Only the participation rate turns out to be statistically insignificant. The negative coefficient for human capital may be explained by the equilibrating effect of regional differences in human capital endowment on migration flows after controlling for the other explanatory labour market factors. However, this latter partial equilibrium view may not reflect the full direct and indirect effect of regional human capital differences on migratory movements, which has to be analysed through impulse-response functions (e.g. in order to capture the likely link between human capital and productivity growth, which in turn may translate into a positive migration response due to a shock in regional human capital differences). Finally, as expected from above the dummy for Lower Saxony (D_{NIE}) turns out to be negative and statistically highly significant.

If we turn to the postestimation tests we see that the Sargan (1958) and Hansen (1958) overidentification tests yield clearly contrasting testing results: While the Hansen J-Statistic does not reject the null hypothesis of the joint validity of the included IV set, the Sargan statistic casts serious doubts on the consistency of the latter. As discussed above, the reason for the divergence in the testing results is the huge number of instruments employed for estimation (a total of 459), which lowers the power of the J-Statistic. The huge number of potentially available instruments in the SYS-GMM approach is due to the exponential growth of IV selection with growing time horizon T according to the standard moment condition in eq. 14. As Roodman (2007) points out numerous instruments can over fit the instrumented variables, failing to expunge their endogenous components and biasing coefficient estimates towards those from uninstrumented estimators. In a series of Monte Carlo simulations Bowsher (2002) shows that the J-Statistic based on the full instrument set essentially never rejects the null when T becomes too large for a given value of N. The author proposes to reduce the number of lag length l employed for estimation in order to improve the size properties of the test.

Alternatively, Roodman (2007) argues in favour of using 'collapsed' instruments, which has the potential advantage of retaining more information since no lags are dropped as instruments. This strategy is equivalent to imposing certain coefficient homogeneity assumptions on the IV set and thus makes the instrument count linear in T. The author further shows that for cases where the 'no conditional heteroscedasticity' (NCH) assumption holds, the simple Sargan (1958) statistic may be used as an appropriate indicator to check for IV consistency, which does not suffer does not suffer from the above problem since it does not depend on an estimate of the optimal weighting matrix in the two-step GMM approach. In column 2 of table 4 we therefore employ the collapsed IV set, which reduces the number of instruments to 90.

For this specification the Hansen J-statistic now clearly rejects the null of joint validity of the IV set and is thus in line with the Sargan (1958) statistic. This result underlines the point raised by Bowsher (2002) and Roodman (2007) that the J-Statistic has no power with increasing number of instruments, while the Sargan test still has. Finally, based on the collapsed IV set we further reduce the number of instruments using a C-statistic based algorithm, which is able to subsequently identify those IV subsets with the highest test results (see Mitze, 2009, for details). This gives us a model with a total of 20 instruments, which passes both the Sargan and Hansen J-Stat. criteria as reported in table 4. The regression results show that the estimated parameter coefficients are qualitatively in line with the full IV set specification in column 1. Moreover, the downward tested model also shows to have the smallest RMSE and does not show any sign of heteroscedasticity in the residuals.[22]

We apply the same estimation strategy for the whole PVAR(1) system. Table 3 reports the robust Sargan statistic, since we still include a total amount of 222 instruments (which is nevertheless by large reduced compared to a maximum 2382 in the full IV case). Our proposed IV set passes the test statistic for reasonable confidence levels. Moreover, we compute a Breusch–Pagan LM test for the significance of cross–effects in the first step residuals (χ^2_{CE}) as suggested in Dufour & Kalaf (2001) in order to check for the likely efficiency gains in applying a full information approach. The Breusch–Pagan type test clearly rejects the null hypothesis of independence among the residuals of our 6-equation system. Finally, in order to compare the appropriateness of our chosen efficient two-step approach relative to a limited information 2SLS benchmark, we employ the Hausman

[22] For the latter we use the proposal in Wooldridge (2002) and run a regression of the squared residuals on the squared fitted values.

(1978) m-statistic:[23] The results do not reject the null of consistency and efficiency of our two-step approach compared to the one-step specification.

If we take a (preliminary) look at the estimated variable coefficients in the remaining equations in the PVAR(1) model, table 3 shows that lagged migration has a significantly negative direct effect on the wage rate, while the impact on the participation rate and the human capital index is positive. These results already hint at the important role of instantaneous causality among the variables and support our theoretical a-priori expectations that migration has an equilibrating effect on regional labour markets in line with the neoclassical model: That is, an increased level of net in-migration in region i lowers the regional wage rate differential (the wage in region i decreases relative to j) and thus works towards a cross-regional wage equalization as outlined above. Our empirical results also give a first empirical indication for the existence of a wage curve a la Blanchflower & Oswald (1994, 2005) since in the wage equation the unemployment rate has a negative coefficient sign.

As expected from the above theoretical discussion labour productivity growth has a positive impact on the wage rate, while in the equation for labour productivity the wage rate itself has the expected negative effect, indicating that higher wages reduces location attractiveness. In the equation for the labour participation rate real wage and unemployment rate differentials have the a-priori 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 mirrors earlier micro results finding a positive impact of wage rates and labour productivity on regional human capital endowments, while higher unemployment rates are negatively correlated with the regional human capital endowment. Finally, net in–migration is estimated to have a positive effect on the relative regional distribution of human capital. Whether this latter effect may hint at the possible role of regional 'brain drain' effects will be analysed through the help of impulse-response functions.

<< Table 3 and Table 4 about here >>

In order to assess the full (direct and indirect) two-way effects among migration and the labour market variables we compute impulse-response functions of the PVAR. The latter tool describes the reaction of one variable to innovations in another variable of the system while holding all other shocks equal to zero. Since the actual variance-covariance matrix of

[23] By construction, if the variance of the limited information approach is larger than its full information counterpart, the test statistic will be negative. Though the original test is typically not defined for negative values, here we follow Schreiber (2007) and take the absolute value of the m-statistics as indicator.

the model is not diagonal, we first orthogonalize the residuals starting from their moving average presentation in order to isolate the shocks, while the (orthogonalized) approach is still able to account for the correlation of shocks among variables (for details see Lütkepohl, 2005, and Love & Zicchino, 2006). To do so, the orthogonalization of the residuals needs a particular causal variable ordering, which is sometimes referred to as Wold–causality. One important implication of this ordering is that variables appearing earlier in the system are more exogenous and the ones that appear later are more endogenous since the ordering affects the following variables contemporaneously, as well as with a lag, while the variables that come later only affect the previous variables with a lag. To minimize the degree of subjectivity in this modelling step we tried out different ways of ordering, though the results on average seem to be rather insensitive with respect to the chosen ordering.

Figure 4 to figure 5 plot selected impulse-response functions together with 5% errors bands generated through Monte Carlo simulations with 500 repetitions.[24] We choose the following ordering $[\widetilde{hc}_{ij,t} \rightarrow \widetilde{q}_{ij,t} \rightarrow \widetilde{ylr}_{ij,t} \rightarrow \widetilde{wr}_{ij,t} \rightarrow \widetilde{ur}_{ij,t} \rightarrow \widetilde{nm}_{ij,t}]$, which is based on the assumption that migration and the core labour market variables are more endogenous compared productivity growth, labour participation (due to its demographic component) and human capital endowment.[25] Additionally, table 5 reports variance decompositions derived from the orthogonalised impulse response coefficient matrices. The variance decompositions display 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 MSE forecast error variance for each variable is explained by innovations to each explanatory variable (we report s until 20).

<< Figure 4 to Figure 5 about here; Table 5 about here >>

Figure 4 shows the responses of migration to a unit shock in the remaining variables of the PVAR (rescaled in terms of shocks of one standard deviation). As the figure shows the unemployment shock turns out to be negative with most of the migration response being absorbed after six years (similar results for West German are obtained in Möller, 1995). The response to a shock in the regional wage rate differential has the expected positive dynamics and fades out even more rapidly. The migration responses to labour productivity and human capital shocks turn out to be positive and show a higher degree

[24] A full graphical presentation of the system's impulse-response functions are given in the appendix. The Monte Carlo simulations randomly generate a draw of coefficients Γ in eq.(9) using the estimated coefficients and their variance-covariance matrix and re-calculate the impulse-resonses. This procedure is repeatd 500 times to generate 5th and 95th percentiles of this distribution, which are then used as a confidence interval for each element of impulse-response.

[25] Impulse-response functions for a reversed ordering are also reported in the appendix. The results are much in line with our orginial variable choice.

of persistence. Especially for human capital the overall effect in the system context is thus different from the partial equilibrium view. Though the direct effect of regional human capital differences on net in-migration gave some indication for an equilibrating effect after controlling for key labour market factors, the overall effect obtained from the impulse-response functions shows that a relatively better skill composition in region i acts as a pull factor for additional net in-migration reflecting disequilibrating or agglomeration forces associated with scale effects (e.g. in the educational system). The link from human capital to enhanced in-migration is especially expected to work through the productivity growth channel of human capital, which has been tested highly significant in the PVAR(1) estimation results. The negative migration response to a positive shock in the labour participation rate may hint at the role of regional labour market tightness, which reduces net in-migration.

This general picture is also supported by plotting the forecast error variance decompositions in table 5. In the short run, a shock in the unemployment rate has the biggest effect on net in–migration (with a maximum after 3 periods). In the long run, most of the error variance in net in–migration is accounted for by shocks in labour productivity growth and human capital. If we look at the impulse-response functions of the remaining variables of he system subject to a unit shock in net in-migration, we get a similar picture: For both unemployment and real wage rate figure 5 shows the equilibrating effect of a positive shock in the in–migration to regional labour market differences in terms of an increase in the unemployment rate, while it reduces regional wage rate differentials (though smaller in magnitude). Both effects fade out after about 6 to 7 years. Responses of labour productivity and labour participation w.r.t. migration are positive but rather marginal, while the impact on human capital shows indeed some indication for regional 'brain drain' effects given that net out-migration negatively affects the regional skill composition (and vice versa).

The impulse responses and the computation of forecast error variance decompositions give the general impression that most adjustment processes in the PVAR system fade out within one decade. Only migration responses to shocks in labour productivity growth and human capital endowment indicate persistent effects. Moreover, beside those effects involving migration either as source or destination of shocks, the PVAR system allows further helpful insights in the better understand regional labour market and macroeconomic dynamics in the case of Germany. A full graphical description of the impulse-response functions is given in figure A.1. If we look for example at the response of real wages and human capital endowment to a shock in regional unemployment, we see the following reaction: In both cases the impulse-response functions show a significantly negative adjustment path, which only fades out after about one decade. In terms of the wage determination this adjustment process is consistent with the existence of a wage curve for German data linking low real wages and high regional unemployment rates (as already discussed above). Likewise a shock in the unemployment rate leads to deterioration of the regional human capital endowment, which supports the view of regional 'brain drain' effects as a reaction to regional labour market differences operating through the above identified migration channel.

Given the overall satisfactory model reactions of our PVAR(1), we will finally apply the model to the challenging question in how far our small scale system is able to track the distinct East-West net out-migration trend since re-unification and to explain the East German "empirical puzzle".

7 East-West migration and the labour market: Still an "empirical puzzle"?

We have already seen from the stylised facts that East-West net out-migration made up a large part of overall German internal migration flows. Moreover, we did not oberserve a steadily stream of migratory movements but rather two distinct waves waves. The first one directly started after opening out the intra-German border and thereafter declined until 1997. The late 1990s then have witnessed a second wave of East-West net out–migration with a distinct peak in 2001. It thus may be a challenging task to carefully check, whether the specific path of East–West migration can be explained within the above specified neoclassical migration model embedded in the PVAR(1). We are thereby especially interested in answering the following question: Can we explain these distinct ups and downs in East-West net migration on grounds of regional disparities in labour market variables? Or are they due to other unobserved and possibly non-economic factors, which are present in the two macro regions?

The question of East-West migration is also of special interests since earlier findings in Alecke & Untiedt (2000) gave rise to such a German "empirical puzzle" in line with similar 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 labour market disparities.[26] To find an appropriate answer to this puzzle of insufficient migration to equilibrate regional

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

labour market disparities is of special importance for determining the role of migratory movement in the process of regional economic development and income convergence. A first check for the empirical performance of our PVAR(1) model in the light of East-West migration is thus to compare the actual and (in-sample) predicted net migration flows for the involved state pairs.

In figure 6 we report the results for two selected state pairs including the East German regions Mecklenburg-Vorpommern and Saxony and their interaction with the two Western counterparts Baden-Württemberg and North Rhine-Westphalia. Detailed graphical plots for all East–West pairs are additionally given in the appendix. As the results in figure 6 and the appendix show, on average there is a rather high concordance of actual and fitted values over time for most bilateral pairs indicating that the estimated elasticities for the total German sample in conjunction with the temporal variation in the explanatory variables are able to explain the distinct trends in the East-West migration since 1994. However, though we see that the model is generally well equipped to predict changes in migratory movements for a variety of state pairs we observe a gap in the level of actual and predicted net migration flows over time, which may require a closer examination beyond the labour market signals.

In the exemplary case of net flows from Mecklenburg-Vorpommern and Saxony relative to Baden-Württemberg and North Rhine-Westphalia we get the following picture: In the first part of the in-sample period until 1997 we gather from figure 6 that the structural labour market model overfits observed net migration, that is, actual net outflows out of the two East German states are much smaller than their predicted values. This result is in line with earlier evidence given in Alecke & Untiedt (2000) as well as Fachin (2007) for the Italian case. However, during the second wave of East-West migration with its peak around 2001 this relationship is reversed resulting higher actual net outflows than predicted values based on the included structural labour market parameters. Towards the sample end actual and fitted values are again more closely in line, indicating that labour market signals now properly translate into migratory flows between East and West Germany.

In solving this implied "empirical puzzle" one prominently advocated line of argumentation in the field of regional science speaks in favour of fixed regional amenities to explain persistent labour market differences even in the long-term equilibrium. Thereby regional amenities are typically defined as a proxy variable for (unobserved) specific climatic, ecological or social conditions in a certain region. According to the amenity approach regional differences in labour market signals then only exhibit an effect on migration after a critical threshold has been passed. Since in empirical terms it is often hard to operationalize amenity relevant factors, Greenwood et al. (1991) propose to test the latter effect by the inclusion (macro-)regional dummy variables in the empirical model. For the long run net migration equation amenity-rich regions then should have dummy coefficients greater than zero (and vice versa), indicating that amenity-rich regions exhibit higher than average in–migration rates as we would expected after controlling for regional labour market and macroeconomic differences.

To test the above hypothesis we thus augment the PVAR(1) by a dummy variable (per equation) capturing inter-regional migration flows for the East German macro region. We also specify a similar dummy variable for East-West border regions. In order to analyse the time evolution of these dummies we use a recursive estimation strategy in the following way:

$$Dummy_{[East;Border]} = \begin{cases} 1 \text{ for } 1991 - s, \text{ with } s = 1997, \ldots, 2006 \\ 0 \text{ otherwise.} \end{cases} \tag{24}$$

Detailed estimation results for the PVAR with $s = 1997$ and $s = 2006$ are given in the appendix. The results generally show that the inclusion of the dummy variables does not affect the coefficients of the structural variables in the system. The results for the migration equation also indicate that the East-Dummy turns out to be insignificant for the whole sample with $s = 2006$. However, in line with Alecke & Untiedt (2000) the dummy variable for $s = 1997$ shows a positive and statistically significant coefficient sign. Similar results are found for the Border-dummy. For the recursive estimation experiment we plot the time evolution of two dummy coefficients together with their respective t-values and the 10% critical t-value: For the East-dummy in figure 7 we see that the coefficient turns out to be statistically significant and positive only up to 1997, while it becomes insignificant or even turns significantly negative for subsequent periods. The latter finding coincides with the peak of the second huge wave of East-West net out–migration around 2001. The coefficient of the border dummy remains positive for the whole sample period, but is found to be statistically significant only between 1997–1999 and again in 2005 (see figure 8).

<< Figure 7 and figure 8 about here >>

When interpreting these results it does not seem reasonable to take a positive dummy variable in favor of any kind of climatic or similar ecological regional fixed amenities for the East German states that keep people living there (which actually may only sound reasonable for the case of Hawaii but not for Bitterfeld). A further substantial critique to the amenities interpretation of the dummy variable approach is that the latter can only be interpreted as amenities under the premise that the influence of other latent variables on regional net migration indicate a negligible variable order. However, this is more than doubtful with respect to the Eastern states if we for example consider the determinants of individual migration decisions (as worked out in the field of microeconomic migration theories) including the age structure of the work force potential, the relative wage structure, network effects, or the option value of waiting. Moreover, the analysis has only implicitly (via the labour participation rate) tackled the issue of particular high commuter flows between East and West, which may be seen as a substitute to the migration decision and give a reasonable explanation for the positive dummy variable coefficient of the Eastern border regions.

Finally and maybe most important from an aggregate East German perspective, politically induced distortions to the East German labour market and general economy may be seen as an impediment to sufficient high migration rates as balancing factor for regional labour market disparities until the mid-1990s. The latter comprises 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 (see e.g. Bradley et al., 2006), which kept people away from leaving the Eastern states. Only recently these transfers have been reduced in volume and now gradually fade out (e.g. the Solidarity Pact II), which in turn may explain the second wave of East German net out–migration and the estimated negative dummy variable coefficient for that period. In this interpretation the negative dummy variable hints at a "repressed" migration potential in East Germany as for that period, which only cancels out in the end of the sample period along with a gradual fading out of labour market and macroeconomic distortions.

Also for the remaining equations of the PVAR(1) the two dummies variables gives some interesting results with respect to East-West labour market and macroeconomic disparities:[27] With respect to the unemployment rate the East-dummy shows the expected negative level effect between the Eastern and Western region even after controlling for key labour market factors and also seems to worsen over time given the strong increase in the coefficient of the dummy variable coefficient. For East-German border regions this negative effect seems to be less present. Another key fact is that growth in labour productivity does not show significant differences for the two macro-regions during the sample period 1994 to 2006 (after controlling for labour market differences). This results mirrors recent findings reported in Smolny & Stiegler (2004) finding that productivity adjustment in the East German states was fast in the early years after 1991, but also that the equilibrium gap to the Western average is large (the authors calculate a gap of about 35 %, which

[27] See table A.1 and A.1 for $s = 1997$ and $s = 2006$. Further results from the recursive estimation strategy can be obtained from the authors upon request.

explains the significant reduction in the convergence speed of the East German states starting from the second half of the 1990s). Similar results were also obtained for the wage rate, for which we get insignificant dummy variable coefficients in the PVAR(1). Finally, for both Border regions and the East Germany as a whole, the human capital equation shows that the region has subsequently lost its initial advantage in human capital endowment. This latter trend is typically associated with the above identified 'brain drain' effect for East Germany (see also Schneider, 2005). Summing up, these first results call for further in-depths studies on the long-run structural differences in key labour market and economic indicators for the two East-West macro-regions almost twenty years after re-unification.

8 Conclusion

In this paper we have analysed the linkages between regional disparities in labour market variables and interregional migration flows among German states since re–unification. Building upon recent methodological advances in the analysis of (dynamic) panel data models we have specified a VAR model for panel data using efficient GMM estimation as proposed by Blundell & Bond (1998). One advantage of our chosen approach is that it allows to appropriately handle the issues of endogeneity, simultaneity and multi-way feedback relationships among variables in focus. By the computation of impulse-response functions of the PVAR we are able check for the full dynamic properties of our estimated Panel VAR system and evaluate the responses of migratory movements to different labour market shocks. Turning to the empirical results, we identify a clear role of regional differences in the real wage and unemployment rate as major driving force of internal migration in Germany. We also find that regional differences in labour productivity growth enhance net in-migration, while a shock in the labour participation rate negatively affects migratory movements mainly through increased labour market tightness. A positive shock in the regional human capital endowment attracts net inflows mainly through the positive link between human capital accumulation and productivity growth as suggested by the New growth theory.

Moreover, the dynamic simultaneous nature of our PVAR(1) also allows to work out the feedback effects from migratory movements to regional labour market variables. Here we mainly find that migration has an equilibrating effect on regional labour markets in line with the neoclassical view: That is, a high level of in–migration in region i increases the region's unemployment rates relative to region j, while at the same the net in–migration lowers regional wage rate differences (the wage in region i decreases relative to j) and thus works towards a cross-regional wage equalization. Responses of labour productivity and labour participation w.r.t. migration are positive but rather small in magnitude, while the positive impact on human capital hints at the risks of regional 'brain drain' effects for German data given that increased net out-migration flows are not neutral to the regional distribution of human capital endowment, but in fact negatively affect the relative regional skill composition. As the analysis of impulse-response functions of the PVAR(1) thereby shows, this deterioration of the regional human capital base (via the migration channel) is largely driven by shocks in the regional unemployment rate.

We finally use the model to analyse the evolution of the two distinct waves of East-West net out-migration up to 2006. Adopting a dummy variable approach to test for structural differences for the whole East German macro region as well as the East-West border regions compared to the German average we find that throughout the mid–1990s East-West migratory movements did not fully react to regional labour market signals as expected from the PVAR(1) results. The latter finding supports earlier empirical evidence for German and Italian regional data. Likely explanations for this "empirical puzzle" may be seen e.g. in huge income transfers and the possibility of high East-West commuting. However, by using a recursive estimation strategy we find that for subsequent periods this relationship becomes less stable or even reversed: That is, along with the peak of a second wave of East-West migratory movements around 2001 the East dummy turns significantly negative. Since this second wave is accompanied by a gradual fading out of macroeconomic distortions such as massive East-West transfers, this supports the view of repressed migration flows out of East Germany for that period given the overall weak labour market and macroeconomic performance. Towards the sample end in 2006 the dummy turns insignificant, indicating that migratory movements between East and West Germany are well explained by regional labour market signals. This latter result may also hint at an advancing labour market integration between the two macro regions. Together with the empirical findings for the further dummy variable coefficients in the PVAR (e.g. regarding locational attractiveness, productivity growth and the ongoing income convergence debate as well as causes and consequences of East Germany's 'brain drain') our first results calls for further in-depth studies on the relative evolution of key labour market and macroeconomic variables in the two macro-regions twenty years after opening up the 'German Wall'.

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Table 1: Data description and source

Variable	Description	Source
$outm_{ijt}$	Total number of outmigration from region i to j	Destatis (2008)
inm_{ijt}	Total number of in-migration from region i to j	Destatis (2008)
$y_{i(j)t}$	Gross domestic product in region i and j respectively	VGRdL (2008)
$py_{i(j)t}$	GDP deflator in region i and j respectively	VGRdL (2008)
$ylr_{i(j)t}$	Real labour productivity defined as $(yl_{j,t} - py_{j,t})$	VGRdL (2008)
$pop_{i(j)t}$	Population in region i and j respectively	VGRdL (2008)
$emp_{i(j)t}$	Total employment in region i and j respectively	VGRdL (2008)
$unemp_{i(j)t}$	Total unemployment in region i and j respectively	VGRdL (2008)
$ur_{i(j)t}$	Unemployment rate in region i and j respectively defined as $(unemp_{i,t} - emp_{i,t})$	VGRdL (2008)
$pcpi_{i(j)t}$	Consumer price index in region i and j respectively based on Roos (2006) and regional CPI inflation rates	Roos (2006), RWI (2007)
$wr_{i(j)t}$	Real wage rate in region i and j respectively defined as wage compensation per employee deflated by $pcpi_{i(j)t}$	VGRdL (2008)
$q_{i(j)t}$	Labour market participation rate in region i and j respectively defined as $(emp_{i,t} - pop_{i,t})$	VGRdL (2008)
$hc_{i(j)t}$	Human capital index as weighted average of: 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 pop. (*hcpat*)	Destatis (2008)

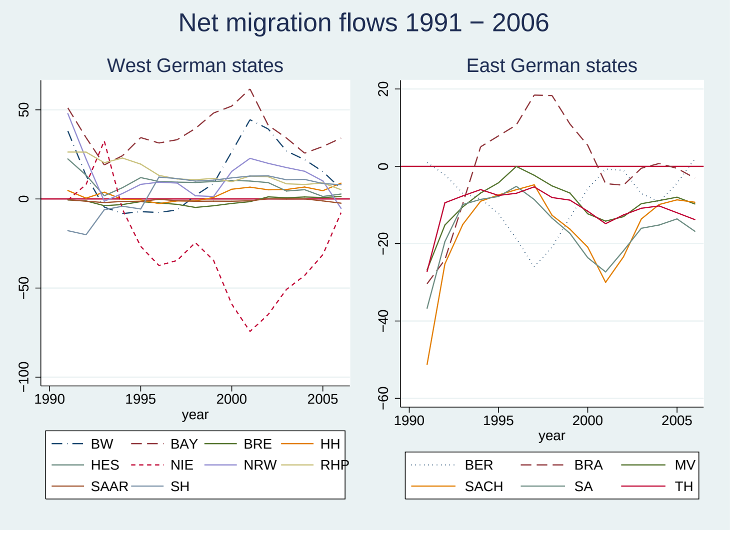
Note: All variables in logs. For Bemen, Hamburg and Schleswig-Holstein no consumer price inflation rates are available. We took the West German aggregate for these states, this also accounts for Rhineland-Palatine and Saarland until 1995.

Table 2: P-values of Im-Pesaran-Shin (1997) Panel unit root test for variables in levels and regional differences

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

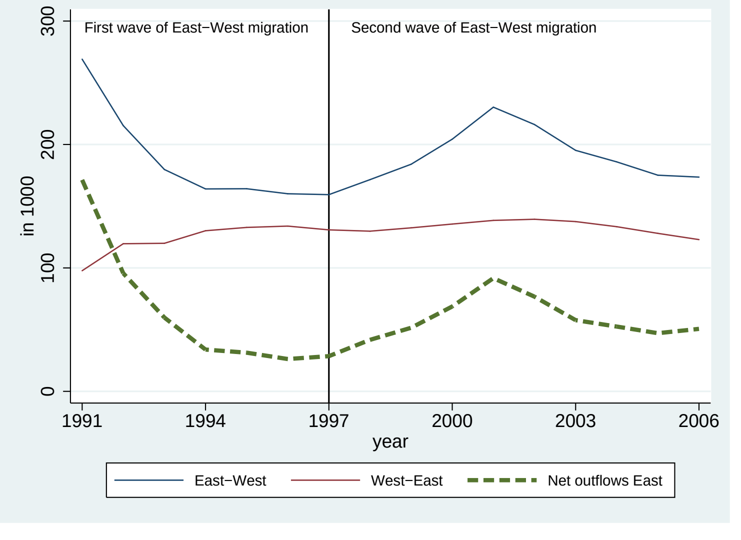
Note: Variant 1 = lag(0), no trend; variant 2 = lag(0), trend; variant 3 = lag(1), no trend; variant 4 = lag(1), trend. The tests are based on the *ipshin* Stata-routine by Bornhorst & Baum (2006, 2007).

Figure 1: Time series plots for German state level net migration between 1991 and 2006



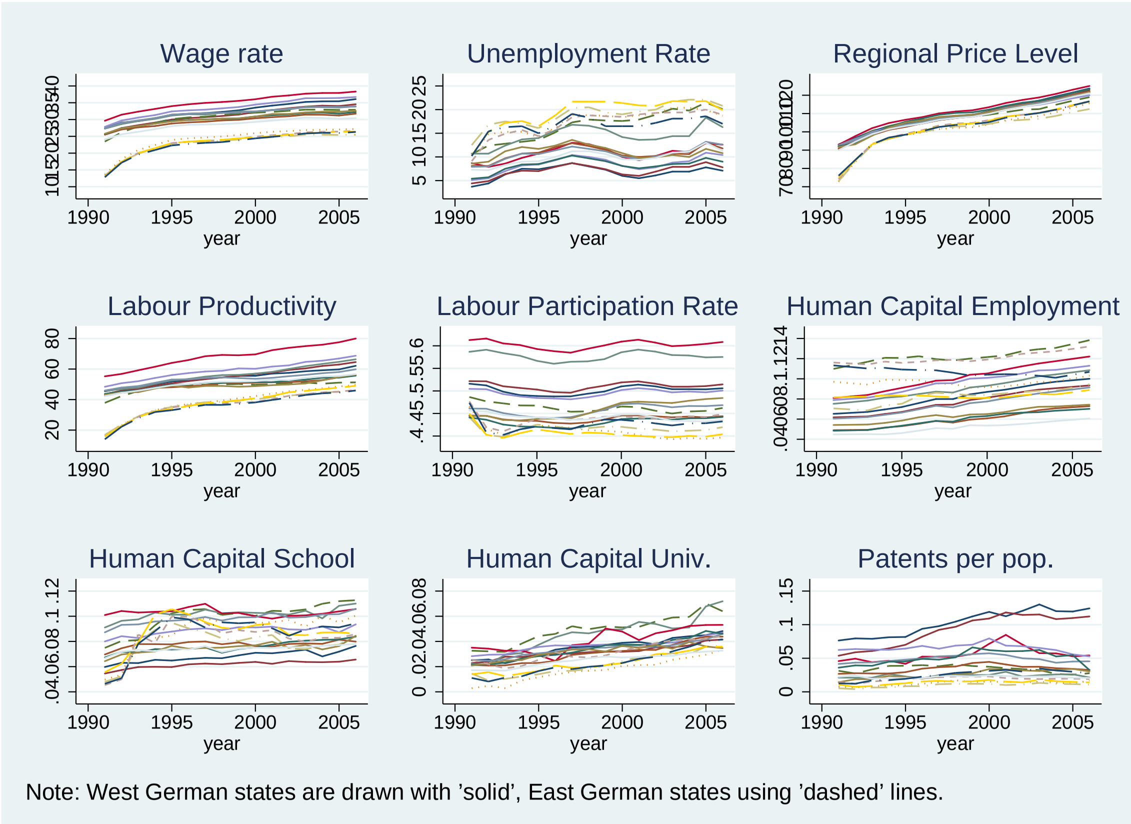
Note: BW = Baden-Wurttemberg, BAY = Bavaria, BER = Berlin, BRA = Brandenburg, BRE = Bremen, HH = Hamburg, HES = Hessen, MV = Mecklenburg-Vorpommern, NIE = Lower Saxony, NRW = North Rhine-Westphalia, RHP = Rhineland-Palatine, SAAR = Saarland, SACH = Saxony, ST = Saxony-Anhalt, SH = Schleswig-Holstein, TH = Thuringia. *Source:* Data from Destatis (2008).

Figure 2: Gross and net migration flows between East and West Germany 1991–2006



Source: Data from Destatis (2008).

Figure 3: Time series plots for German state level labour market and marcoeconomic variables between 1991 and 2006



Source: For data description see table 1.

Table 3: Estimation Results - Panel VAR with lag(1) for $[nm_{ij,t}, \widetilde{wr}_{ij,t}, \widetilde{ur}_{ij,}, \Delta\widetilde{ylr}_{ij,t}, \tilde{q}_{ij,t}, \widetilde{hc}_{ij,t}]$

Dep. Var.	**r.h.s. Var.**	**Coef.**	**Corr. S.E.**	**t-stat.**	**P-value**
$nm_{ij,t}$	$nm_{ij,t-1}$	0.43***	0.051	8.41	(0.00)
$nm_{ij,t}$	$\widetilde{wr}_{ij,t-1}$	0.49***	0.144	3.41	(0.00)
$nm_{ij,t}$	$\widetilde{ur}_{ij,t-1}$	-0.12**	0.050	-2.46	(0.01)
$nm_{ij,t}$	$\Delta\widetilde{ylr}_{ij,t-1}$	0.66***	0.073	9.06	(0.00)
$nm_{ij,t}$	$\tilde{q}_{ij,t-1}$	0.02	0.277	0.07	(0.94)
$nm_{ij,t}$	$\widetilde{hc}_{ij,t-1}$	-0.02*	0.012	-1.78	(0.07)
$\widetilde{wr}_{ij,t}$	$nm_{ij,t-1}$	-0.02***	0.003	-4.89	(0.00)
$\widetilde{wr}_{ij,t}$	$\widetilde{wr}_{ij,t-1}$	0.46***	0.028	16.32	(0.00)
$\widetilde{wr}_{ij,t}$	$\widetilde{ur}_{ij,t-1}$	-0.10***	0.030	-3.35	(0.00)
$\widetilde{wr}_{ij,t}$	$\Delta\widetilde{ylr}_{ij,t-1}$	0.12***	0.015	7.70	(0.00)
$\widetilde{wr}_{ij,t}$	$\tilde{q}_{ij,t-1}$	0.71***	0.105	6.77	(0.00)
$\widetilde{wr}_{ij,t}$	$\widetilde{hc}_{ij,t-1}$	-0.001	0.001	-1.37	(0.17)
$\widetilde{ur}_{ij,t}$	$nm_{ij,t-1}$	0.06	0.038	1.54	(0.12)
$\widetilde{ur}_{ij,t}$	$\widetilde{wr}_{ij,t-1}$	-0.29***	0.063	-4.68	(0.00)
$\widetilde{ur}_{ij,t}$	$\widetilde{ur}_{ij,t-1}$	0.067***	0.055	12.07	(0.00)
$\widetilde{ur}_{ij,t}$	$\Delta\widetilde{ylr}_{ij,t-1}$	-0.39***	0.042	-9.42	(0.00)
$\widetilde{ur}_{ij,t}$	$\tilde{q}_{ij,t-1}$	-0.99***	0.244	4.06	(0.00)
$\widetilde{ur}_{ij,t}$	$\widetilde{hc}_{ij,t-1}$	0.02***	0.005	4.10	(0.00)
$\Delta\widetilde{ylr}_{ij,t}$	$nm_{ij,t-1}$	-0.03	0.017	-1.52	(0.13)
$\Delta\widetilde{ylr}_{ij,t}$	$\widetilde{wr}_{ij,t-1}$	-0.23***	0.051	-4.51	(0.00)
$\Delta\widetilde{ylr}_{ij,t}$	$\widetilde{ur}_{ij,t-1}$	0.09***	0.023	3.90	(0.00)
$\Delta\widetilde{ylr}_{ij,t}$	$\Delta\widetilde{ylr}_{ij,t-1}$	0.55***	0.024	22.61	(0.00)
$\Delta\widetilde{ylr}_{ij,t}$	$\tilde{q}_{ij,t-1}$	0.46***	0.124	3.71	(0.00)
$\Delta\widetilde{ylr}_{ij,t}$	$\widetilde{hc}_{ij,t-1}$	0.17***	0.026	6.41	(0.00)
$\tilde{q}_{ij,t}$	$nm_{ij,t-1}$	0.01***	0.001	4.03	(0.00)
$\tilde{q}_{ij,t}$	$\widetilde{wr}_{ij,t-1}$	0.08***	0.006	12.70	(0.00)
$\tilde{q}_{ij,t}$	$\widetilde{ur}_{ij,t-1}$	-0.01**	0.003	-2.52	(0.01)
$\tilde{q}_{ij,t}$	$\Delta\widetilde{ylr}_{ij,t-1}$	0.09***	0.004	24.70	(0.00)
$\tilde{q}_{ij,t}$	$\tilde{q}_{ij,t-1}$	0.81***	0.014	54.67	(0.00)
$\tilde{q}_{ij,t}$	$\widetilde{hc}_{ij,t-1}$	-0.01***	(0.001)	-4.56	(0.00)
$\widetilde{hc}_{ij,t}$	$nm_{ij,t-1}$	0.07**	0.031	2.18	(0.02)
$\widetilde{hc}_{ij,t}$	$\widetilde{wr}_{ij,t-1}$	0.31***	0.140	2.23	(0.03)
$\widetilde{hc}_{ij,t}$	$\widetilde{ur}_{ij,t-1}$	-0.15***	0.033	-4.36	(0.00)
$\widetilde{hc}_{ij,t}$	$\Delta\widetilde{ylr}_{ij,t-1}$	0.24***	0.071	3.43	(0.00)
$\widetilde{hc}_{ij,t}$	$\tilde{q}_{ij,t-1}$	-0.07	0.306	-0.24	(0.81)
$\widetilde{hc}_{ij,t}$	$\widetilde{hc}_{ij,t-1}$	0.55***	0.057	9.70	(0.00)

No. of obs. per eq.	3120
No. of system obs.	18720
No. of instruments	222
F-Test (joint significance)	608.6 (0.00)
Sargan Statistic	179.1 (0.61)
Hausman $\lvert m\rvert - stat.$	2.45 (0.99)
$\chi^2_{CE}(15)$	33.47 (0.00)

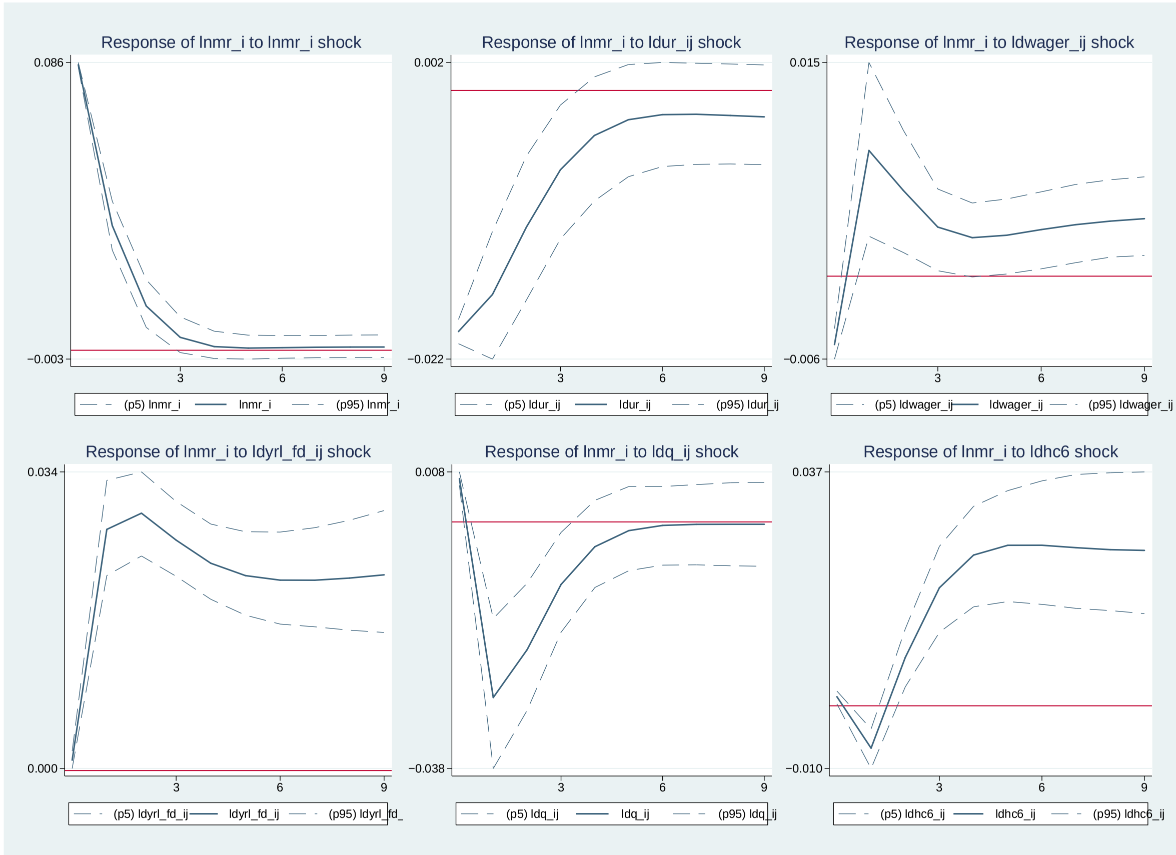
Note: ***, **, * = denote significance levels at the 1%, 5% and 10% level respectively. Standard errors are computed based on Windmeijer's (2005) finite-sample correction.

Table 4: Downward testing approach to instrument consistency in the PVAR model

Dep. Var.	**r.h.s. var.**	**I**	**II**	**III**
$nm_{ij,t}$	$nm_{ij,t-1}$	0.37*** (0.039)	0.28*** (0.056)	0.43*** (0.052)
$nm_{ij,t}$	$\widetilde{wr}_{ij,t-1}$	0.61*** (0.095)	0.37*** (0.110)	0.49*** (0.144)
$nm_{ij,t}$	$\widetilde{ur}_{ij,t-1}$	-0.14*** (0.034)	-0.23*** (0.057)	-0.12** (0.051)
$nm_{ij,t}$	$\Delta\widetilde{ylr}_{ij,t-1}$	0.61*** (0.052)	0.43*** (0.074)	0.66*** (0.073)
$nm_{ij,t}$	$\tilde{q}_{ij,t-1}$	0.12 (0.110)	-0.09 (0.307)	0.02 (0.277)
$nm_{ij,t}$	$\widetilde{hc}_{ij,t-1}$	-0.02** (0.011)	-0.02* (0.014)	-0.02* (0.013)
$nm_{ij,t}$	D_{NIE}	-0.21*** (0.053)	-0.22** (0.090)	-0.18*** (0.055)
(...)				
F-Test		219.4 (0.00)	61.18 (0.00)	109.73 (0.00)
RMSE		0.214	0.238	0.204
No. of IVs		459	90	20
Sargan		1671.9 (0.00)	343.3 (0.00)	11.2 (0.59)
Hansen J		239.9 (0.99)	191.3 (0.00)	16.7 (0.21)
C-Stat. Level-Eq.				7.41 (0.28)
$\chi^2_{Het}(7)$				2.18 (0.94)
$\chi^2_m(7)$				10.33 (0.17)

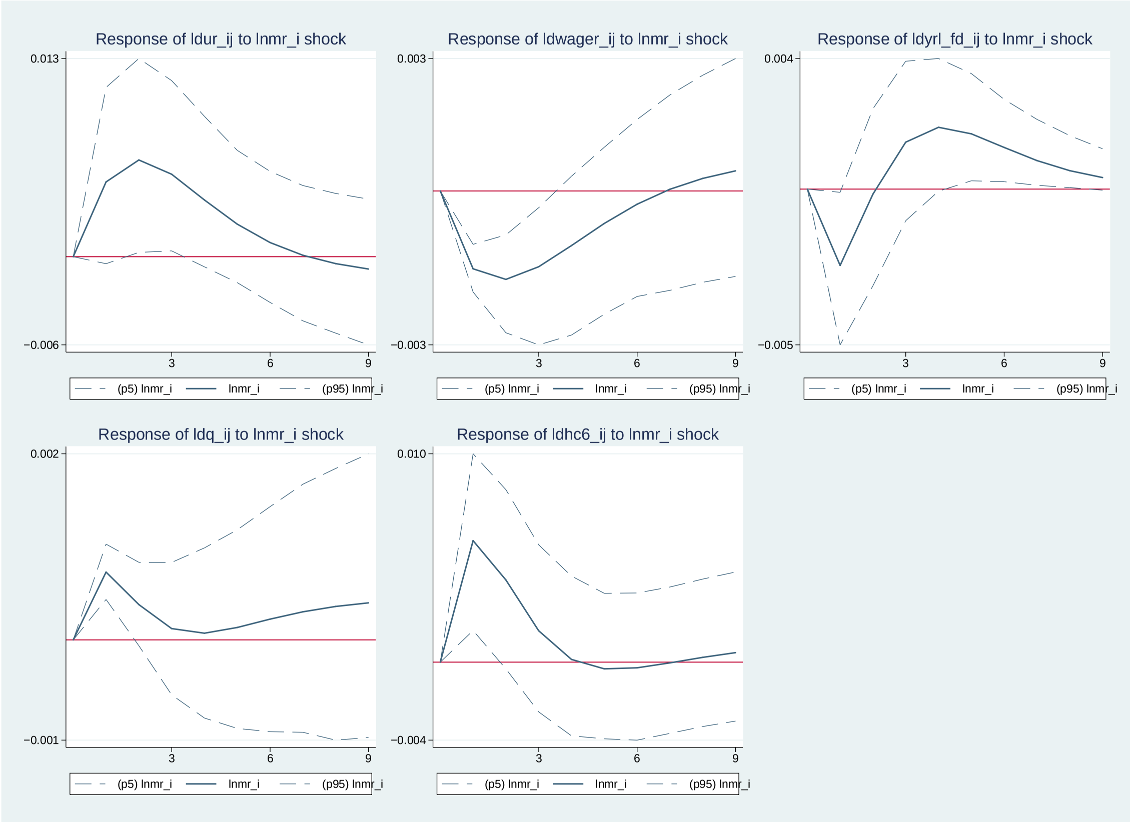
Note: ***, **, * = denote significance levels at the 1%, 5% and 10% level respectively. Standard errors are computed based on Windmeijer's (2005) finite-sample correction. χ^2_{Het}: Heteroscedasticity test based on the regression of squared residuals on squared fitted values. χ^2_m: Hausman $|m|$-statistic based on the absolute values as discussed in Schreiber (2007).

Figure 4: Migration responses to shocks of one standard deviation in the variables from the PVAR(1)



Note: Confidence intervals based on Monte Carlo simulation with 500 reps.

Figure 5: Variable responses in the PVAR(1) to a shock of one standard deviation in the migration rate



Note: Confidence intervals based on Monte Carlo simulation with 500 reps.

Table 5: Variance decomposition with percent variation in row variable explained by column variable

	s	$\text{nm}_{ij,t}$	$\widetilde{ur}_{ij,t}$	$\widetilde{wr}_{ij,t}$	$\Delta\widetilde{ylr}_{ij,t}$	$\tilde{q}_{ij,t}$	$\widetilde{hc}_{ij,t}$
$\text{nm}_{ij,t}$	5	0.590	0.056	0.010	0.188	0.084	0.069
$\widetilde{ur}_{ij,t}$	5	0.008	0.548	0.009	0.191	0.201	0.041
$\widetilde{wr}_{ij,t}$	5	0.004	0.057	0.324	0.228	0.334	0.051
$\Delta\widetilde{ylr}_{ij,t}$	5	0.003	0.036	0.009	0.413	0.123	0.415
$\tilde{q}_{ij,t}$	5	0.002	0.008	0.045	0.508	0.311	0.126
$\widetilde{hc}_{ij,t}$	5	0.002	0.021	0.004	0.047	0.039	0.886
$\text{nm}_{ij,t}$	10	0.428	0.042	0.010	0.252	0.061	0.205
$\widetilde{ur}_{ij,t}$	10	0.005	0.318	0.013	0.331	0.114	0.217
$\widetilde{wr}_{ij,t}$	10	0.002	0.034	0.173	0.380	0.168	0.241
$\Delta\widetilde{ylr}_{ij,t}$	10	0.003	0.035	0.009	0.391	0.116	0.444
$\tilde{q}_{ij,t}$	10	0.001	0.004	0.027	0.506	0.096	0.364
$\widetilde{hc}_{ij,t}$	10	0.002	0.021	0.006	0.118	0.033	0.818
$\text{nm}_{ij,t}$	20	0.256	0.027	0.012	0.332	0.036	0.334
$\widetilde{ur}_{ij,t}$	20	0.002	0.131	0.014	0.408	0.046	0.396
$\widetilde{wr}_{ij,t}$	20	0.001	0.015	0.072	0.431	0.061	0.418
$\Delta\widetilde{ylr}_{ij,t}$	20	0.003	0.034	0.009	0.390	0.115	0.446
$\tilde{q}_{ij,t}$	20	0.001	0.004	0.019	0.472	0.029	0.473
$\widetilde{hc}_{ij,t}$	20	0.001	0.015	0.009	0.232	0.022	0.718

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

Figure 6: Actual and fitted net migration for selected East-West state pairs

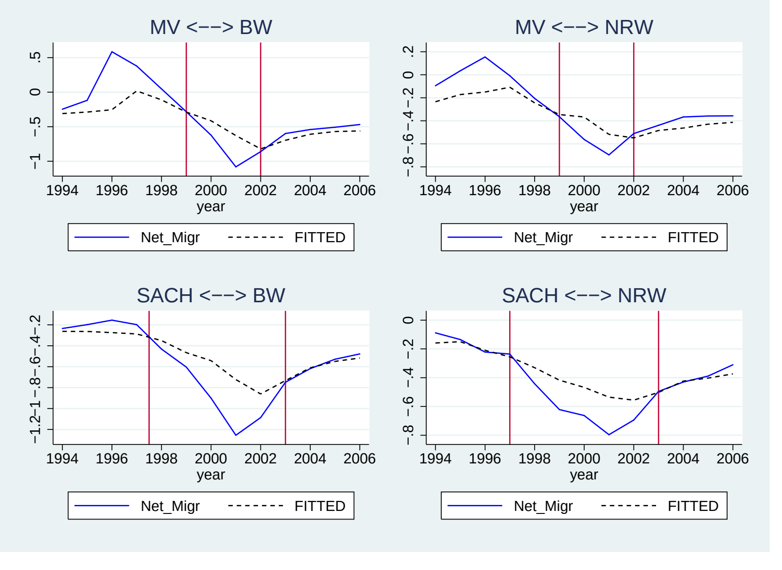


Figure 7: Time evolution of the East German dummy in the augmented PVAR(1)

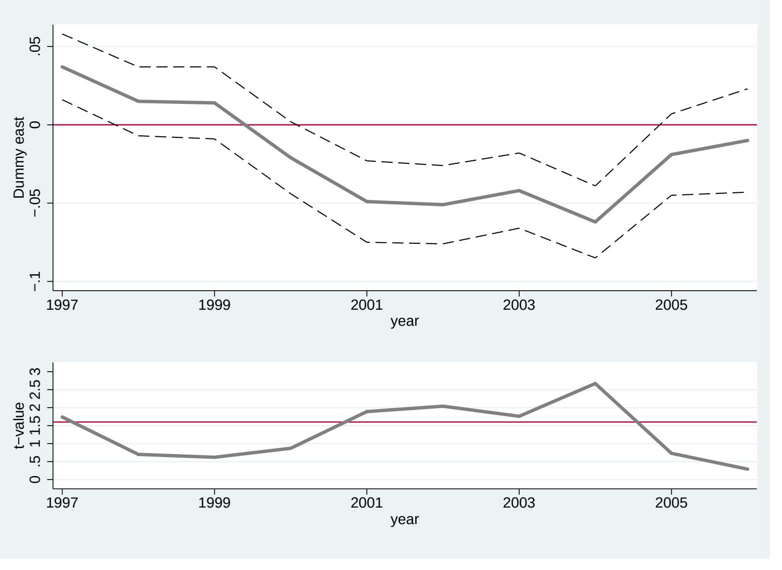


Figure 8: Time evolution of the East-West border dummy in the augmented PVAR(1)

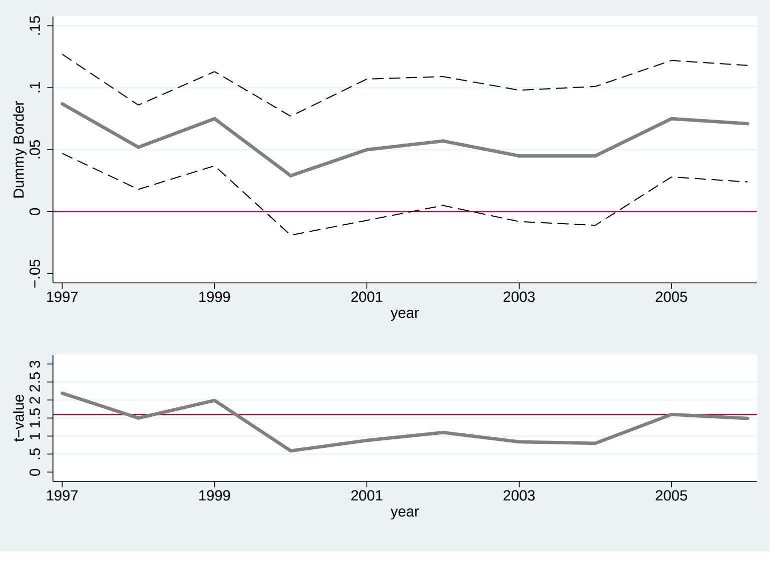


Figure A.1: Impulse-Responses for PVAR(1) with ordering $[\widetilde{hc}_{ij,t} \rightarrow \tilde{q}_{ij,t} \rightarrow \Delta\widetilde{ylr}_{ij,t} \rightarrow \widetilde{wr}_{ij,t} \rightarrow \tilde{ur}_{ij,t} \rightarrow nm_{ij,t}]$

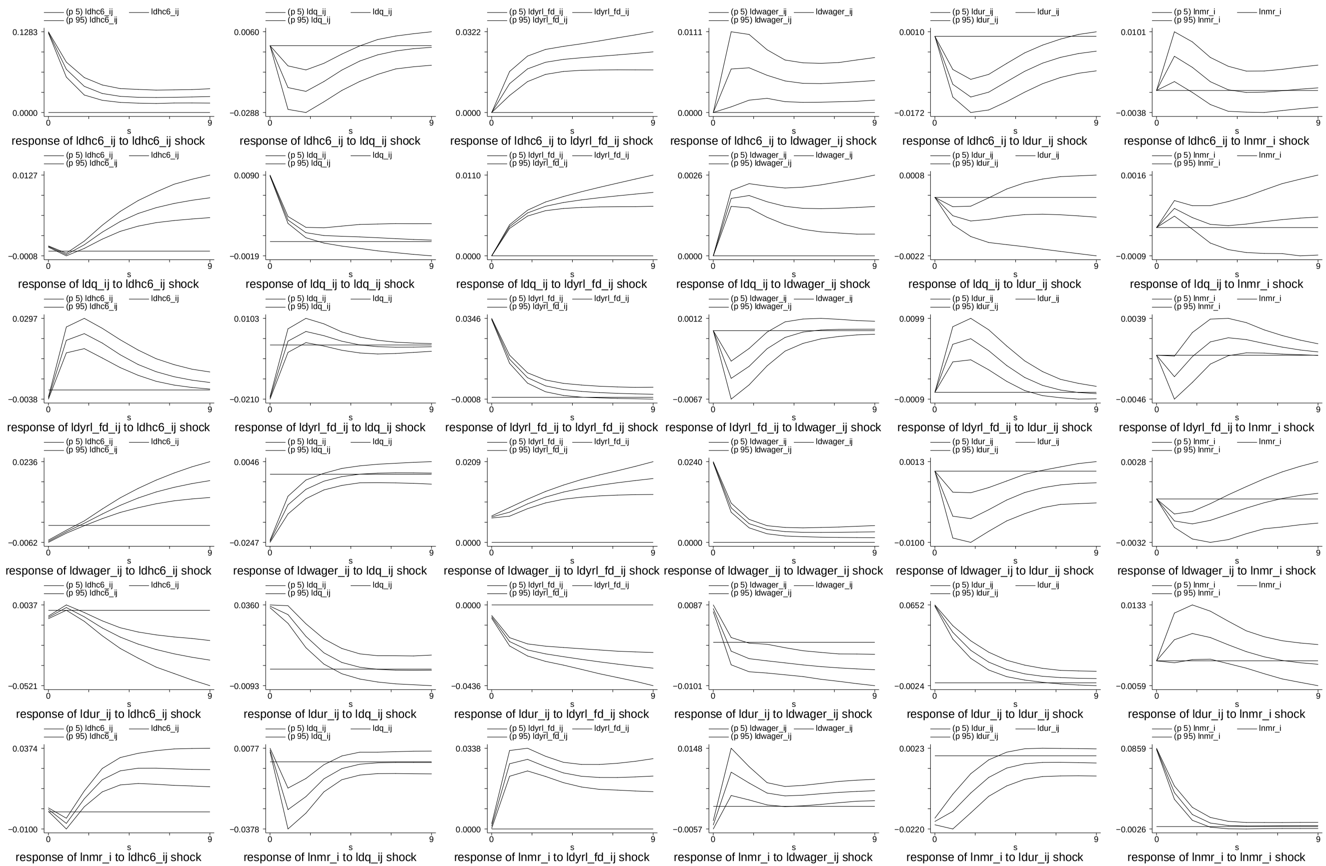


Figure A.2: Impulse-Responses for PVAR(1) with ordering $[nm_{ij,t} \rightarrow \widetilde{ur}_{ij,t} \rightarrow \widetilde{wr}_{ij,t} \rightarrow \Delta\widetilde{ylr}_{ij,t} \rightarrow \tilde{q}_{ij,t} \rightarrow \widetilde{hc}_{ij,t}]$

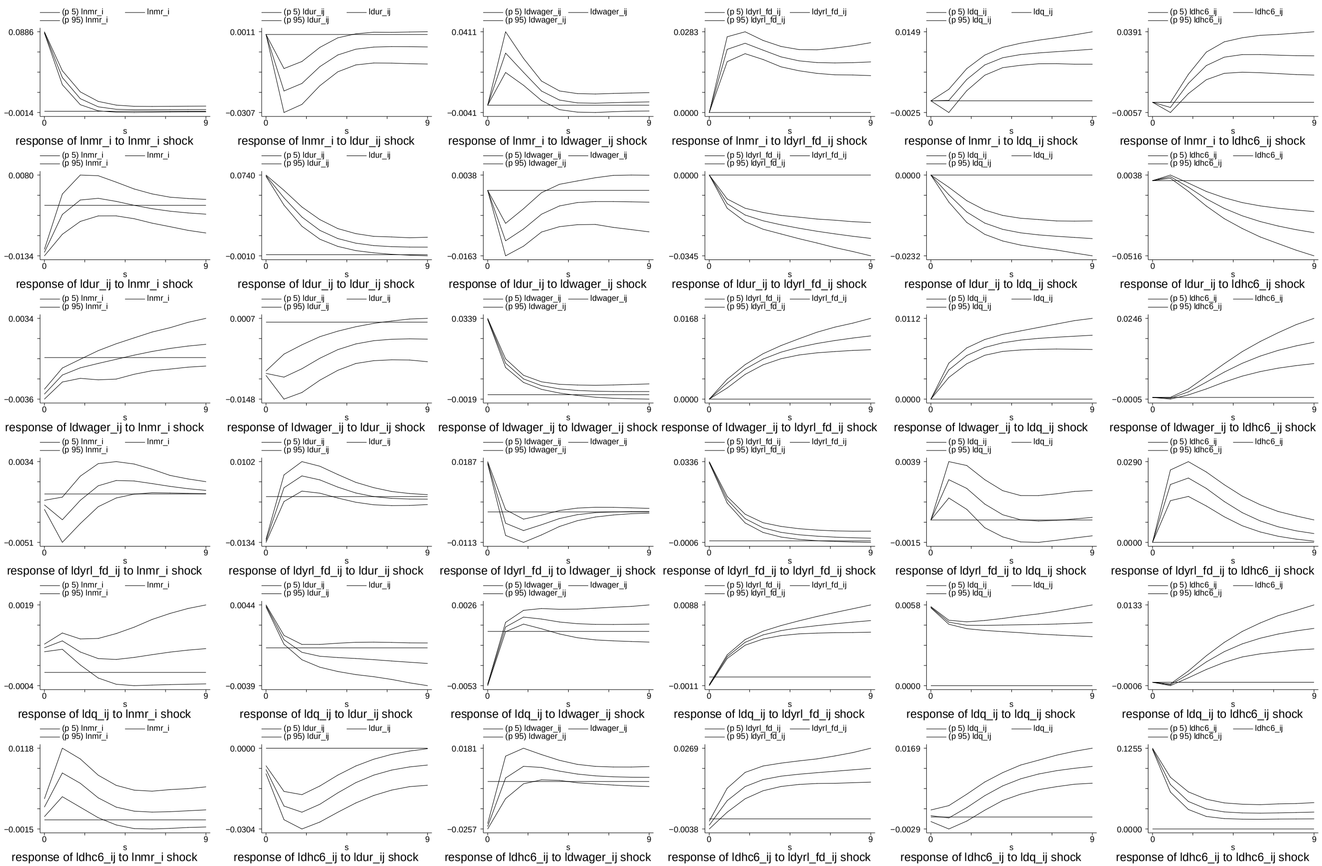


Figure A.3: Actual and fitted net migration between East and West German state pairs

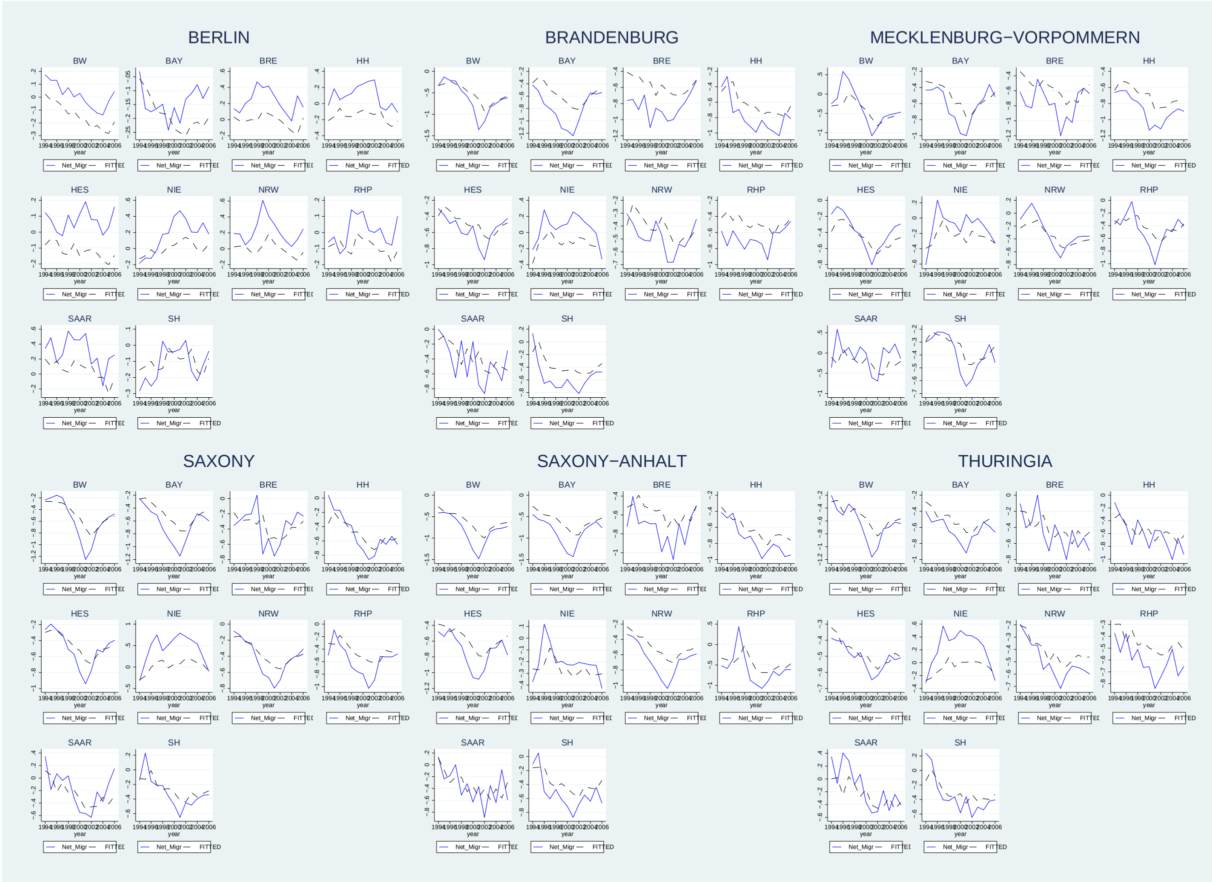


Table A.1: Estimation Results for East-Dummy augmented PVAR(1)

Time Period		D_{East} with $s = 2006$			D_{East} with $s = 1997$		
Dep. Var.	**r.h.s. var.**	**Coef.**	**Corr. S.E.**	**P-value**	**Coef.**	**Corr. S.E.**	**P-value**
$nm_{ij,t}$	$nm_{ij,t-1}$	0.44***	0.051	(0.00)	0.42***	0.052	(0.00)
$nm_{ij,t}$	$\widetilde{ur}_{ij,t-1}$	-0.12***	0.058	(0.04)	-0.14***	0.054	(0.00)
$nm_{ij,t}$	$\widetilde{wr}_{ij,t-1}$	0.49***	0.148	(0.00)	0.56***	0.145	(0.00)
$nm_{ij,t}$	$\Delta\widetilde{ylr}_{ij,t-1}$	0.66***	0.079	(0.00)	0.65***	0.075	(0.00)
$nm_{ij,t}$	$\tilde{q}_{ij,t-1}$	0.01	0.282	(0.97)	-0.14	0.284	(0.61)
$nm_{ij,t}$	$\widetilde{hc}_{ij,t-1}$	-0.02*	0.013	(0.07)	-0.02*	0.012	(0.10)
$nm_{ij,t}$	D_{East}	-0.01	0.033	(0.77)	0.04*	0.021	(0.08)
$\widetilde{ur}_{ij,t}$	$nm_{ij,t-1}$	0.02	0.039	(0.61)	0.04	0.038	(0.31)
$\widetilde{ur}_{ij,t}$	$\widetilde{ur}_{ij,t-1}$	0.63***	0.057	(0.00)	0.74***	0.049	(0.00)
$\widetilde{ur}_{ij,t}$	$\widetilde{wr}_{ij,t-1}$	-0.25***	0.062	(0.00)	-0.19***	0.066	(0.00)
$\widetilde{ur}_{ij,t}$	$\Delta\widetilde{ylr}_{ij,t-1}$	-0.37***	0.045	(0.00)	-0.41***	0.048	(0.00)
$\widetilde{ur}_{ij,t}$	$\tilde{q}_{ij,t-1}$	-0.79***	0.241	(0.00)	-0.74***	0.244	(0.00)
$\widetilde{ur}_{ij,t}$	$\widetilde{hc}_{ij,t-1}$	0.03***	0.005	(0.00)	0.03***	0.006	(0.00)
$\widetilde{ur}_{ij,t}$	D_{East}	0.15***	0.039	(0.00)	0.06***	0.015	(0.00)
$\widetilde{wr}_{ij,t}$	$nm_{ij,t-1}$	-0.02***	0.003	(0.00)	-0.02***	0.003	(0.00)
$\widetilde{wr}_{ij,t}$	$\widetilde{ur}_{ij,t-1}$	-0.06***	0.027	(0.02)	-0.10***	0.031	(0.00)
$\widetilde{wr}_{ij,t}$	$\widetilde{wr}_{ij,t-1}$	0.58***	0.023	(0.00)	0.48***	0.034	(0.00)
$\widetilde{wr}_{ij,t}$	$\Delta\widetilde{ylr}_{ij,t-1}$	0.12***	0.015	(0.00)	0.12***	0.016	(0.00)
$\widetilde{wr}_{ij,t}$	$\tilde{q}_{ij,t-1}$	0.61***	0.092	(0.00)	0.72***	0.103	(0.00)
$\widetilde{wr}_{ij,t}$	$\widetilde{hc}_{ij,t-1}$	0.001	0.001	(0.84)	-0.01	0.01	(0.29)
$\widetilde{wr}_{ij,t}$	D_{East}	0.01	0.019	(0.86)	0.01	0.01	(0.57)
$\Delta\widetilde{ylr}_{ij,t}$	$nm_{ij,t-1}$	-0.02	0.016	(0.17)	-0.03	0.017	(0.15)
$\Delta\widetilde{ylr}_{ij,t}$	$\widetilde{ur}_{ij,t-1}$	0.11***	0.021	(0.00)	0.09***	0.023	(0.00)
$\Delta\widetilde{ylr}_{ij,t}$	$\widetilde{wr}_{ij,t-1}$	-0.25***	0.046	(0.00)	0.23***	0.051	(0.00)
$\Delta\widetilde{ylr}_{ij,t}$	$\Delta\widetilde{ylr}_{ij,t-1}$	0.52***	0.027	(0.00)	0.54***	0.026	(0.00)
$\Delta\widetilde{ylr}_{ij,t}$	$\tilde{q}_{ij,t-1}$	0.47***	0.116	(0.00)	0.44***	0.126	(0.00)
$\Delta\widetilde{ylr}_{ij,t}$	$\widetilde{hc}_{ij,t-1}$	0.16***	0.027	(0.00)	0.17***	0.026	(0.00)
$\Delta\widetilde{ylr}_{ij,t}$	D_{East}	-0.03***	0.013	(0.00)	0.01	0.008	(0.64)
$\tilde{q}_{ij,t}$	$nm_{ij,t-1}$	0.01***	0.001	(0.00)	0.01***	0.002	(0.00)
$\tilde{q}_{ij,t}$	$\widetilde{ur}_{ij,t-1}$	-0.01***	0.003	(0.00)	-0.01***	0.003	(0.00)
$\tilde{q}_{ij,t}$	$\widetilde{wr}_{ij,t-1}$	0.08***	0.006	(0.00)	0.09***	0.007	(0.00)
$\tilde{q}_{ij,t}$	$\Delta\widetilde{ylr}_{ij,t-1}$	0.09***	0.004	(0.00)	0.10***	0.004	(0.00)
$\tilde{q}_{ij,t}$	$\tilde{q}_{ij,t-1}$	0.80***	0.014	(0.00)	0.80***	0.015	(0.00)
$\tilde{q}_{ij,t}$	$\widetilde{hc}_{ij,t-1}$	-0.01***	0.001	(0.00)	-0.01***	0.001	(0.00)
$\tilde{q}_{ij,t}$	D_{East}	0.01	0.002	(0.69)	0.003*	0.001	(0.07)
$\widetilde{hc}_{ij,t}$	$nm_{ij,t-1}$	007**	0.031	(0.02)	0.06*	0.037	(0.10)
$\widetilde{hc}_{ij,t}$	$\widetilde{ur}_{ij,t-1}$	-0.14***	0.035	(0.00)	-0.11**	0.047	(0.02)
$\widetilde{hc}_{ij,t}$	$\widetilde{wr}_{ij,t-1}$	0.34***	0.126	(0.00)	0.46***	0.144	(0.00)
$\widetilde{hc}_{ij,t}$	$\Delta\widetilde{ylr}_{ij,t-1}$	0.25***	0.064	(0.00)	0.23***	0.087	(0.00)
$\widetilde{hc}_{ij,t}$	$\tilde{q}_{ij,t-1}$	-0.14	0.267	(0.61)	-0.22	0.336	(0.52)
$\widetilde{hc}_{ij,t}$	$\widetilde{hc}_{ij,t-1}$	0.57***	0.048	(0.00)	0.61***	0.070	(0.00)
$\widetilde{hc}_{ij,t}$	D_{East}	0.02	0.033	(0.63)	0.09***	0.024	(0.00)
No. of obs. per eq.		3120			3120		
No. of system obs.		18720			18720		
No. of system IVs		228			228		
P-value Sargan Stat.		(0.30)			(0.11)		

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 A.2: Estimation Results for Border-Dummy augmented PVAR(1)

Time Period		D_{Border} **with** $s = 2006$			D_{Border} **with** $s = 1997$		
Dep. Var.	**r.h.s. var.**	**Coef.**	**Corr. S.E.**	**P-value**	**Coef.**	**Corr. S.E.**	**P-value**
$nm_{ij,t}$	$nm_{ij,t-1}$	0.43***	0.051	(0.00)	0.43***	0.051	(0.00)
$nm_{ij,t}$	$\widetilde{ur}_{ij,t-1}$	-0.13**	0.051	(0.01)	-0.13**	0.051	(0.01)
$nm_{ij,t}$	$\widetilde{wr}_{ij,t-1}$	0.51***	0.144	(0.00)	0.52***	0.143	(0.00)
$nm_{ij,t}$	$\Delta\widetilde{ylr}_{ij,t-1}$	0.67***	0.073	(0.00)	0.65***	0.073	(0.00)
$nm_{ij,t}$	$\tilde{q}_{ij,t-1}$	0.01	0.276	(0.97)	-0.04	0.280	(0.89)
$nm_{ij,t}$	$\widetilde{hc}_{ij,t-1}$	-0.02*	0.012	(0.06)	-0.02*	0.012	(0.07)
$nm_{ij,t}$	D_{Border}	0.07	0.047	(0.13)	0.09**	0.040	(0.03)
$\widetilde{ur}_{ij,t}$	$nm_{ij,t-1}$	0.05	0.037	(0.17)	0.05	0.038	(0.15)
$\widetilde{ur}_{ij,t}$	$\widetilde{ur}_{ij,t-1}$	0.67***	0.055	(0.00)	0.68***	0.056	(0.00)
$\widetilde{ur}_{ij,t}$	$\widetilde{wr}_{ij,t-1}$	-0.28***	0.063	(0.00)	-0.29***	0.065	(0.00)
$\widetilde{ur}_{ij,t}$	$\Delta\widetilde{ylr}_{ij,t-1}$	-0.39***	0.041	(0.00)	-0.39***	0.044	(0.00)
$\widetilde{ur}_{ij,t}$	$\tilde{q}_{ij,t-1}$	-0.98***	0.244	(0.00)	-0.99***	0.248	(0.00)
$\widetilde{ur}_{ij,t}$	$\widetilde{hc}_{ij,t-1}$	0.02***	0.005	(0.00)	0.02***	0.005	(0.00)
$\widetilde{ur}_{ij,t}$	D_{Border}	0.07	0.068	(0.27)	0.03	0.058	(0.64)
$\widetilde{wr}_{ij,t}$	$nm_{ij,t-1}$	-0.02***	0.003	(0.00)	-0.02***	0.003	(0.00)
$\widetilde{wr}_{ij,t}$	$\widetilde{ur}_{ij,t-1}$	-0.10***	0.031	(0.00)	-0.10***	0.031	(0.00)
$\widetilde{wr}_{ij,t}$	$\widetilde{wr}_{ij,t-1}$	0.46***	0.028	(0.00)	0.47***	0.031	(0.00)
$\widetilde{wr}_{ij,t}$	$\Delta\widetilde{ylr}_{ij,t-1}$	0.12***	0.016	(0.00)	0.12***	0.016	(0.00)
$\widetilde{wr}_{ij,t}$	$\tilde{q}_{ij,t-1}$	0.72***	0.104	(0.00)	0.72***	0.106	(0.00)
$\widetilde{wr}_{ij,t}$	$\widetilde{hc}_{ij,t-1}$	-0.01	0.014	(0.28)	-0.001	0.001	(0.23)
$\widetilde{wr}_{ij,t}$	D_{Border}	0.01	0.044	(0.89)	0.02	0.029	(0.59)
$\Delta\widetilde{ylr}_{ij,t}$	$nm_{ij,t-1}$	-0.03	0.017	(0.12)	-0.03	0.018	(0.16)
$\Delta\widetilde{ylr}_{ij,t}$	$\widetilde{ur}_{ij,t-1}$	0.09***	0.023	(0.00)	0.09***	0.024	(0.00)
$\Delta\widetilde{ylr}_{ij,t}$	$\widetilde{wr}_{ij,t-1}$	-0.23***	0.051	(0.00)	-0.23***	0.052	(0.00)
$\Delta\widetilde{ylr}_{ij,t}$	$\Delta\widetilde{ylr}_{ij,t-1}$	0.55***	0.024	(0.00)	0.54***	0.025	(0.00)
$\Delta\widetilde{ylr}_{ij,t}$	$\tilde{q}_{ij,t-1}$	0.46***	0.125	(0.00)	0.46***	0.126	(0.00)
$\Delta\widetilde{ylr}_{ij,t}$	$\widetilde{hc}_{ij,t-1}$	0.17***	0.026	(0.00)	0.17***	0.026	(0.00)
$\Delta\widetilde{ylr}_{ij,t}$	D_{Border}	-0.01	0.018	(0.79)	0.03*	0.014	(0.06)
$\tilde{q}_{ij,t}$	$nm_{ij,t-1}$	0.01***	0.001	(0.00)	0.01***	0.001	(0.00)
$\tilde{q}_{ij,t}$	$\widetilde{ur}_{ij,t-1}$	-0.01***	0.003	(0.01)	-0.01**	0.004	(0.01)
$\tilde{q}_{ij,t}$	$\widetilde{wr}_{ij,t-1}$	0.08***	0.006	(0.00)	0.08***	0.006	(0.00)
$\tilde{q}_{ij,t}$	$\Delta\widetilde{ylr}_{ij,t-1}$	0.10***	0.003	(0.00)	0.10***	0.004	(0.00)
$\tilde{q}_{ij,t}$	$\tilde{q}_{ij,t-1}$	0.81***	0.015	(0.00)	0.81***	0.014	(0.00)
$\tilde{q}_{ij,t}$	$\widetilde{hc}_{ij,t-1}$	-0.01***	0.001	(0.00)	-0.01***	0.001	(0.00)
$\tilde{q}_{ij,t}$	D_{Border}	-0.001	0.005	(0.79)	0.002	0.003	(0.45)
$\widetilde{hc}_{ij,t}$	$nm_{ij,t-1}$	0.07**	0.031	(0.03)	0.06**	0.031	(0.04)
$\widetilde{hc}_{ij,t}$	$\widetilde{ur}_{ij,t-1}$	-0.15***	0.033	(0.00)	-0.14***	0.035	(0.00)
$\widetilde{hc}_{ij,t}$	$\widetilde{wr}_{ij,t-1}$	0.31**	0.139	(0.02)	0.32***	0.139	(0.02)
$\widetilde{hc}_{ij,t}$	$\Delta\widetilde{ylr}_{ij,t-1}$	0.24***	0.071	(0.00)	0.23***	0.072	(0.00)
$\widetilde{hc}_{ij,t}$	$\tilde{q}_{ij,t-1}$	-0.08	0.309	(0.78)	-0.08	0.299	(0.78)
$\widetilde{hc}_{ij,t}$	$\widetilde{hc}_{ij,t-1}$	0.55***	0.056	(0.00)	0.56***	0.058	(0.00)
$\widetilde{hc}_{ij,t}$	D_{Border}	-0.03	0.047	(0.58)	0.08*	0.044	(0.07)
No. of obs. per eq.		3120			3120		
No. of system obs.		18720			18720		
No. of system IVs		228			228		
P-value Sargan Stat.		(0.60)			(0.59)		

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