Determinants of East-West-migration in Germany: A macroeconometric analysis*

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Abstract

A main feature characterising the transition process of eastern Germany is the scope with which East-West migration took place before, during, and after the German reunification. Overall, 4 million individuals left East Germany to migrate to the west between 1989 and 2007 (gross migration). Taking into account West-East migration, cumulative net migration amounted to 1.7 million persons. This relates to a share of 10.3 % of the original East German population at the beginning of 1989. These figures highlight the relevance of the migration phenomenon in the East-West German context and underline that it is highly indicated to examine it and the resulting effects more closely. They also raise questions about the reasons and the determinants of this migration movement.

This paper explicitly analyses the determinants of East-West migration in Germany using a macroeconometric panel data model and applying pair-wise gross migration flows and rates between the respective eastern and western German federal states for the period 1991 – 2007. In order to provide a thorough sensitivity analysis, the basic empirical migration model is not only estimated in a variety of different specifications and using different estimation methods for the full sample period. In addition, the model is also estimated for three different subsamples.

Investigating both absolute gross migration and gross migration rates East-West the results of the conducted estimations can be summarised as follows. The regional income difference as well as separately integrated income variables for both regions can be identified as highly significant explanatory variables explaining the gross migration flows and rates from the eastern to the western part. Regional differentials in the employment and labour market situation approximated by the respective differences in labour market size, the intensity of labour demand as well as unemployment between both German parts, also act as important explanatory factors. Furthermore, a pro-cyclical dependency of migration can be confirmed in all estimated model specifications and almost all estimated subsamples. Theory predicts a positive relationship between the level of qualification of individuals and the subsequent migration. This, too, can be indirectly confirmed with the analysed panel data set. Whereas increasing rents in the east act as a push-factor to East-West German migration, rising regional infrastructural differences seem to draw people towards the west. Distance as an approximation for migration costs shows the expected negative sign in all model specifications and estimated subsamples.

Keywords: East-West German migration, determinants of migration
JEL-Classification: J61, J62, R23

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1 Introduction

A main feature characterising the transition process of eastern Germany is the scope with which East-West migration took place before, during, and after the German reunification. Overall, 4 million individuals left East Germany to migrate to the west between 1989 and 2007 (gross migration). Taking into account West-East migration, cumulative net migration amounted to 1.7 million persons. This relates to a share of 10.3 % of the original East German population at the beginning of 1989. Moreover, there are mainly young and qualified individuals migrating to the western part. The fraction of young individuals between 18 and 29 years of age amounted to 47.4 %.[1] These figures highlight the relevance of the migration phenomenon in the East-West German context and underline that it is highly indicated to examine it and the resulting effects more closely. They also raise questions about the reasons and the determinants of this migration movement.

The existing literature analysing the determinants of migration within Germany after reunification can be broadly grouped into two main categories, namely microeconometric and macroeconometric studies. Of the existing macroeconometric studies, only a minority focus more or less explicitly on East-West German migration. Most of the studies within this category focus on the determinants of migration for all of Germany. Moreover, a fact common to all empirical investigations in this category is that they are conducted for rather small periods of time. Furthermore, the primary constraint of some of these macroeconometric studies of including wage and unemployment variables as well as their differences as the main explanatory factors in their empirical regression equations seems to be too restrictive, in particular, against the backdrop of other important migration determinants proposed by microeconomic theory. Considering that the fall of the Berlin Wall took place nearly 20 years ago, it seems highly indicated to conduct a macroeconometric investigation that focuses explicitly on the various factors determining East-West migration after the German reunification for a longer time period.

This paper explicitly analyses the determinants of East-West migration in Germany using a macroeconometric panel data model and applying pair-wise gross migration flows and rates between the respective eastern and western German federal states for the period 1991 – 2007.

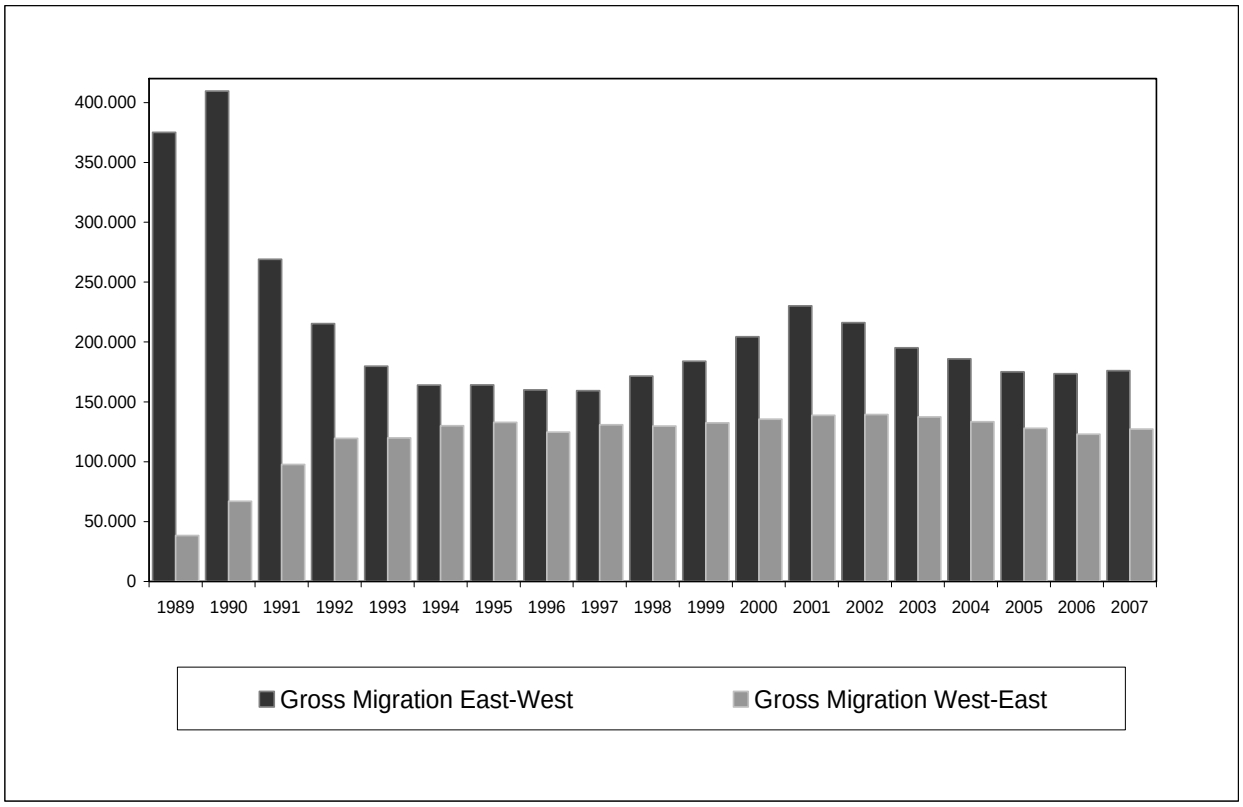
The remainder of this paper is structured as follows. The next section provides some background information about East-West German migration after the fall of the Berlin Wall. Section 3 presents and critically reviews a few selected examples of the existing literature in this context. The underlying theoretical concept that is employed to explain regional mobility is outlined in section 4, whereas the empirical approach and the relevant data are discussed in section 5. Section 6 presents the econometric results as well as a sensitivity analysis. A conclusion in section 7 completes the paper.

[1] See for example Arntz (2006) for descriptive evidence on East-West German migration of the qualified and highly educated individuals.

2 Background to East-West migration in Germany

East-West migration in Germany took place on an unprecedented scale following the events of the fall of the Berlin Wall and the subsequent reunification. Considering these migration movements for the time period from 1989 until 2007 in more detail, East-West migration in Germany can be classified into main 5 phases.

Figure 1: Migration within Germany, 1989 – 2007

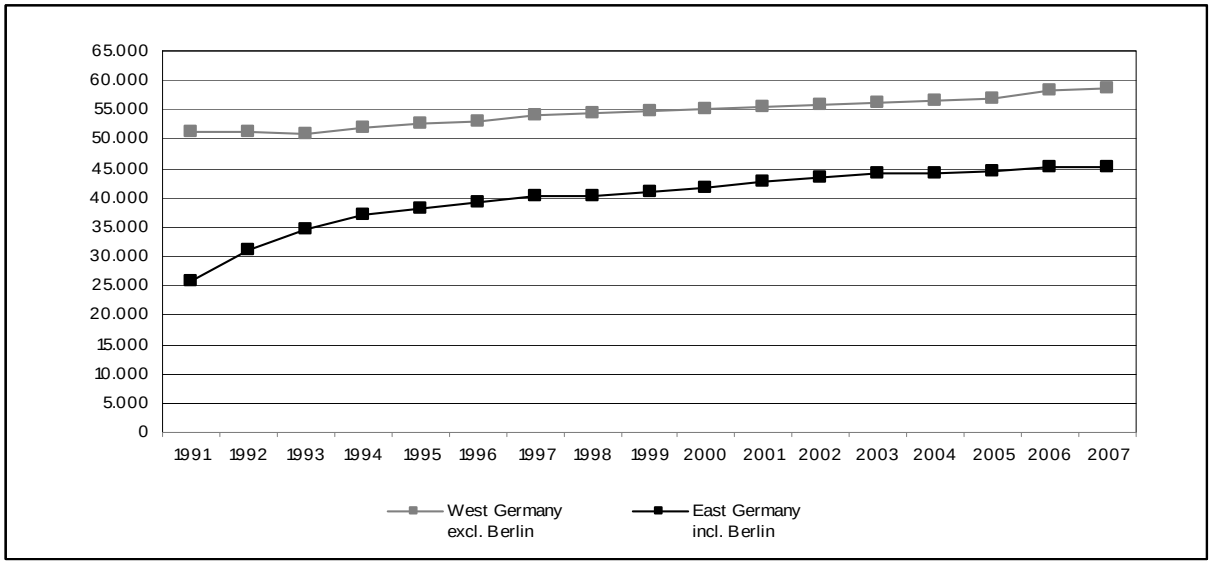


Source: German Federal Statistical Office (Statistisches Bundesamt)
Note: In this illustration Berlin is assigned to eastern Germany over the whole time period from 1989 – 2007.

As can be seen from figure 1, the first major wave of East-West outmigration took place between 1989 and 1990. With the fall of the Berlin Wall on 9 November 1989, direct migration from the eastern to the western part of Germany became possible. During this period gross migration East-West amounted to around 785.000 individuals, corresponding to outmigration rates of about 2 and 2.3 %, respectively. These movements of persons were mainly politically motivated. The first democratic elections held in the former German Democratic Republic in March 1990 showed strong support for parties supporting rapid unification with the west, reducing the political motive for leaving the east. Monetary, economic and social union was consolidated in July 1990, followed by political union in October. The second major phase in East-West German migration, i.e. the period from 1991 – 1996, is characterised by a sharp decline in eastern outmigration. At the same time gross migration from the west steadily increased and reached its peak in 1995. Moreover, eastern

wages and real per capita incomes (figure 2) rose rapidly – a development which was mainly fostered by western labour unions and government officials who were afraid of massive ongoing outmigration from the east.[2]

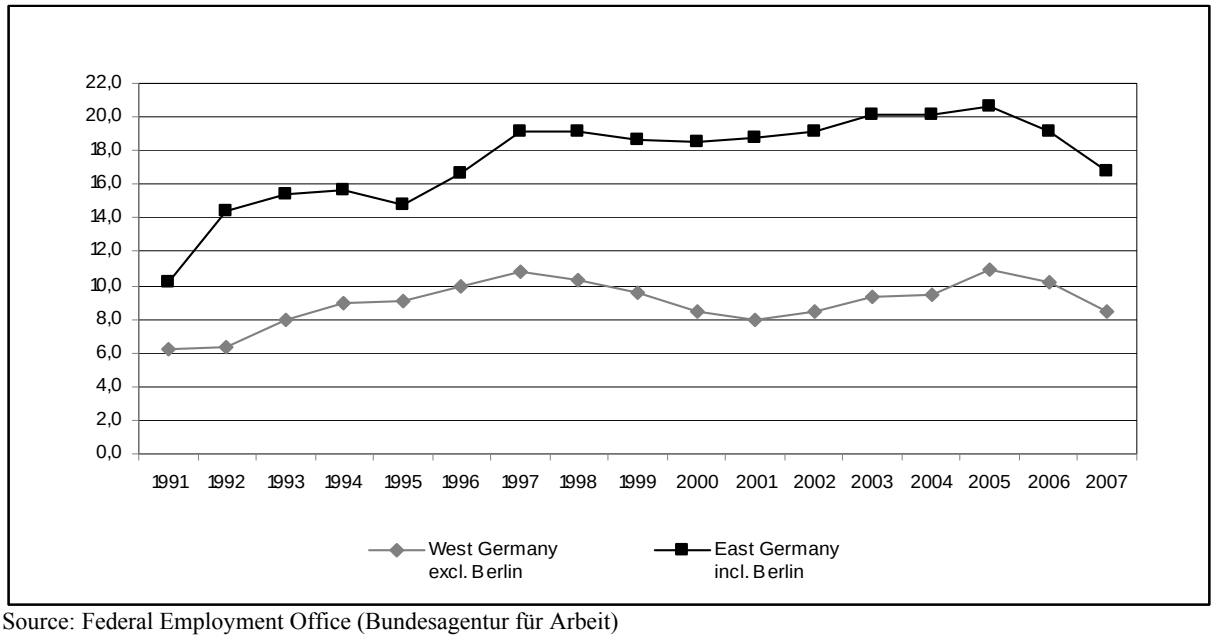
Figure 2: The development of real GDP per employee in East and West Germany, 1991 – 2007



Source: Regional Accounts VGR d L (Arbeitskreis Volkswirtschaftliche Gesamtrechnungen der Länder)
Notes: - Real per capita income as measured by GDP per employee (in euro, absolute terms) in prices of 2000.
- In this illustration Berlin is considered as part of East Germany.

Related to the massive fall in eastern Germany's production, there was a sharp decline in employment until the mid 1990s. As can be seen from figure 3 unemployment rates increased officially from around 10 % in 1991 to nearly 16 % in 1994 then decreased and eventually rose again.

Figure 3: The development of unemployment rates in East and West Germany, 1991 – 2007



Source: Federal Employment Office (Bundesagentur für Arbeit)
Notes: - Unemployment rates (in %) as an annual average referring to the dependent civilian labour force.
- In this illustration Berlin is considered as part of East Germany.

[2] See Hunt (2006), p. 1017.

The third major phase of East-West migration in Germany took place between 1997 and 2001. This period was characterised by increasing outmigration flows from the east accompanied by relatively stable eastern unemployment rates between 18 and 19 %. Western gross outmigration flows remained rather stable from the mid 1990s onwards with around 130.000 people on average leaving the west each year. The fourth phase of East-West migration in Germany comprises the period from 2002 to 2004. As can be seen from figure 1, gross migration from the east decreased again, with 216.000 individuals in 2002 and about 186.000 persons in 2004. At the same time, overall unemployment in the east reached a level of 20 % and was thus more than twice as high as the corresponding figures for the western part. Finally, the fifth major phase of East-West outmigration in reunified Germany is the period from 2005 onwards. Since 2005 gross migration flows from the eastern part remain more or less stable, amounting to an average of 175.000 people per year.

In conclusion, there are four aspects worth mentioning. Firstly, considering the period from 2005 onwards and taking stable West-East migration from the mid 1990s into account, East Germany still loses around 50.000 individuals or 0.3 % of its population each year. Secondly, summing up East-West as well as West-East migration from 1989 until the end of 2007, cumulative net migration amounted to 1.7 million persons. This relates to a remarkable share of 10.3 % of the original East German population at the beginning of 1989. Thirdly, since 1999 the income gap per capita between East and West Germany, as measured by real GDP per employee (figure 2), has hardened. East German per capita income is still between 22 to 25 % lower than in the west. Finally, unemployment remains a major cause for concern for eastern Germany, it being more than twice as high as in the west since the mid 1990s.

3 Previous empirical studies of German migration

The existing literature analysing the determinants of migration within Germany after reunification can be broadly grouped into two main categories. Whereas there are several empirical studies investigating the considered migration movements using micro data, there are only a few investigations that analyse interregional migration within all of Germany using macro level data. A selection of empirical studies from both categories is to be presented in this section.[3]

Schwarze/Wagner (1992) provide one of the first studies analysing the determinants of German migration, especially East-West migration, using micro level data. To answer the question regarding the determinants of migration in the East-West German context, the authors use data from the eastern subsample of the German Socioeconomic Panel (GSOEP) for the first two waves of 1990 and 1991. Due to the fact that these waves do not contain enough actual migration observations, Schwarze/Wagner (1992) utilise migration intentions or migration readiness as the dependent variable in their empirical investigation.[4] As expected, unemployment, imminent job loss or unemployment of the spouse increases migration readiness substantially. The empirical results of Schwarze/Wagner (1992) provide no evidence of a significant relationship between the formal qualification and the migration intention of the surveyed people. The authors state that the actual basis for the selection effect is the young age of those willing to migrate. Lastly, it is referred to another important effect: according to Schwarze/Wagner (1992) the discontent about the environmental status increases the migration readiness from the eastern to the western part of Germany sizeably.[5]

Similarly to Schwarze/Wagner (1992), Burda (1993) investigates the determinants of the migration intention of East Germans using individual level data from the GSOEP for 1991. In contrast to the empirical investigation of Schwarze/Wagner (1992) Burda (1993) attempts, amongst others, to test for the 'option value of waiting' theory[6] of migration. In this regard the author tries to implement the assumption of uncertainty into his empirical approach by integrating two specific variables which are supposed to describe the subjective expectation of an imminent future job loss. In his empirical investigation Burda (1993) proves that these two variables significantly increase the migration intention, thus supporting the author's 'option value of waiting' approach.[7] Moreover, Burda (1993) finds a negative relationship between age and migration readiness. Whereas the existence of friends and/or relatives in the west (as a proxy for possible network effects) and the rent level in the East are significantly positive

[3] See Wolff (2006) for a detailed review of the literature on the determinants of German migration, in particular East-West German migration, after reunification.
[4] See Schwarze/Wagner (1992), p. 59.
[5] See ibid., p. 59 et seqq.
[6] For more information on the 'option value of waiting' theory of migration see Burda (1995) as well as Bauer (1995).
[7] Burda, et al. (1998) use the empirical analysis of Burda (1993) as a point of departure to test again for the 'option value of waiting' theory of migration.

influencing variables, no statistically significant evidence is found for the expected positive relationship between formal qualification and the migration intention.[8]

In contrast to Burda (1993), Schwarze (1996) not only investigates the determinants of migration readiness of East Germans. Using a sequential decision model (sequential probit model) and controlling for unobserved heterogeneity of individuals, the author goes one step further and analyses the migration behaviour of persons who previously stated their migration intention and fulfilled this intention in subsequent years. Micro level data from the GSOEP for 1991 – 1994 are used to answer the question as to whether the wage-gap between the eastern and the western federal states of Germany significantly influences the migration behaviour of the East Germans.[9] The main results of the empirical analysis emphasise that the estimation of the model using actually observed wages does not provide the results that one would expect from the theory. However, estimating the model utilising expected wages to take individual wage uncertainty into account, Schwarze (1996) shows that the wage-gap between the eastern and the western federal states does influence the migration behaviour of the East Germans. Moreover, qualification is also identified as a positively influencing determinant of migration.[10]

Brücker/Trübswetter (2007) provide the last microeconometric study which is to be presented here. At the core of their study lies an analysis of the self-selection of migrants à la Borjas (1987) and Roy (1951), i.e. the self-selection process of East-West migrants after the German reunification.[11] Utilising a switching regressing model and data from the IAB-employment sample (regional file) for 1992 – 1997,[12] Brücker/Trübswetter (2007) come up with the following results. In contrast to the predictions of the standard Roy model, the authors find that employed individuals migrating from the eastern to the western part of Germany remain positively self-selected with respect to unobserved abilities. However, Brücker/Trübswetter (2007) align this result with the predictions of their developed extended Roy model which considers moving costs that are negatively related to the labour market abilities of individuals.[13] Another important result refers to the influence of the wage differential and eastern unemployment on the probability of actual migration of the considered individuals. Brücker/Trübswetter (2007) identify wage disparities and differences in employment opportunities as key factors influencing the migration behaviour of East Germans after the reunification.[14]

Having critically analysed the above-mentioned studies, two important points are noteworthy. Firstly, some microeconometric studies use migration intentions or migration readiness instead of actual migration as the dependent variable in their econometric analyses. However, the fact that they are only predictions of potential migrants' actual behaviour in the future

[8] See Burda (1993), p. 456 et seqq.
[9] See Schwarze (1996), p. 51.
[10] See ibid., p. 62 et seqq.
[11] See Brücker/Trübswetter (2007), p. 371.
[12] In the empirical investigation the authors, however, only use data from the years 1994 – 1997.
[13] See Brücker/Trübswetter (2007), p. 390 et seq.
[14] See ibid., p. 388.

makes intention variables highly problematic.[15] Secondly, all studies in this category examine relatively short sample periods. Given that one cannot make statements concerning the robustness of the empirical results over longer time intervals, one should interpret the given results with caution.

In contrast to the considerable number of microeconometric studies, of which some examples have been reviewed above, there are only a few investigations that analyse the determinants of interregional migration within Germany using macroeconomic data.

Alecke/Untiedt (2000) provide one of the first empirical investigations in this category. The authors analyse the determinants of interregional migration within Germany for the period 1991 – 1997 at the federal state level using aggregate panel data. In particular, Alecke/Untiedt (2000) investigate whether regional disparities in the wage level and in real wages as well as unemployment influence the inner German migration behaviour after reunification.[16] In their empirical analysis the authors estimate gross and net migration flows as well as the corresponding migration rates. In estimating the relevant gross and net migration functions the following results can be emphasised. Regional disparities in real wages and unemployment influence both gross and net migration. For this reason regional real wage and unemployment differentials are proven to be the essential determinants of inner German migration after reunification. Furthermore, the empirical results show that gross migration depends positively on the degree of capacity utilisation, i.e. there is a pro-cyclical dependency of migration within Germany. In contrast, the influence of the degree of capacity utilisation as a business cycle indicator on net migration is not significant, which means that net migration remains stable over the economic cycle.[17] Following this, Alecke/Untiedt (2000) use the estimated net migration function to analyse, in particular, East-West migration. Using the previously estimated net migration function (without considering region-specific effects) it is shown that there is a high consistency between actual and estimated net migration. However, the actual level of net outmigration from the eastern part of Germany is considerably overestimated. The authors state East-West commuting as well as the granting of massive income transfers to the eastern part as possible explanations for this empirical finding.[18]

Another macroeconometric study which is to be presented here is that of Parikh/Van Leuvensteijn (2003). In this study, the authors investigate the determinants of interregional migration between the federal states of Germany after reunification using data on labour migration for the period 1993 – 1995. Their focus lies on the influence of wage and unemployment differentials between the considered regions on the migration behaviour of the labour force. Moreover, Parikh/Van Leuvensteijn (2003) try to investigate whether there is a non-linear relationship between regional wage differentials and migration for the analysed employee categories (blue-collar workers vs. white collar workers), as suggested by the risk aversion of individuals and by the 'option value of waiting' theory. Finally, the authors

[15] See Manski (1990) for a detailed discussion of this issue.
[16] See Alecke/Untiedt (2000), p. 4.
[17] See ibid., p. 9 et seqq.
[18] See ibid., p. 20 et seqq.

analyse the relationship between home ownership and labour mobility.[19] Using a simple panel data approach Parikh/Van Leuvensteijn (2003) present the following results. At first, it is demonstrated that wage differentials between German regions act as a migration determining factor. However, the authors then find evidence for a non-linear relationship between regional wage differentials and migration for the analysed employee categories. Whereas this relationship seems to be U-shaped or convex for white collar workers, an inverted U-shaped or concave relationship is found for blue-collar workers. The 'option value of waiting' theory and the risk aversion of individuals serve as an explanation for the detected phenomenon according to Parikh/Van Leuvensteijn (2003). Moreover, the authors state that this relationship is also supported by the wage convergence between the eastern and western German regions and the associated decreasing net returns to migration. Regional unemployment differentials as well as the general unemployment level do not play any significant role in explaining labour migration movements within Germany. Finally, there is evidence that home ownership negatively influences labour mobility.[20]

Hunt (2006) provides the macroeconometric study which will be lastly presented here.[21] The author uses aggregate migration data to analyse to the extent to which regional wage and unemployment levels and their development over time are able to explain East-West migration patterns within unified Germany. For this purpose Hunt (2006) applies pair-wise gross migration flows between the federal states of Germany and utilises the corresponding migration flows within West Germany as a comparison. The investigated sample period is 1991 – 2000.[22] Using a macroeconometric estimation model Hunt provides an explanation for the decreasing trend in East-West German migration from 1992 until the mid 1990s by applying data on, amongst others, deflated manufacturing wages as well as regional unemployment rates. Increasing wages in the eastern part until the mid 90s and the associated wage convergence between both parts of reunified Germany are the most important factors in explaining this migration pattern. In contrast, soaring eastern unemployment contributes only little to explaining this development. Hunt (2006) emphasises that this fact reflects the behaviour of the young, who are very sensitive to source region wages and relatively insensitive to source unemployment.[23]

In concluding the review of this category of studies, the following implications are most worth singling out. Two of the reviewed studies focus on East-West German migration more or less explicitly. However, the majority of these studies (most of which are not presented here) focus on the determinants of migration for all of Germany. Moreover, as is the case with the previous category, all empirical investigations are conducted for rather small periods of

[19] See Parikh/Van Leuvensteijn (2003), p. 931 et seq.

20 See ibid., p. 937 et seqq.

21 The analysis of Hunt (2006) contains both a macroeconometric investigation and a microeconometric examination of the determinants of German migration. Here, we focus on the macroeconometric part of the analysis although the microeconometric study of Hunt (2006) could also be presented in the first part of this section. A former version of Hunt (2006) was entitled "Why Do People Still Live in East Germany?". See Hunt (2000). Hunt (2000), in turn, provides the basis for the macroeconometric investigation on the determinants of German migration of Burda/Hunt (2001) which is not considered here.

[22] See Hunt (2006), p. 1015 et seq.

[23] See ibid., p. 1023 et seqq.

time. Furthermore, the primary constraint of some of these macroeconometric studies of including wage and unemployment variables as well as their differences as the main explanatory factors in their empirical regression equations seems to be too restrictive, in particular, against the backdrop of other important migration determinants proposed by microeconomic theory. Considering that the German reunification took place nearly 19 years ago, it seems highly indicated to conduct an empirical investigation at the macroeconomic level that focuses explicitly on the various factors determining East-West migration after the reunification for a longer time period.

4 The human capital approach as the underlying theoretical model framework

The human capital approach is widely diffused in the field of economic research on migration. For instance, the most important theoretical models and empirical studies in the field of migration are based on this approach.[24]

The foundations of the human capital approach date back to the investment theory. Thus, it is possible to translate a company's investment decision to buy a technologically newly developed machine into a decision taken at the household or individual level. In this way, the human capital approach explained the individual investments in training and education by comparing the private and social gains with the resulting costs.[25] The approach was also used to analyse the job search of employers and potential employees as well as to explain couples' decisions to have children.[26]

The human capital approach is, therefore, not to be seen only as a concept that explains individual investments in training and education, but also as a tool that can be easily applied in the field of migration to help explain decisions both on the individual as well as on the household level. The first author who applied this approach to the migration decision was Larry A. Sjaastad. Sjaastad (1962) considered the decision to migrate as the result of a cost-benefit calculation, whereby migration represents an investment, from which the potential migrant expects to gain.[27] In Sjaastad's own words: *"..., we treat migration as an investment increasing the productivity of human resources, an investment which has costs and which also renders returns."*[28] In the following, the general formulation of Sjaastad's adopted human capital approach on migration will be illustrated.

According to Sjaastad's individual cost-benefit analysis, an individual tries to maximise his utility over his entire lifespan through migration. The total utility of the individual in case depends on two main factors: a) the yearly consumption of private and public goods ($C_{L,t}$) realisable in the country of residence (L) and b) a number of individual factors ($X_{L,t}$) (e.g. climatic conditions, regional location, cultural and social environment, established social networks, etc.) that can be assessed differently according to each individual. The final decision as to whether to migrate depends entirely on the total utility of the migration. In this respect, the above-mentioned factors are considered at their present value discounted at the interest rate (r). This is expressed by the equation:

$$U_0^G = \int_0^T e^{-rt} U\left[C_{L,t}, X_{L,t}\right] dt \qquad (1)$$

24 See Dresel (2005), p. 39.
25 Compare the works of Becker (1962), Becker (1964), Mincer (1962), Mincer (1974) as well as Schultz (1962) regarding this topic.
26 See Milne (1991), p. 137.
27 See Dresel (2005), p. 40.
28 Sjaastad (1962), p. 83.

Consequently, the individual calculates the present value of the total utility (U^G_0) in each potential destination (j), including his country of origin (i). Migration takes place if the expected net benefit of migrating (NB_0), i.e. the present value of the utility in the destination region (j) less the costs of migration (K_0), is greater than the present value of utility in the source region ($U^G_{i,0}$). If the expected net gain from migration is positive, then individuals will migrate to the destination in which this amount is maximised. Mathematically explained, this means:[29]

$$NB_0 = \left(U^G_{j,0} - K_0\right) > U^G_{i,0} \qquad (2)^{30}$$

According to Sjaastad (1962), the usability of the individual human capital is the core of the migration decision. Following the author, there are two different types of migration costs. One has to distinguish between the so called *„money costs"* (direct migration costs) and *„non-money costs"* (indirect migration costs).[31] Sjaastad (1962) considers not only travel and transport costs as direct expenses but also other costs such as the search and acquisition of new lodging or losses incurred through the shifting of property due to, for example, the sale of property in the home country.[32] Under indirect migration costs Sjaastad (1962) subsumes, on the one hand, opportunity costs, such as income forgone during the period of the actual migration, expenses of the job search or the costs of familiarisation at the new place of work and, on the other hand, the "psychical" costs, such as losses sustained through leaving friends and family behind or through having to build a new social network, learn a new language or overcome cultural barriers.[33]

At this point it is worth mentioning another important aspect. Three elements of the general formulation of the individual cost-benefit calculation (see equation (1)) are of great relevance. To begin with, the individual utility, as already indicated, does not depend only on the expected consumption possibilities, which in turn depend on the realised income, but also on various individual factors (e.g. the social environment, language and culture gaps, etc.), whose assessment may vary according to the different economic agents. Secondly, the utility of migration is time-related, which means that it is also significantly determined by the agent's life-expectancy. This, in turn, implies that younger persons have a greater propensity to migrate, or rather, migrate more often than older persons because the periods in which an individual may benefit through migration diminish with increasing age. In addition to the time factor, the present value of the net benefit of migrating is also considerably affected by the migrant's level of qualification. The level of qualification is a decisive factor because it indirectly determines the realisable consumption possibilities through the level of income. Thirdly, it is to be noted that the utility evaluation is afflicted with a degree of risk due to uncertainties regarding the region of origin as well as the destination region. Hence the

[29] See Dresel (2005), p. 40 for the above explanations.
[30] Own illustration, based on ibid., p. 40.
[31] Sjaastad (1962), p. 83.
[32] See ibid., p. 83 et seq.
[33] See ibid., p. 84 et seq.

inclusion of information about the living and labour market conditions in the destination region is a key determining factor.[34]

With regard to the migration decision, it seems more appropriate to express the utility in the form of an indirect utility function which expresses utility as income. Many models within the migration theory make use of this implication and set utility equal to income, where income in turn is taken as the income the migrant can earn in the region of origin (W_i) or in the destination region (W_j).[35] As a result, the migration decision represents an investment calculus for the individual human capital. Thereby the potential migrant decides where his human capital yields the highest utility, i.e. in which region his human capital maximises his income.[36]

The illustrated human capital approach experienced a fundamental extension through the works of Todaro (1969) and Harris/Todaro (1970) by incorporating uncertainty over the destination region's labour market situation into the analysis. Besides differences in income between the region of origin and of destination, which are represented by the respective wages, the possibility of finding a job in the destination region plays an important role in the cost-benefit analysis. Hence, the potential migrants weight the wage rates (W_j) and (W_i) with the factors ($1-u_j$) and ($1-u_i$) reflecting the labour market situation[37] in the region of destination and of origin respectively.[38] Thus, the migration decision can be formulated as dependent on the expected wage/income difference between both regions.

$$NB_0 = \int_0^T e^{-rt} \left\{ \left[1 - u_{j,t}\right] W_{j,t} - \left[1 - u_{i,t}\right] W_{i,t} \right\} dt - K_0 \qquad (3)^{39}$$

Just as in the simplified approach, the benefits of migration are contrasted with the respective costs in the extended illustration too.[40] Thus, migration makes sense only if the benefits, expressed by the present value of the expected income difference between the destination region and the region of origin, are greater than the incurred costs, i.e. if the net gain of migration (NB_0) is positive. As can be seen above, the equation comprises both push as well as pull elements. Thereby, the wage (or income) level (W_j) and the probability of employment, i.e. the labour market situation ($1-u_j$) represent the pull factors of the destination country. In contrast, the employment probability ($1-u_i$) and the wage (or income) level (W_i)

[34] See Sinn, et al. (2001), p. 25 et seq.

[35] Here, income refers to real income. Since the decision to migrate depends most likely on the real income, individuals will also try to take into account the different price levels in each region. See Milne (1991), p. 149.

[36] See Sinn, et al. (2001), p. 26.

[37] u_j and u_i represent the unemployment rates in the destination region and the region of origin, respectively. Therefore, the factors ($1-u_j$) and ($1-u_i$) correspond to the respective employment situation, i.e. the probability of finding work, whereas the weighted wage rates $W_j(1-u_j)$ and $W_i(1-u_i)$ stand for the corresponding expected wages/income.

[38] See Todaro (1969), pp. 139 et seqq. and Harris/Todaro (1970), p. 127 et seqq.

[39] Own illustration, based on Steinmann (1996), p. 39.

[40] Rather than the extended formulation (as seen above), most theoretical treatises on the human capital approach to migration usually make use of the basic formulation similar to the following: $NB_0 = \int_0^T e^{-rt} \left\{ W_{j,t} - W_{i,t} \right\} dt - K_0$

See Greenwood (1975), Massey, et al. (1993), Chies (1994), Dresel (2005) and Milne (1991).

represent the push factors of the country of origin. The inclusion of further elements does not occur in this extended, but simplified, illustration of the human capital approach. Nevertheless, further factors influencing migration between emigration and immigration country are essential for a wholesome analysis – a fact of which Sjaastad (1962) was very well aware. These factors are not explicitly included in the above illustration, but are already, if only rudimentarily, expressed in the individual factors of Sjaastad's cost-benefit analysis.
Thus, the presented equations, especially equations (2) and (3), provide a theoretical foundation for the migration decision based on the human capital approach. However, in order to test the migration determinants involved in the human capital approach, it is necessary to derive some sort of general human capital model that can eventually be estimated. A general formulation of the human capital model, which is found in many empirical studies and which will serve later on as the basis for the estimation model, describes the migration of individuals from home country (i) to destination country (j) as follows:[41]

$$M_{ij} = f_{ij}\left(X_i, X_j, K_{ij}\right) \qquad (4)^{42}$$

- $X_i \equiv$ Vector of explanatory variables of the emigration country influencing the migration decision;
- $X_j \equiv$ Vector of explanatory variables of the immigration country influencing the migration decision;
- $K_{ij} \equiv$ the costs of migration from i to j; and
- $f_{ij} \equiv$ a particular functional form (e.g. linear or log-linear).

As can be seen from equation (4), this general formulation of the human capital model allows the possibility of various factors to affect the migration movements between regions or countries. Furthermore, this general illustration differs quite strongly from earlier applications of the human model of migration theory. In these earlier applications the discounted (expected) income was principally the only decisive variable determining migration. By contrast, the vectors (X_i) and (X_j) in the general formulation comprise all those factors that influence the life of individuals in the country of origin and destination.[43]

The human capital approach is clearly attributed to the microeconomic theories of migration. These theories focus on the determinants or rather, on the reasons behind individual or familial migration decisions and therefore concentrate basically on the migration motives. In contrast, the macroeconomic migration theories, such as the push and pull approach focus mainly on the analysis of the resulting migration flows – a fact seemingly expressed by the general formulation of the human capital model in equation (4). These flows trace back to demographic, economic and political differences between the emigration and immigration countries.[44] However, micro- and macroeconomic theories do not as such contradict each

[41] See Milne (1991), p. 140.
[42] Own illustration, based on ibid., p. 140.
[43] See ibid., p. 140.
[44] See Steinmann (1996), p. 41.

other. On the contrary, these two mainstreams of economic migration research do not contradict each other precisely because it is the individuals, or rather, a group of individuals that decide whether to migrate, and it is they who, after all, migrate from A to B. It is, therefore, the individuals who are behind the flows of migration and in the limelight of the macroeconomic migration theory. Thus, even if the general formulation of the human capital model in equation (4) gives the prima facie impression of a common macroeconomic push and pull approach, a microeconomic foundation of the aimed-at empirical estimations is, by all means, reasonable and justifiable.

Applied in the context of East-West German migration, it is to be assumed that the following factors possibly affect the migration movements between the old West German states and the newly-formed ones. For instance, factors such as income and wage differences, differences in the labour market situation or, for that matter, the employment situation, regional differences in infrastructure or differences in the housing and property markets could, from a macro-economic point of view, be considered as possible factors between eastern and western Germany, and may therefore also be considered as relevant migration determinants. In addition, it may also be reasonable to take other possibly influential factors into account, e.g. the geographical distance (as an approximation of migration costs), existing social networks between the old and newly-formed German states, the macroeconomic situation (to analyse the migration flows' dependency on the business cycle) as well as other region-specific characteristics.

In the following sections it will be discussed in detail which macroeconomic determinants are best suited to explain the East-West German migration movements since the fall of the Berlin Wall and Germany's subsequent reunification.

5 Empirical approach and data

In order to analyse the determinants of East-West German migration, the following macroeconometric panel data model is estimated using pair-wise gross migration flows as well as the corresponding gross migration rates between the respective eastern and western German federal states for the period from 1991 – 2007. Using yearly migration data, the two stated basic estimation equations are estimated in logarithmic form[45]. Unobserved heterogeneity or fixed effects are also taken into account.

$$\begin{aligned}\ln\left(\mathrm{om}_{ij}\right)_t &= \alpha + \beta_1 \ln\left(\frac{y_j}{y_i}\right)_{t-1} + \beta_2 \ln\left(\frac{empl_j}{empl_i}\right)_{t-1} + \beta_3 \ln\left(\frac{vac_j/empl_j}{vac_i/empl_i}\right)_{t-1} + \beta_4 \ln\left(\frac{ms_j}{l_j}\right)_{t-1} \\ &+ \beta_5 \ln\left(kap\right)_{t-1} + \beta_6 \ln\left(\frac{appr_j}{appr_i}\right)_{t-1} + \beta_7 \ln\left(psqm_i\right)_{t-1} + \beta_8 \ln\left(\frac{yage_i}{l_i}\right)_{t-1} + \beta_9 \ln\left(\frac{qual_i}{empl_i}\right)_{t-1} \\ &+ \beta_{10} \ln\left(d_{ij}\right) + \mu_{ij} + \varepsilon_{ijt}\end{aligned} \tag{5}$$

$$\begin{aligned}\ln\left(\frac{\mathrm{om}_{ij}}{\mathrm{l}_i}\right)_t &= \alpha + \beta_1 \ln\left(\frac{y_j}{y_i}\right)_{t-1} + \beta_2 \ln\left(\frac{empl_j}{empl_i}\right)_{t-1} + \beta_3 \ln\left(\frac{vac_j/empl_j}{vac_i/empl_i}\right)_{t-1} + \beta_4 \ln\left(\frac{ms_j}{l_j}\right)_{t-1} \\ &+ \beta_5 \ln\left(kap\right)_{t-1} + \beta_6 \ln\left(\frac{appr_j}{appr_i}\right)_{t-1} + \beta_7 \ln\left(psqm_i\right)_{t-1} + \beta_8 \ln\left(\frac{yage_i}{l_i}\right)_{t-1} + \beta_9 \ln\left(\frac{qual_i}{empl_i}\right)_{t-1} \\ &+ \beta_{10} \ln\left(d_{ij}\right) + \mu_{ij} + \varepsilon_{ijt}\end{aligned} \tag{6}$$

The empirical investigation is conducted for the period from 1991 onwards because disaggregated migration data for all 16 German federal states[46] is not available prior to that. Unified Berlin is treated as the sixth eastern German federal state because separate migration data for East and West Berlin are not available after 1999[47]. The variables integrated into the basic estimation equations are defined as follows:[48]

i ≡ Source region / source federal state, here defined as an East German federal state or Berlin total

[45] See Fields (1979), p. 22 et seq. and Schultz (1982), p. 572 for the advantages of a double log-linear specification of empirically specified migration estimation equations.

46 The 16 German federal states are: Brandenburg, Berlin, Mecklenburg-Western Pomerania (Mecklenburg-Vorpommern), Saxony (Sachsen), Saxony-Anhalt (Sachsen-Anhalt), Thuringia (Thüringen), Baden-Württemberg, Bavaria (Bayern), Bremen, Hesse (Hessen), Hamburg, Lower Saxony (Niedersachsen), North Rhine-Westphalia (Nordrhein-Westfalen), Rhineland-Palatinate (Rheinland-Pfalz), Schleswig-Holstein and Saarland.

47 The reasons and justifications for treating unified Berlin as the sixth eastern German federal state in this empirical investigation are given below.

48 See the data appendix for detailed information on denotations and data sources of the variables used in the respective migration model specifications.

j ≡ Destination region / federal state of destination, here defined as a West German federal state

om_{ij} ≡ Gross emigration from an East German federal state or Berlin total (i) to one of the ten West German federal states (j)

om_{ij} / l_i ≡ Gross emigration rate East-West
- Quotient of gross emigration from an East German federal state or Berlin total (i) to one of the ten West German federal states (j) and the resident population l_i of an East German federal state or Berlin total (i).

α ≡ Constant

y_j / y_i ≡ Quotient of the real income per capita in the respective federal state of destination (j) and the source region (i)
- Real income per capita approximated by the gross domestic product in prices of 2000 per employee.

$empl_j / empl_i$ ≡ Quotient of the number of employees in the respective federal state of destination (j) and the source region (i)

$(vac_j/empl_j)/(vac_i/empl_i)$ ≡ Quotient of the respective shares on the number of open/reported job vacancies and the number of employees in destination region (j) and source region (i)

ms_j / l_j ≡ Quotient of the share of East-West migrants, who already live in West Germany and the total population of West Germany l_j

kap ≡ Degree of capacity utilization in the manufacturing industry for Germany as a whole

$appr_j / appr_i$ ≡ Quotient of the regional provision of infrastructure in the respective federal state of destination (j) and the source region (i)
- Regional provision of infrastructure is approximated by the number of apprenticeship places available per 1000 residents of the eligible age group.

$psqm_i$ ≡ Indicator for the regional housing and real estate market situation in the respective East German federal state or Berlin total (i)
- Regional housing and real estate market situation here approximated by the monthly estimated / expected rent in EUR/m2.

$yage_i / l_i$ ≡ Quotient of 16 to under 30-year-olds and the total population of the respective East German federal state or Berlin total (i)

$qual_i / empl_i$ ≡ Share of highly qualified (here: white-collar workers and public servants) in the total labour force (total number of

employees) of the respective East German federal state or Berlin total (i)

d_{ij} ≡ Geographical distance, expressed in km between the capital of the respective East German federal state or Berlin total (i) and the capital of the respective West German federal state (j)

μ_{ij} ≡ Unobserved heterogeneity or fixed effects, where each fixed effect μ_{ij} represents a pair-wise flow in the East-West German direction

ε_{ij} ≡ Error term.

As can be seen from equations 5 and 6, gross migration East-West as well as the corresponding gross migration rate is used as the relevant dependent variable in the empirical analysis.[49] The concept of the rate of migration accounts for the fact that regions or federal states with a large population also have a higher number of potential migrants.[50] The utilisation of a net migration measure is renounced in this empirical investigation for the following reasons. The possible correlation of the flows of migration from A to B and vice versa make using net migration (defined as the absolute difference between emigration and immigration in a region) as the relevant dependent variable in an empirical analysis problematic. Applying such an approach would mean that the different factors, i.e. the various push and pull factors, affecting gross migration in both directions could not be distinguished.[51] Whereas regression coefficients for variables which have the same impact on migration flows in both directions tend to be overestimated, coefficients for variables with a different impact on immigration and remigration tend to be underestimated.[52] Therefore, it seems more appropriate to apply gross migration as well as gross migration rates instead of net migration measures as the relevant dependent variable in an empirical migration model.

The following has to be said concerning the utilisation of the various independent variables in the empirical analysis. The quotient of the real income per capita, approximated by the gross domestic product (GDP) in prices of 2000 per employee, between the respective federal state of destination (j) and the source region (i) is used to capture income differentials between the eastern and the western part of Germany. According to the economic theory of migration, i.e. the human capital approach, increasing real per capita incomes in the federal states of origin (i) should decrease outmigration from the East whereas rising incomes per capita in the western federal states should encourage emigration from the east. Hence, an increasing income differential between source and destination region should increase migration movements from East to West Germany. The use of real GDP per employee as a measure of income per capita has an advantage over the utilisation of real GDP per resident. Comparing the GDP per resident of different regions, one has to take into account that the level of GDP in some regions will be substantially influenced through individuals commuting into that

[49] See Krugman/Bhagwati (1976) for a discussion on the right choice of the dependent variable in empirical migration models.
[50] See Bauer/Zimmermann (1999), p. 22.
[51] See ibid., p. 23.
[52] See Brosnan/Poot (1987), p. 315.

region. GDP, namely, measures the aggregate economic activity within a region, independent of whether it is generated by the local labour force or by work-related commuters. Therefore, the number of employees at the workplace seems to be the more appropriate reference parameter of GDP per capita than the corresponding resident population of that region. Especially economic centres, like Hamburg or Bremen, for instance, could exhibit comparatively high values of GDP per resident, whereas GDP per resident in the surrounding regions, i.e. the regions where the commuters live, is underestimated.[53] An adequate wage measure to account for wage differentials between source and destination region is not included in this empirical investigation. The reason for this is that one cannot account for regional price differences and thereby real wage differences between the respective federal states of Germany. Cost of living indices only exist for East Germany and West Germany in total. There are no separate deflators or cost of living indices at the disaggregated level for the 16 federal states.

Regional differentials in the employment and labour market situation are captured using two specific variables. On the one hand, the variable ($empl_j$ / $empl_i$) is used to cover the different sizes of the labour markets between the western and eastern German federal states. Here, the size of the labour market of the considered region is approximated by the number of employees. Hence, it is expected that migrants move to regions with bigger labour markets where it should be easier for them to find jobs according to their professional qualifications and personal perceptions. Consequently, the number of employees as an approximation for the labour market size of a region can be regarded as an indicator of employment opportunities. The higher the number of employees in the region of destination is, the higher the chances are to get a job there. Hence, the coefficient on $empl_j$ is expected to exhibit a positive sign whereas the corresponding coefficient on $empl_i$ is supposed to show a negative sign. Consequently, an increasing difference in the labour market sizes between the respective source and destination regions should encourage people to migrating from the eastern to the western part of Germany. On the other hand, the variable ($vac_j/empl_j$)/($vac_i/empl_i$) is used as a measure of the intensity or strength of labour demand between the federal states of destination and origin. While a higher intensity of labour demand in the western German federal states, i.e. $vac_j/empl_j$, should attract people from the east, a higher strength of labour demand in the respective eastern regions is supposed to discourage eastern outmigration. Consequently, an increasing differential in the intensity of labour demand between both parts of Germany is expected to pull people out of the east. Testing different model specifications in the sensitivity analysis of this empirical investigation, the unemployment differential between source and destination region will also be integrated as an explanatory factor.

Furthermore, a network variable covering potential network effects of migration is considered in the empirical analysis. Here, the quotient of the share of East-West migrants, who already live in West Germany, weighted by the total population of West Germany (l_j), acts as an approximation for potential network effects.[54] To construct this variable, net East emigration over the period from 1957 to 1990 is cumulated, whereas 1957 is the first year for which

[53] See Statistisches Bundesamt (2006), p. 67.
[54] See Straubhaar (2001) for a similar approach in the context of European migration.

aggregate migration data in an East-West German context is available. Thereafter further yearly summation of net East emigration results in a kind of net migration stock of East-West migrants in West Germany for the respective year. This yearly figure is then weighted by the total resident population of West Germany of the corresponding year. According to the economic theory of migration, existing and well functioning migrant networks in the country or region of destination should reduce the costs and risks for subsequent migrants to move to that region. This cost and risk reduction leads, in turn, to a higher net return of mobility and consequently to a higher probability of migration.[55] As a consequence, the regression coefficient on the network variable is supposed to show a positive sign.

An additional aspect that emerges from the empirical literature is the dependency of migration flows on the business cycle. Considering the coefficient covering the business cycle effect of migration, one cannot expect an unambiguous sign a priori: on the one hand, labour demand as well as the search intensity of people looking for a new job is low in recession, while on the other hand, one can expect a higher mobility of the supply of labour due to the higher overall level of unemployment in a recession. Nevertheless, a pro-cyclical dependency of gross migration seems to be an internationally stylised fact.[56] Different variables like employment, unemployment or the degree of capacity utilisation in the aggregate region are included as additional explanatory factors in various empirical investigations.[57] To capture the effect of the dependency of migration flows on the business cycle the degree of capacity utilization in the manufacturing industry for the whole of Germany is included in the empirical model.

Another aspect that emerges from the economic theory of migration is the need to take regional differentials in infrastructure between source and destination region into account. Here, regional differences in infrastructure are approximated by the number of apprenticeship places available per 1000 residents of the eligible age group (appropriate population group » 16-19 years) in the respective federal state of origin and destination. Companies will locate in regions with better infrastructural conditions and with an appropriate business environment. Consequently, regions with better infrastructural conditions will attract more companies and thus it is more likely that located companies will also offer more apprenticeship places. Considering the East-West German context, better infrastructure in the western part, i.e. a higher number of apprenticeship places available per 1000 residents of the eligible age group in the respective western federal state, should attract migrants from the east. In contrast, eastern outmigration should be discouraged if there are better infrastructural conditions in the east. Increasing regional differentials in infrastructure between the respective federal states of East and West Germany are expected to support gross outmigration from the east.

Factors determining migration can also be found in the regional housing and real estate market situation within a country. One possible indicator capturing the regional housing and real estate market situation could be a measure of monthly rents in the respective currency per square meter of living space. Such an indicator could, to a certain extent, be a measure of or

[55] See Bauer/Zimmermann (1998), p. 102.
[56] See Alecke/Untiedt (2000), p. 8.
[57] See for instance Jackman/Savouri (1992), Westerlund (1997) or Alecke/Untiedt (2000).

reflects the availability of living space in a region. Thus, the sign of a regression coefficient of such a variable is expected to be positive, i.e. increasing rents in a region push individuals out of that region. In this empirical investigation an indicator capturing the regional housing and real estate market situation is approximated by the monthly basic net rent in EUR/m^2. Due to the fact that data on this indicator are not available for the ten western German federal states from 1991 – 1993, this variable is only integrated for the respective East German regions. Following what was mentioned above, an increasing rent level in the east should push people out of their respective region when this indicator reflects the availability of living space. Thus, the sign of the coefficient is expected to be positive.

Two additional aspects that emerge from the human capital approach of migration relate to the age structure and to the qualification structure of those individuals migrating from the source to the destination region. The relationship between the age of individuals and migration is expected to be negative, i.e. younger people tend to have a higher probability of migration because they have more time to profit from the potential net gains of migration. In contrast, the relationship between the qualification of individuals and migration is expected to be positive, meaning that highly qualified people tend to migrate more often. According to the economic theory of migration it is said that individuals who are more skilled and are better qualified than others are more capable of collecting and processing information and thus lowering the risks of migration.[58] In this empirical investigation, an age structure variable indirectly covering the potential relationship between the age of individuals and migration from the eastern to the western part of Germany is approximated by the quotient of 16 to under 30-year-olds and the total population of the respective East German federal state or Berlin total. Hence, a higher share of 16 to under 30-year-olds in relation to the total population of the respective eastern German federal state or Berlin total is expected to lead to higher outmigration from the east. A qualification variable indirectly capturing the corresponding qualification effects of East-West German migration is approximated by the share of highly qualified (here: white-collar workers and public servants) in the total labour force (total number of employees) of the respective East German federal state or Berlin total. Consequently, a higher share of highly qualified individuals in the total labour force of an eastern German region or Berlin total is expected to lead to higher outmigration.

Migration costs as suggested by the human capital approach are approximated by the geographical distance, expressed in km between the capital of the respective East German federal state or Berlin total (i) and the capital of the respective West German federal state (j): the longer the distance between source and destination region, the higher the expected migration costs and thus the lower the number of people migrating from source to destination. Consequently, the regression coefficient on the distance variable is expected to exhibit a negative sign.

Fixed effects or unobserved heterogeneity are also integrated into the empirical estimation models to take into account time-invariant, unobserved factors that also influence migration. Thereby, each fixed effect μ_{ij} represents a pair-wise flow in the East-West German direction.

[58] See Bauer/Zimmermann (1998), p. 97.

One could think of unobserved heterogeneity in the sense that this variable captures all time-invariant, unobserved regional characteristics, such as regional features or the existence of local goods (e.g. the beauty of nature) or other particular regional features that cannot be measured or observed but have, nonetheless, an influence on migration.

The hypotheses about the single estimation parameters can be summarised as follows:

$\beta_1 > 0$, $\beta_2 > 0$, $\beta_3 > 0$, $\beta_4 > 0$, $\beta_5 > 0$ or $\beta_5 < 0$, $\beta_6 > 0$, $\beta_7 > 0$, $\beta_8 > 0$, $\beta_9 > 0$, $\beta_{10} < 0$.

Except for the distance variable and the fixed effects, which remain time-invariant, all regressors are lagged by one period (t-1) to account for the fact that migration is built upon experiences and expectations that are rooted in the past.[59] Overall, there are six emigrating regions, i.e. the federal states of East Germany plus unified Berlin and 10 immigrating regions, the western German federal states. Considering the time period from 1991 to 2007, the total number of observations amounts to 1020 (= 6 x 10 x 17). Due to the first lag of most explanatory variables 960 observations remain for the empirical analysis.

As it was mentioned before, unified Berlin is treated as the sixth eastern German federal state in this empirical investigation. Due to an area reform in Berlin which came into effect on 1 January 2001 East and West Berlin are not distinguished any more in various data sources. With respect to the disaggregated migration data on the federal state level the Federal Statistical Office of Germany (Statistisches Bundesamt) does not provide separate migration data for East and West Berlin after 1999. Hence, from 2000 onwards migration data at the federal state level are only available for unified Berlin. The question that arises is how to treat Berlin in the empirical investigation. Here, unified Berlin is treated as the sixth eastern German federal state in order to have consistent time series for Berlin over the whole period from 1991 – 2007. This procedure can be justified for two reasons. Firstly, Berlin as a whole lies on the territory of the former German Democratic Republic. Secondly, large migration movements from unified Berlin to the surrounding federal state of Brandenburg took place from the mid 1990s until 2007. On a net scale, unified Berlin lost around 205.000 individuals to the surrounding area of Brandenburg. This relates to a share of 6 % of the population of Berlin total at the end of 1990. In conclusion, one might say that unified Berlin has more in common with the eastern than the western part of Germany.

The empirical investigation is not only undertaken for the entire period from 1991 to 2007. The model is also estimated in various different specifications (including different measures for the same factor) and for three different subsamples, i.e. for 1991 – 1995, 1997 – 2001 as well as 2003 – 2007. All these tests and varieties are estimated to provide a thorough sensitivity analysis in order to be able to make statements based on robust results. Finally, descriptive statistics on the integrated variables can be found below.

[59] See Straubhaar (2001), p. 17.

Table 1: Descriptive Statistics of the variables used in the empirical analysis

Variable	Observations	Mean	Std. Dev.	Min.	Max.
om_{ij}	1,020	3,160.353	3,085.477	52	23,416
$\ln(om_{ij})$	1,020	7.445885	1.280623	3.951244	10.06117
om_{ij} / l_i	1,020	0.0011255	0.0010273	0.0000285	0.0052215
$\ln(om_{ij} / l_i)$	1,020	-7.385787	1.272538	-10.4648	-5.25497
y_i	1,020	39,500.25	7,185.746	18,589.28	50,300.28
$\ln(y_i)$	1,020	10.56456	0.2070012	9.83034	10.82577
y_j	1,020	54,817.59	6,029.727	45,337.06	73,026.13
$\ln(y_j)$	1,020	10.90614	0.1044067	10.72188	11.19857
$\ln(y_j / y_i)$	1,020	0.3415761	0.2036912	-0.0745848	1.222782
$empl_i$	1,020	1,245,385	409,787	707,895	2,250,348
$\ln(empl_i)$	1,020	13.98352	0.3178606	13.47005	14.6266
$empl_j$	1,020	3,096,775	2,543,270	379,430	8,582,915
$\ln(empl_j)$	1,020	14.51948	1.00202	12.84643	15.96528
vac_i	1,020	11,704.91	6,175.241	3,392	36,460
$\ln(vac_i)$	1,020	9.247087	0.4848714	8.129175	10.50397
vac_j	1,020	32,743.14	27,957.52	1,555	123,328
$\ln(vac_j)$	1,020	9.919001	1.091151	7.349231	11.7226
$\ln[(vac_j / empl_j) / (vac_i / empl_i)]$	1,020	0.1359502	0.4341062	-0.8549929	1.455102
(ms_i / l_i)	1,020	0.0467582	0.0034503	0.041627	0.0527785
$\ln(ms_i / l_i)$	1,020	-3.065456	0.0732153	-3.179006	-2.941651
kap	1,020	84.06176	2.231551	78.75	88.225
ln(kap)	1,020	4.431198	0.0266563	4.366278	4.47989
$appr_i$	1,020	148.5443	25.97092	87.69401	219.8697
$\ln(appr_i)$	1,020	4.985278	0.1782166	4.473854	5.393035
$appr_j$	1,020	186.6729	50.04863	109.4234	332.8383
$\ln(appr_j)$	1,020	5.195964	0.255353	4.695225	5.807657
$\ln(appr_j / appr_i)$	1,020	0.2106864	.2430229	-0.5655757	0.9431028
$psqm_i$	1,020	3.297057	1.04898	0.9714546	4.56
$\ln(psqm_i)$	1,020	1.114201	0.4477532	-0.0289608	1.517323
$(yage_i / l_i)$	1,020	0.1782023	0.007201	0.1662322	0.2100448
$\ln(yage_i / l_i)$	1,020	-1.725623	0.0393425	-1.79437	-1.560434
$\ln(qual_i / empl_i)$	1,020	-1.478309	0.1107009	-1.697278	-1.21742
d_{ij}	1,020	451.8667	158.7481	109	769
$\ln(d_{ij})$	1,020	6.038507	0.4132519	4.691348	6.645091

6 Econometric results and sensitivity analysis

This section is divided into two parts. Whereas the first part presents the econometric results as well as a sensitivity analysis on the gross migration flows in the East-West German direction, the second part provides the corresponding results on the respective gross migration rate.

6.1 Gross migration flows East-West

As a point of departure, the empirical model with gross migration flows from the eastern to the western German federal states as the relevant dependent variable is estimated for the period 1991 - 2007 using different estimation methods as can be seen from table 2 below. It begins with the Least-Squares Dummy Variable (LSDV)-estimation (column 1), continues with the Fixed Effects (FE) and Random Effects (RE) regression (columns 2 and 3), and ends with the Feasible Generalized Least-Squares (FGLS)-estimation, taking, firstly, heteroscedasticity alone, then, autocorrelation on its own, and then both aspects together into account (columns 4 - 6). Applying the Breusch/Pagan Lagrange multiplier test for random effects the null hypothesis that the variance of the fixed effects equals zero can be rejected (column 3).[60] As expected, unobserved heterogeneity is existent when considering East-West German migration over the regarded sample period. Furthermore, heteroscedasticity as well as first order autocorrelation in the residuals can also be detected in the applied migration model (columns 4 and 5).[61]

Reviewing the econometric results of table 2, one can detect that most of the regression coefficients show the expected sign and are significant or highly significant. An increasing regional income differential between East and West Germany enhances eastern outmigration, i.e. an increase of 1% in real GDP per employee between western and eastern federal states of Germany in t-1 raises outmigration flows by 0.3 to 0.59%. Moreover, regional differences in the employment and labour market situation, covered by the two integrated labour market variables, also play a significant role in explaining East-West German migration flows. Furthermore, a pro-cyclical dependency of gross East-West migration can be detected by applying different estimation methods on the empirical migration model. This means that a 1% increase in the degree of capacity utilization for Germany as a whole in t-1 raises eastern outmigration flows by 1.35 to 2.62%. In addition, increasing rent levels in the eastern federal states (in t-1) foster emigration from East Germany. The distance variable as an approximation for migration costs shows the expected negative sign and is highly significant. Finally, the econometric results of the variable capturing potential network effects of migration have to be discussed. Almost all coefficients of the network variable exhibit an unexpected negative sign and are statistically significant (with the exception of the

[60] See Breusch/Pagan (1980).

61 See Greene (2000) for the corresponding modified Wald-test for groupwise heteroscedasticity in the residuals of a fixed effect regression model as well as Baltagi/Li (1995) for the Baltagi-Li (1995) test for first-order serial correlation.

coefficients in columns 5 and 6). This means in essence that East-West German migrants seem not to be attracted by existing social networks in the west. On the contrary, eastern outmigration decreases with a higher share of East-West migrants already living in western Germany.

Table 2: Gross Migration East-West (Absolute) 1991 – 2007

Dependent Variable
$\ln(om_{ij})_t$

	(1)	(2)	(3)	(4)	(5)	(6)
Estimation Method:	OLS [a] incl. C.-Dumm. (LSDV)	FE [b]	RE	FGLS [a] incl. H-Std. Err.	FGLS [a] incl. AC-Std. Err.	FGLS [a] incl. HAC-Std. Err.
Independent Variable						
$\ln(y_j / y_i)_{t-1}$	0.53***	0.53***	0.50***	0.59***	0.30***	0.43***
	(4.91)	(4.91)	(5.87)	(8.13)	(2.86)	(6.28)
$\ln(empl_j / empl_i)_{t-1}$	0.93***	0.93***	0.95***	1.04***	0.28	0.49**
	(3.49)	(3.49)	(14.92)	(5.19)	(1.05)	(2.46)
$\ln[(vac_j / empl_j) / (vac_i / empl_i)]_{t-1}$	0.18***	0.18***	0.18***	0.12***	0.13***	0.09***
	(8.24)	(8.24)	(8.09)	(7.87)	(6.41)	(6.58)
$\ln(ms_j / l_j)_{t-1}$	-0.64**	-0.64**	-0.63***	-0.58***	0.19	-0.03
	(-2.12)	(-2.12)	(-3.34)	(-2.66)	(0.64)	(-0.14)
$\ln(kap)_{t-1}$	2.54***	2.54***	2.62***	2.12***	1.72***	1.35***
	(9.02)	(9.02)	(9.64)	(10.73)	(7.67)	(8.80)
$\ln(appr_j / appr_i)_{t-1}$	0.34***	0.34***	0.35***	0.23***	0.20***	0.10***
	(5.50)	(5.50)	(5.69)	(5.02)	(3.90)	(2.63)
$\ln(psqm_i)_{t-1}$	0.44***	0.44***	0.43***	0.34***	0.21***	0.17***
	(7.23)	(7.23)	(8.46)	(7.65)	(4.39)	(5.10)
$\ln(yage_i / l_i)_{t-1}$	2.78***	2.78***	2.70***	1.96***	1.33***	0.88***
	(6.87)	(6.87)	(7.85)	(6.78)	(3.70)	(3.71)
$\ln(qual_i / empl_i)_{t-1}$	0.96***	0.96***	0.96***	0.64***	0.65***	0.37***
	(5.34)	(5.34)	(5.36)	(4.80)	(3.53)	(2.65)
$\ln(d_{ij})$	-1.30***	–	-0.87***	-1.38***	-0.70***	-0.86***
	(-5.39)		(-5.22)	(-7.48)	(-2.87)	(-4.71)
N:	960	960	960	960	960	960
Adj. R^2:	0.98	–	–	–	–	–
Overall R^2:	–	0.59	0.67	–	–	–
BP-LM-Test χ^2:	–	–	5282.89 (0.0000)	–	–	–
Hausman-Test χ^2:	–	–	5.37 (0.7175)	–	–	–
mod. Wald-Test for grw. Heterosked. χ^2:	–	–	–	3597.56 (0.0000)	–	–
Baltagi.-Li Test for AC(1) χ^2:	–	–	–	–	802.56 (0.0000)	–

Notes:
- *** ≡ significant at the 1 % level; ** ≡ significant at the 5 % level; * ≡ significant at the 10 % level;
- t and z-statistics in parentheses;
- constants not reported;
- [a] Dummy variables used to account for unobserved heterogeneity not shown;
- [b] By using the FE estimation method all time-invariant variables are removed;

Table 3 presents the econometric results of the empirical migration model which is estimated in various different specifications and which also includes different measures for the same

factor. Column 1 of table 3 shows the identical results as column 6 of table 2 and serves as a point of departure for the following considerations.

Table 3: Sensitivity Analysis – Tests of Different Model Specifications
Gross Migration East-West (Absolute) 1991 – 2007

Dependent Variable $\ln(om_{ij})_t$					
	(1)	(2)	(3)	(4)	(5)
Estimation Method:	FGLS [a] incl. HAC-Std. Err.	FGLS [a] incl. HAC-Std. Err.	FGLS [a] incl. HAC-Std. Err.	FGLS [a] incl. HAC-Std. Err.	FGLS [a] incl. HAC-Std. Err.
Independent Variable					
$\ln(y_j / y_i)_{t-1}$	0.43***	0.54***	0.30***	0.27***	–
	(6.28)	(10.66)	(4.15)	(5.27)	
$\ln(y_j)_{t-1}$	–	–	–	–	1.98***
					(9.07)
$\ln(y_i)_{t-1}$	–	–	–	–	-0.29***
					(-3.93)
$\ln(empl_j / empl_i)_{t-1}$	0.49**	–	0.14	-0.35**	–
	(2.46)		(0.74)	(-2.22)	
$\ln(empl_j)_{t-1}$	–	–	–	–	1.75***
					(4.83)
$\ln(empl_i)_{t-1}$	–	–	–	–	0.21
					(0.99)
$\ln[(vac_j / empl_j) / (vac_i / empl_i)]_{t-1}$	0.09***	–	0.08***	0.46***	–
	(6.58)		(4.84)	(3.17)	
$\ln(vac_j / empl_j)_{t-1}$	–	–	–	–	0.13***
					(5.86)
$\ln(vac_i / empl_i)_{t-1}$	–	–	–	–	-0.04***
					(-2.76)
$\ln(u_j / u_i)_{t-1}$	–	-0.36***	–	–	–
		(-9.23)			
$\ln(ms_j / l_j)_{t-1}$	-0.03	-0.36**	0.30	0.20	-0.42
	(-0.14)	(-2.42)	(1.46)	(1.31)	(-1.39)
$\ln(kap)_{t-1}$	1.35***	1.44***	–	0.81***	0.47***
	(8.80)	(10.23)		(5.64)	(2.58)
$\ln(u)_{t-1}$	–	–	-0.36***	–	–
			(-6.09)		
$\ln(appr_j / appr_i)_{t-1}$	0.10***	0.10**	-0.07*	0.10***	–
	(2.63)	(2.51)	(-1.83)	(2.59)	
$\ln(appr_j)_{t-1}$	–	–	–	–	0.40***
					(6.3)
$\ln(appr_i)_{t-1}$	–	–	–	–	0.05
					(1.15)
$\ln(psqm_i)_{t-1}$	0.17***	0.24***	0.14***	–	0.20***
	(5.10)	(7.65)	(4.11)		(6.29)
$\ln(appvac_i)_{t-1}$	–	–	–	0.12***	–
				(10.22)	
$\ln(yage_i / l_i)_{t-1}$	0.88***	1.03***	0.27	-0.30*	1.14***
	(3.71)	(4.83)	(1.08)	(-1.78)	(4.78)
$\ln(qual_i / empl_i)_{t-1}$	0.37***	0.41***	0.23*	0.02	0.32**
	(2.65)	(3.05)	(1.67)	(0.19)	(2.48)
$\ln(d_{ij})$	-0.86***	-0.45***	-0.54***	-0.10	-1.06***
	(-4.71)	(8.78)	(-3.02)	(-0.69)	(-6.41)
N:	960	960	960	960	960
mod. Wald-Test for grw.	3597.56	3679.84	3197.70	3913.86	4422.12
Heterosced. χ^2:	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Baltagi.-Li Test for AC(1)	802.56	765.79	777.16	763.86	730.00
χ^2:	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)

Notes:
- *** ≡ significant at the 1 % level; ** ≡ significant at the 5 % level; * ≡ significant at the 10 % level;
- t and z-statistics in parentheses;
- constants not reported;
- [a] Dummy variables used to account for unobserved heterogeneity not shown;

As can be seen from table 3, all different model specifications are estimated by FGLS including heteroscedasticity- and autocorrelation-adjusted standard errors (HAC-Std. Err.). In the empirical specification in column 2 of table 3 the two integrated labour market variables of the outlined basic migration model are substituted by the regional unemployment differential between the respective western and eastern federal states of Germany. As can be seen from column 2 the unemployment differential exhibits the expected negative sign and is significant at the 1% level. This means that a 1% increase in the regional unemployment differential between destination and source states decreases eastern emigration flows by 0.36%. Moreover, the coefficient on the network variable still exhibits a negative sign and is significant at the 5% level, whereas in all other estimated specifications this coefficient shows no significance. The coefficient of the age-structure variable which is supposed to capture one important aspect of the relationship between the age of individuals and migration (younger individuals have a higher probability of migration) shows the expected sign and is highly significant. Hence, a higher share of 16 to under 30-year-olds in relation to the total population of the respective eastern German federal state or Berlin total (in t-1) increases emigration from the east (in period t).

The migration model that is estimated in column 3 of table 3 represents a specification in which the degree of capacity utilisation covering potential business cycle effects of migration is exchanged by the aggregate unemployment rate for Germany as a whole. Looking at the regression coefficient on this variable in detail a pro-cyclical dependency of migration can also be detected, i.e. a 1% increase in the overall unemployment rate of total Germany in t-1 decreases East-West German migration by 0.36% in t.

In column 4 of table 3 the rent level variable capturing the housing and real estate market situation in the eastern part of Germany is substituted by a variable which represents the apartment vacancy rate of the respective East German federal state or Berlin total.[62] As can be seen from column 4, a higher apartment vacancy rate in East Germany increases the emigration from that region.

Finally, column 5 of table 3 presents the econometric results of a model specification in which single explanatory variables for real income per capita, labour market size, intensity of labour demand and infrastructure are introduced for the respective eastern and western federal states of Germany. As can be seen from column 5, most of the coefficients on the integrated single explanatory variables exhibit the expected sign. For instance, increasing real incomes per capita in the west as well as better infrastructural conditions enhance outmigration from the east. In contrast, rising real per capita incomes and an increasing intensity of labour demand in the eastern part decrease East-West German emigration. Note that eastern labour market size and infrastructure do not play a significant role in explaining East-West migration after the German reunification.

Besides using different estimation methods and estimating the model in a variety of different specifications for the full sample period from 1991 – 2007, the model is also estimated for three different subsamples, i.e. for 1991 – 1995, 1997 – 2001 as well as 2003 – 2007. Table 4

[62] See data appendix for detailed information on this particular variable.

below presents the respective econometric results for the different subsamples applying the outlined basic empirical migration model. The basic empirical migration model is estimated by FGLS for all subsamples taking heteroscedasticity as well as first-order autocorrelation in the residuals into account.

Table 4: – Sensitivity Analysis –
Estimation of Gross Migration East-West (Absolute) for different sample periods

Dependent Variable
$\ln(om_{ij})_t$

Estimation Method:	FGLS	FGLS	FGLS
Independent Variable	1991 – 1995	1997 – 2001	2003 – 2007
$\ln(y_j / y_i)_{t-1}$	0.87***	1.51***	0.97***
	(3.81)	(8.21)	(3.44)
$\ln(empl_j / empl_i)_{t-1}$	-0.20	4.53***	1.21**
	(-0.61)	(12.10)	(2.34)
$\ln[(vac_j / empl_j) / (vac_i / empl_i)]_{t-1}$	-0.04*	0.18***	0.04**
	(-1.76)	(6.55)	(2.52)
$\ln(ms_j / l_j)_{t-1}$	8.28***	-2.37**	-0.30
	(3.07)	(-2.35)	(-0.39)
$\ln(kap)_{t-1}$	2.38***	-1.17**	0.77**
	(6.04)	(-2.50)	(2.17)
$\ln(appr_j / appr_i)_{t-1}$	0.42***	0.66***	0.07*
	(5.49)	(10.50)	(1.64)
$\ln(psqm_i)_{t-1}$	0.20***	2.00***	-1.04**
	(3.89)	(6.88)	(-2.44)
$\ln(yage_i / l_i)_{t-1}$	6.25***	11.00***	-1.23***
	(5.02)	(8.25)	(-2.83)
$\ln(qual_i / empl_i)_{t-1}$	3.82***	1.51***	0.67***
	(10.25)	(6.32)	(4.34)
$\ln(d_{ij})$	-0.15	-4.51***	-1.58***
	(-0.54)	(-13.31)	(-3.33)
N:	240	240	240

Notes:
- Feasible Generalized Least Squares (FGLS) regression with HAC adjusted standard errors;
- *** ≡ significant at the 1 % level;
- ** ≡ significant at the 5 % level;
- * ≡ significant at the 10 % level;
- z-statistics in parentheses;
- constants not reported;

As is evident from table 4, an increasing regional income differential between East and West Germany enhances eastern outmigration in every subsample. Moreover, the regression coefficients of the two integrated labour market variables covering regional differences in the employment and labour market situation between eastern and western German federal states only exhibit the expected signs for the two sample periods from 1997 – 2001 (column 2) and 2003 – 2007 (column 3). Furthermore, the network variable coefficient is positive and highly significant for the period from 1991 – 1995 (column 1). The magnitude of this regression

coefficient is striking: a 1% increase in the share of East-West migrants already living in West Germany weighted by the total population of the western part (in t-1) increases eastern outmigration by the sizable amount of 8.28%. In the second subsample from 1997 – 2001, this coefficient turns negative but is still significant, whereas it becomes insignificant in the third sample period. Considering the business cycle effect of migration for the sample period from 1997 – 2001 it has to be noted that the coefficient on the degree of capacity utilisation in the manufacturing industry for Germany as a whole is negative and significant at the 5% level. For this period a countercyclical dependency of East-West German migration can be detected. Another point that is worth discussing concerns the rent level variable and its effect on eastern emigration for the period from 2003 – 2007. Here, the regression coefficient on the eastern rent level exhibits a negative sign and is significant at the 5% level, meaning that a 1% increase of monthly basic net rents in the East German federal states or Berlin total reduces eastern outmigration by 1.04%. One possible explanation for this effect might be that an indicator such as the rent level could, to a lesser or greater extent, also reflect the attractiveness or non-attractiveness of a region. If so, the sign of the coefficient could, indeed, be negative. Normally, economic centres or metropolitan regions are accompanied by increasing rent levels. In the eastern part of Germany such regions could be, for instance, Dresden, Leipzig or Erfurt. Increasing rent levels in these regions could foster immigration into these regions and could also reduce further outmigration if this indicator reflects the attractiveness of a region.

6.2 Gross migration rate East-West

In this section an approach similar to the one described in the previous section is applied. This time, however, the empirical model is estimated using gross migration rates as the relevant dependent variable. As can be seen from table 5 below, the estimation procedure starts again with a LSDV-regression (column 1), followed by FE and RE-regressions (columns 2 and 3) and FGLS-regressions taking, firstly, heteroscedasticity, then, autocorrelation, and then both aspects into account (columns 4 - 6). Just like in the previous section the Breusch/Pagan Lagrange multiplier test for random effects provides evidence that unobserved heterogeneity is existent when considering East-West German migration rates over the regarded sample period 1991 – 2007. Furthermore, heteroscedasticity as well as first-order autocorrelation in the residuals can also be detected in this model (columns 4 and 5).

Reviewing the econometric results of table 5, one can detect that most of the regression coefficients show the expected sign and are significant or highly significant. An increasing regional income differential between East and West Germany enhances eastern emigration rates, i.e. an increase of 1% in real GDP per employee between the western and eastern federal states of Germany in t-1, raises outmigration rates by 0.3 to 0.54%. Moreover, regional differences in the employment and labour market situation, represented by the two integrated labour market variables, i.e. labour market size as well as the intensity of labour demand, also play a significant role in explaining migration rates from East to West Germany.

Table 5: Gross Migration Rate East-West 1991 – 2007

Abhängige Variable
$\ln(om_{ij} / l_i)_t$

	(1)	(2)	(3)	(4)	(5)	(6)
Schätzmethode:	OLS [a] incl. C.-Dumm.	FE [b]	RE	FGLS [a] incl. H-Std. Err.	FGLS [a] incl. AC-Std. Err.	FGLS [a] incl. HAC-Std. Err.
Unabhängige Variable						
$\ln(y_j / y_i)_{t-1}$	0.53***	0.53***	0.44***	0.54***	0.30***	0.39***
	(4.87)	(4.87)	(5.19)	(7.31)	(2.86)	(5.50)
$\ln(empl_j / empl_i)_{t-1}$	1.23***	1.23***	1.05***	1.20***	0.47*	0.56***
	(4.55)	(4.55)	(22.94)	(5.90)	(1.73)	(2.80)
$\ln[(vac_j / empl_j) /$	0.18***	0.18***	0.18***	0.13***	0.13***	0.10***
$(vac_i / empl_i)]_{t-1}$	(8.41)	(8.41)	(8.42)	(8.43)	(6.69)	(7.28)
$\ln(ms_j / l_j)_{t-1}$	-0.53*	-0.53*	-0.36*	-0.37*	0.35	0.20
	(-1.75)	(-1.75)	(-1.95)	(-1.70)	(1.21)	(0.97)
$\ln(kap)_{t-1}$	2.77***	2.77***	2.80***	2.26***	1.86***	1.44***
	(9.71)	(9.71)	(10.22)	(11.41)	(8.18)	(9.22)
$\ln(appr_j / appr_i)_{t-1}$	0.34***	0.34***	0.37***	0.23***	0.20***	0.10**
	(5.57)	(5.57)	(5.89)	(4.94)	(3.91)	(2.48)
$\ln(psqm_i)_{t-1}$	0.47***	0.47***	0.44***	0.35***	0.23***	0.18***
	(7.60)	(7.60)	(8.59)	(7.75)	(4.87)	(5.32)
$\ln(yage_i / l_i)_{t-1}$	3.12***	3.12***	2.91***	2.15***	1.64***	1.04***
	(7.61)	(7.61)	(8.54)	(7.35)	(4.53)	(4.35)
$\ln(qual_i / empl_i)_{t-1}$	0.88***	0.88***	0.89***	0.58***	0.61***	0.35**
	(4.82)	(4.82)	(5.10)	(4.25)	(3.32)	(2.47)
$\ln(d_{ij})$	-1.58***	–	-1.06***	-1.53***	-0.88***	-0.94***
	(-6.46)		(-9.01)	(-8.21)	(-3.56)	(-5.07)
N:	960	960	960	960	960	960
Adj. R^2:	0.98	–	–	–	–	–
Overall R^2:	–	0.71	0.83	–	–	–
BP-LM-Test χ^2:	–	–	4771.34 (0.0000)	–	–	–
Hausman-Test χ^2:	–	–	– [c]	–	–	–
mod. Wald-Test for grw. Heterosced. χ^2:	–	–	–	2547.70 (0.0000)	–	–
Baltagi.-Li Test for AC(1) χ^2:	–	–	–	–	770.48 (0.0000)	–

Notes:
- *** ≡ significant at the 1 % level; ** ≡ significant at the 5 % level; * ≡ significant at the 10 % level;
- t and z-statistics in parentheses;
- constants not reported;
- [a] Dummy variables used to account for unobserved heterogeneity not shown;
- [b] By using the FE estimation method all time-invariant variables are removed;
- [c] The Hausman-Test could not be computed in this model specification, because the model fitted on these data fails to meet the asymptotic assumptions of the Hausman-Test. Comparing the estimated coefficients of the independent variables using FE or RE, one can detect that the regression coefficients of the variable $\ln(empl_j / empl_i)$ differ substantially from each other. Estimating the model without $\ln(empl_j / empl_i)$, the Hausman-Test can be computed and yields the following result: 15,00 (0,0202). Thus, the null hypothesis of orthogonality between the remaining independent variables and the unobserved heterogeneity can be rejected. In turn, this supports the use of the FE-method.

As in the model with absolute figures, a pro-cyclical dependency of East-West German migration rates can be detected applying different estimation methods on the empirical migration model. Here, the regression coefficient of the relevant explanatory variable can be

interpreted as follows: a 1% increase in the degree of capacity utilization in the manufacturing industry for Germany as a whole in t-1 raises eastern outmigration rates by 1.44 to 2.80%. In addition, increasing rent levels in the eastern federal states increase the rate of emigration from East Germany. The potential qualification effects of East-West German migration are indirectly captured by the share of highly qualified (here: white-collar workers and public servants) in the total labour force (total number of employees) of the respective East German federal state or Berlin total. Looking at the coefficients of the qualification variable in table 5 it can be seen that a higher share of highly qualified individuals in the total labour force of an eastern German region or Berlin total has a significant positive influence on the corresponding outmigration rates. The distance variable as an approximation for migration costs shows the expected negative sign and is highly significant. Again, the econometric results of the variable capturing potential network effects of migration represent an exception among the results discussed before. Almost all coefficients of the network variable exhibit an unexpected negative sign and are significant at the 10% level (with the exception of the coefficients in columns 5 and 6). Generally speaking, this means that East-West German migrants seem not to be attracted by existing social networks in the west. On the contrary, a higher share of East-West migrants already living in West Germany weighted by the total population of the western part appears to decrease eastern outmigration rates.

Table 6 presents the econometric results of the empirical migration model which is estimated in various different specifications including different measures for the same factor. Column 1 of table 6 shows the identical results as column 6 of table 5 and, just like in the previous section, serves as a point of departure for the following considerations. As can be seen from table 6, all different model specifications are estimated by FGLS including heteroscedasticity- and autocorrelation-consistent standard errors. The two integrated labour market variables of the outlined basic migration model are substituted by the regional unemployment differential between the respective western and eastern federal states of Germany in the empirical specification outlined in column 2 of table 6. As can be seen from this column the unemployment differential exhibits the expected negative sign and is significant at the 1% level. A 1% increase in the regional unemployment differential between destination and source states decreases eastern emigration rates by 0.34%. The magnitude of the coefficient is similar to the one in the corresponding specification outlined in the previous section. Moreover, the coefficient on the network variable is insignificant whereas in the two subsequent specifications this coefficient is positive and highly significant. The coefficient of the age-structure variable which should capture one important aspect of the relationship between the age of individuals and migration (younger individuals have a higher probability of migration) shows the expected positive sign and is highly significant. Hence, a higher share of 16 to under 30-year-olds in relation to the total population of the respective eastern German federal state or Berlin total (in t-1) increases the rate of emigration from the east (in period t).

The migration model that is estimated in column 3 of table 6 represents a specification in which the degree of capacity utilisation covering potential business cycle effects of migration is substituted by the aggregate unemployment rate for Germany as a whole. Looking at the

regression coefficient of this variable in detail, a pro-cyclical dependency of migration can also be detected, i.e. a 1% increase in the overall unemployment rate of total Germany (in t-1) decreases the rate of East-West German migration by 0.36% (in period t).

Table 6: Sensitivity Analysis – Tests of Different Model Specifications
Gross Migration Rate East-West 1991 – 2007

Dependent Variable $\ln(om_{ij} / l_i)_t$					
	(1)	(2)	(3)	(4)	(5)
Estimation Method:	FGLS [a] incl. HAC-Std. Err.	FGLS [a] incl. HAC-Std. Err.	FGLS [a] incl. HAC-Std. Err.	FGLS [a] incl. HAC-Std. Err.	FGLS [a] incl. HAC-Std. Err.
Independent Variable					
$\ln(y_j / y_i)_{t-1}$	0.39***	0.48***	0.24***	0.22***	–
	(5.50)	(9.11)	(3.27)	(4.23)	
$\ln(y_j)_{t-1}$	–	–	–	–	1.94***
					(8.84)
$\ln(y_i)_{t-1}$	–	–	–	–	-0.26***
					(-3.44)
$\ln(empl_j / empl_i)_{t-1}$	0.56***	–	0.18	-0.33**	–
	(2.80)		(0.92)	(-2.10)	
$\ln(empl_j)_{t-1}$	–	–	–	–	1.83***
					(5.04)
$\ln(empl_i)_{t-1}$	–	–	–	–	0.11
					(0.51)
$\ln[(vac_j / empl_j) / (vac_i / empl_i)]_{t-1}$	0.10***	–	0.09***	0.05***	–
	(7.28)		(5.53)	(3.69)	
$\ln(vac_j / empl_j)_{t-1}$	–	–	–	–	0.15***
					(6.42)
$\ln(vac_i / empl_i)_{t-1}$	–	–	–	–	-0.05***
					(-3.33)
$\ln(u_j / u_i)_{t-1}$	–	-0.34***	–	–	–
		(-8.41)			
$\ln(ms_j / l_j)_{t-1}$	0.20	0.01	0.57***	0.48***	-0.19
	(0.97)	(0.05)	(2.79)	(3.18)	(-0.62)
$\ln(kap)_{t-1}$	1.44***	1.52***	–	0.86***	0.54***
	(9.22)	(10.52)		(5.97)	(2.92)
$\ln(u)_{t-1}$	–	–	-0.36***	–	–
			(-6.21)		
$\ln(appr_j / appr_i)_{t-1}$	0.10**	0.11***	-0.09**	0.09**	–
	(2.48)	(2.65)	(-2.28)	(2.43)	
$\ln(appr_j)_{t-1}$	–	–	–	–	0.39***
					(6.04)
$\ln(appr_i)_{t-1}$	–	–	–	–	0.05
					(1.23)
$\ln(psqm_i)_{t-1}$	0.18***	0.23***	0.14***	–	0.21***
	(5.32)	(7.13)	(4.13)		(6.49)
$\ln(appvac_i)_{t-1}$	–	–	–	0.12***	–
				(10.62)	
$\ln(yage_i / l_i)_{t-1}$	1.04***	1.08***	0.39	-0.19	1.34***
	(4.35)	(4.78)	(1.53)	(-1.13)	(5.52)
$\ln(qual_i / empl_i)_{t-1}$	0.35**	0.36***	0.20	0.003	0.30**
	(2.47)	(2.62)	(1.42)	(-0.02)	(2.29)
$\ln(d_{ij})$	-0.94***	-0.45***	-0.58***	-0.13	-1.03***
	(-5.07)	(-8.56)	(-3.23)	(-0.85)	(-6.25)
N:	960	960	960	960	960
mod. Wald-Test for grw. Heterosked. χ^2:	2547.70 (0.0000)	3131.59 (0.0000)	2765.01 (0.0000)	3532.46 (0.0000)	2760.89 (0.0000)
Baltagi.-Li Test for AC(1) χ^2:	851.14 (0.0000)	832.11 (0.0000)	841.68 (0.0000)	851.94 (0.0000)	724.21 (0.0000)

Notes:
- *** ≡ significant at the 1 % level; ** ≡ significant at the 5 % level; * ≡ significant at the 10 % level;
- t and z-statistics in parentheses;
- constants not reported;
- [a] Dummy variables used to account for unobserved heterogeneity not shown;

In column 4 of table 6 the rent level variable controlling for the housing and real estate market situation in the eastern part of Germany is substituted by a variable representing the apartment vacancy rate of the respective East German federal state or Berlin total. As can be seen from column 4, a higher apartment vacancy rate in East Germany increases the rate of outmigration from that region.

Finally, column 5 of table 6 presents the econometric results of an empirical model specification in which single explanatory variables for real income per capita, labour market size, intensity of labour demand and infrastructure are introduced for the respective eastern and western federal states of Germany. As is evident from column 5 most of the coefficients on the integrated single explanatory variables exhibit the expected sign. For instance, increasing real incomes per capita in the east as well as a higher intensity of labour demand reduce the rate of outmigration from East Germany. In contrast, rising real per capita incomes and better infrastructural conditions in the western part increase the rate of East-West German emigration. Eastern labour market size and infrastructure do not play a significant role in explaining the rate of East-West migration after the German reunification.

In order to provide a thorough sensitivity analysis and to state inferences on robust results, the outlined empirical migration model is not only estimated in a variety of different specifications and using different estimation methods for the full sample period from 1991 – 2007. In addition, the model is also estimated for the three known subsamples, i.e. the periods from 1991 – 1995, 1997 – 2001 as well as 2003 – 2007. Table 7 below presents the respective econometric results. The basic empirical migration model is estimated by FGLS for all subsamples taking both heteroscedasticity as well as first-order autocorrelation in the residuals into account. As can be seen from table 7, an increasing regional income differential between East and West Germany enhances the rate of eastern outmigration in every subsample. Furthermore, the regression coefficients of the two integrated labour market variables covering regional differences in the employment and labour market situation between eastern and western German federal states only exhibit the expected signs for the two sample periods from 1997 – 2001 (column 2) and 2003 – 2007 (column 3). Moreover, the network variable coefficient is positive and highly significant in the first subsample (column 1). Again, the magnitude of this regression coefficient is striking, with a 1% increase in the share of East-West migrants already living in West Germany weighted by the total population of the western part (in t-1) increasing the rate of eastern outmigration by 8.84%. One possible explanation for these findings could be stated as follows. Right after the fall of the Berlin wall and the subsequent reunification of Germany East-West migrant networks started to grow and reached a considerable size over the years. A growing migrant network in the west, among other reasons, attracted further migrants from the east. This could be a possible explanation for the magnitude of the network variable coefficient for the period from 1991 – 1995. Growing social migrant networks in the west and particularly rising real per capita incomes in the east might have been responsible for the resulting decline in net returns of mobility for subsequent migrants and eventually led to a fall in East-West German network migration. This might be a possible explanation for the regression coefficient of the network variable for the subsample period from 1997 to 2001. Finally, existing migrant networks in the west did

not play a significant role in explaining the rate of East-West German migration for the subsequent period from 2003 – 2007. Considering the business cycle effect of migration for the sample period from 1997 – 2001 it has to be noted that the coefficient on the degree of capacity utilisation in the manufacturing industry for Germany as a whole is negative and significant at the 1% level. For this period a counter-cyclical dependency of the rate of East-West German migration can be detected.

Table 7: – Sensitivity Analysis –
Estimation of the Gross Migration Rate East-West for different sample periods

Dependent Variable
$\ln(om_{ij} / l_i)_t$

Estimation Method:	FGLS	FGLS	FGLS
Independent Variable	1991 – 1995	1997 – 2001	2003 – 2007
$\ln(y_j / y_i)_{t-1}$	0.89***	1.55***	0.86***
	(3.87)	(8.22)	(3.13)
$\ln(empl_j / empl_i)_{t-1}$	-0.17	4.67***	1.53***
	(-0.51)	(12.57)	(3.03)
$\ln[(vac_j / empl_j) / (vac_i / empl_i)]_{t-1}$	-0.04*	0.17***	0.04***
	(-1.78)	(6.10)	(2.88)
$\ln(ms_j / l_j)_{t-1}$	8.84***	-2.14**	0.10
	(3.25)	(-2.09)	(0.13)
$\ln(kap)_{t-1}$	2.42***	-1.48***	1.01***
	(6.11)	(-3.14)	(2.99)
$\ln(appr_j / appr_i)_{t-1}$	0.41***	0.71***	0.07*
	(5.37)	(11.11)	(1.68)
$\ln(psqm_i)_{t-1}$	0.21***	2.06***	-1.36***
	(4.05)	(7.13)	(-3.34)
$\ln(yage_i / l_i)_{t-1}$	6.61***	10.93***	-0.99**
	(5.26)	(8.02)	(-2.34)
$\ln(qual_i / empl_i)_{t-1}$	3.96***	1.52***	0.75***
	(10.65)	(6.28)	(4.78)
$\ln(d_{ij})$	-0.17	-4.64***	-1.89***
	(-0.62)	(-13.78)	(-4.06)
N:	240	240	240

Notes:
- Feasible Generalized Least Squares (FGLS) regression with HAC standard errors;
- *** ≡ significant at the 1 % level;
- ** ≡ significant at the 5 % level;
- * ≡ significant at the 10 % level;
- z-statistics in parentheses;
- constants not reported;

Just like in the previous section when analysing East-West German outmigration flows, the regression coefficient on the eastern rent level exhibits an unexpected negative sign and is highly significant, meaning that a 1% increase of monthly basic net rents in the East German federal states or Berlin total reduces the rate of eastern outmigration by 1.36%. Again, one possible explanation for this finding is that an indicator like the rent level could also reflect

the attractiveness or non-attractiveness of a region to a certain extent. Thus, the sign of the coefficient could also be negative.

Reviewing the econometric results of the conducted empirical investigation and the subsequent sensitivity analysis the following can be concluded. The specified basic migration model and all its variations seem to be relatively stable and robust with one exception. This exception concerns the empirical results of the integrated network variable. The econometric results of the network variable differ, in part, considerably depending on which estimation method is applied, which model specification is estimated and whether subsamples are investigated.

7 Conclusions

Of the existing macroeconometric studies investigating the determinants of migration within Germany, only a minority focus more or less explicitly on East-West German migration. Most of the studies in this category focus on the determinants of migration for all of Germany. Moreover, a fact common to all empirical investigations in this category is that they are conducted for rather small periods of time. Furthermore, the primary constraint of some of these macroeconometric studies of including wage and unemployment variables as well as their differences as the main explanatory factors in their empirical regression equations seems to be too restrictive, in particular, against the backdrop of other important migration determinants. Considering that the fall of the Berlin Wall took place nearly 20 years ago, it seems highly indicated to conduct a macroeconometric investigation that focuses explicitly on the various factors determining East-West migration after the German reunification for a longer time period.

Thus, this paper explicitly analyses the determinants of East-West migration in Germany using a macroeconometric panel data model and applying pair-wise gross migration flows and rates between the respective eastern and western German federal states for the period 1991 – 2007. In order to provide a thorough sensitivity analysis and to state inferences on robust results, the outlined empirical migration model is not only estimated in a variety of different specifications and using different estimation methods for the full sample period. In addition, the model is also estimated for three different subsamples, i.e. the periods from 1991 – 1995, 1997 – 2001 as well as 2003 – 2007.

Investigating both absolute gross migration and gross migration rates East-West the results of the conducted empirical estimations can be summarised as follows. Regional income differentials as well as separately integrated income variables for both regions can be identified as highly significant explanatory variables explaining gross migration flows and rates from the eastern to the western part of Germany. These findings are consistent with those of previous empirical studies in that context, for instance Alecke/Untiedt (2000) and Parikh/Van Leuvensteijn (2003). Regional differentials in the employment and labour market situation are captured using two variables: one covering the size of the labour market and the other representing the intensity of labour demand. Labour market size, the intensity or strength of labour demand as well as unemployment (integrated as regional differences between destination and source region) also act as important explanatory factors. The empirical results of the integrated network variable which is supposed to capture potential network effects of migration represent an exception among the other results. The econometric results of the network variable differ, in part, considerably according to estimation method, model specification and subsample. An additional aspect that emerges from the empirical literature is the dependency of migration flows on the business cycle. To capture this effect the degree of capacity utilization in the manufacturing industry for the whole of Germany is included in the model. The pro-cyclical dependency of migration which is stated, for example, in Alecke/Untiedt (2000), can be confirmed in all estimated model specifications and almost

all estimated subsamples. In this empirical investigation, an age structure variable which indirectly covers the potential relationship between the age of individuals and migration from the eastern to the western part of Germany is approximated by the quotient of 16 to under 30-year-olds and the total population of the respective East German federal state. Hence, a higher share of 16 to under 30-year-olds in relation to the total population of the corresponding eastern German federal state is expected to lead to higher outmigration from the east. This can be confirmed by the analysed panel data set. Moreover, theory predicts a positive relationship between the level of qualification of individuals and the subsequent migration, i.e. highly qualified persons are more likely to migrate. This, too, can be indirectly confirmed by the analysed panel data set. Whereas increasing rents in the east act as a push-factor to East-West German migration, rising regional infrastructural differences seem to draw people towards the west. Distance shows the expected negative sign in almost all model specifications and estimated subsamples. Except for the network variable, the specified basic empirical migration model and all its variations seem to be relatively stable and robust.

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Data appendix

Denotations and data sources of the variables used in the respective migration models

Variable	Variable denotation and data source
dependent variables	
om_{ij}	**Gross emigration from an East German federal state or Berlin total (i) to one of the ten West German federal states (j)** Source: Federal Statistical Office of Germany (Statistisches Bundesamt)
om_{ij} / l_i	**Gross emigration rate East-West** • **Quotient of gross emigration from an East German federal state or Berlin total (i) to one of the ten West German federal states (j) and the resident population l_i of an East German federal state or Berlin total (i)** Source: Author's calculations using data from the Federal Statistical Office of Germany (Statistisches Bundesamt)
independent variables	
y_j	**Real income per capita in the respective West German federal state (j)** • **Real income per capita approximated by the gross domestic product of the respective German federal state in prices of 2000 per employee** Source: Regional Accounts VGR d L (Arbeitskreis Volkswirtschaftliche Gesamtrechnungen der Länder)
y_i	**Real income per capita in the respective East German federal state or Berlin total (i)** • **Real income per capita approximated by the gross domestic product of the respective German federal state in prices of 2000 per employee** Source: Regional Accounts VGR d L (Arbeitskreis Volkswirtschaftliche Gesamtrechnungen der Länder)

$\mathbf{empl_j}$	**Working population (number of employees) in the respective West German federal state (j)** Source: Author's calculations using data from the Federal Statistical Office of Germany (Statistisches Bundesamt), Arbeitskreis „Erwerbstätigenrechnung des Bundes und der Länder"
$\mathbf{empl_i}$	**Working population (number of employees) in the respective East German federal state or Berlin total (i)** Source: Author's calculations using data from the Federal Statistical Office of Germany (Statistisches Bundesamt), Arbeitskreis „Erwerbstätigenrechnung des Bundes und der Länder"
$\mathbf{vac_j}$	**Number of open/reported job vacancies in the respective West German federal state (j)** Source: Federal Employment Office of Germany (Bundesagentur für Arbeit)
$\mathbf{vac_i}$	**Number of open/reported job vacancies in the respective East German federal state or Berlin total (i)** Source: Federal Employment Office of Germany (Bundesagentur für Arbeit)
$\mathbf{u_j}$	**Unemployment rate** (based on dependent labour force (employees subject to social insurance contribution and in marginal employment, public servants, the unemployed)) **in the respective West German federal state (j)** Source: Federal Employment Office of Germany (Bundesagentur für Arbeit)
$\mathbf{u_i}$	**Unemployment rate** (based on dependent labour force (employees subject to social insurance contribution and in marginal employment, public servants, the unemployed)) **in the respective East German federal state or Berlin total (i)** Source: Federal Employment Office of Germany (Bundesagentur für Arbeit)
$\mathbf{l_j}$	**Resident population of West Germany in total (excl. Berlin total)** Source:

	Federal Statistical Office of Germany (Statistisches Bundesamt)
l_i	**Resident population of an East German federal state or Berlin total (i)** Source: Author's calculations using data from the Federal Statistical Office of Germany (Statistisches Bundesamt)
ms_j	**Stock of East-West migrants of the East German federal states or Berlin total (i), who already live in the whole of West Germany (j)** • **Calculation:** **Cumulation of the net East emigration over the period 1957 – 1990, thereafter further yearly summation of the net East emigration** **Result: Net migration stock of East-West migrants in West Germany** Source: Author's calculations using data from the Federal Statistical Office of Germany (Statistisches Bundesamt), Arbeitskreis Volkswirtschaftliche Gesamtrechnungen der Länder
ms_j / l_j	**Quotient of the share of East-West migrants, who already live in West Germany and the total population of West Germany l_j** • **Calculation:** **Cumulation of net East emigration over the period 1957 – 1990, thereafter further yearly summation of net East emigration** **Result: Net migration stock of East-West migrants in West Germany measured by the total population of West Germany** Source: Author's calculations using data from the Federal Statistical Office of Germany (Statistisches Bundesamt), Arbeitskreis Volkswirtschaftliche Gesamtrechnungen der Länder
kap	**Degree of capacity utilization in the manufacturing industry for Germany as a whole** Source: OECD Main Economic Indicators; ifo Institut für Wirtschaftsforschung Annual data or values were calculated as means from the quarterly data available
u	**Aggregate unemployment rate** (based on dependent labour

	force (employees subject to social insurance contribution and in marginal employment, public servants, the unemployed)) **in Germany** Source: Federal Employment Office of Germany (Bundesagentur für Arbeit)
$appr_j$	**Regional provision of infrastructure in the respective West German federal state (j)** • **Here, regional provision of infrastructure is approximated by the number of apprenticeship places available per 1000 residents of the eligible age group** (appropriate population group » 16-19 years) **in the respective West German federal state (j)** Source: Author's calculations using data from the Federal Employment Office of Germany (Bundesagentur für Arbeit) and the Federal Statistical Office of Germany (Statistisches Bundesamt)
$appr_i$	**Regional provision of infrastructure in the respective East German federal state or Berlin total (i)** • **Here, regional provision of infrastructure is approximated by the number of apprenticeship places available per 1000 residents of the eligible age group** (appropriate population group » 16-19 years) **in the respective East German federal state or Berlin total (i)** Source: Author's calculations using data from the Federal Employment Office of Germany (Bundesagentur für Arbeit) and the Federal Statistical Office of Germany (Statistisches Bundesamt)
$psqm_i$	**Indicator for the regional housing and real estate market situation in the respective East German federal state or Berlin total (i)** • **Regional housing and real estate market situation here approximated by the monthly estimated / expected rent in EUR/m2** [(basic net rent, based on apartments with prepayments for utilities) in EUR/m2 of the GdW operated housing supply (average values)] **of the respective East German federal state or Berlin total (i)** • **Annotation:** The average rent is an imputed value and is derived from the monthly projected estimated / expected rent and the respective living space. Source:

	GdW Bundesverband deutscher Wohnungs- und Immobilienunternehmen e. V.
$appvac_i$	**Indicator for the regional housing and real estate market situation in the respective East German federal state or Berlin total (i)** • **Regional housing and real estate market situation here approximated by the apartment vacancy rate** (calculated as the number of vacant GdW administrated apartments as a percentage of the total GdW operated apartment supply) **of the respective East German federal state or Berlin total (i)** Source: GdW Bundesverband deutscher Wohnungs- und Immobilienunternehmen e. V.
$yage_i$ / l_i	**Quotient of 16 to under 30-year-olds and the total population of the respective East German federal state or Berlin total (i)** Source: Author's calculations using data from the Federal Statistical Office of Germany (Statistisches Bundesamt)
$yage_i$	**Number of 16 to under 30-year-old-individuals of the respective East German federal state or Berlin total (i)** Source: Author's calculations using data from the Federal Statistical Office of Germany (Statistisches Bundesamt)
$qual_i$ / $empl_i$	**Share of highly qualified (here: white-collar workers and public servants) in the total labour force (total number of employees) of the respective East German federal state or Berlin total (i)** Source: Author's calculations using data from the Federal Statistical Office of Germany / Mikrozensus (Statistisches Bundesamt)
d_{ij}	**Geographical distance, expressed in km between the capital of the respective East German federal state or Berlin total (i) and the capital of the respective West German federal state (j)** Source: ViaMichelin route planner, available under: http://www.viamichelin.de