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Does labour mobility reduce disparities between regional labour markets in Germany?

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Abstract

Differences in regional labour market conditions are still pronounced in Germany, especially between the Eastern and the Western part. Traditional neoclassical models imply that labour mobility should reduce disparities. In contrast, models that include externalities or selective migration suggest that regional differences might well increase due to interregional migration of workers. We investigate the impact of labour mobility on regional disparities in Germany between 1995 and 2005. Considering the impact of migration as well as commuting, effects on regional wages and unemployment are estimated. Our results suggest that labour mobility tends to reduce disparities; however, we find significant effects only on unemployment disparities.

Zusammenfassung

Unterschiede in den regionalen Arbeitsmarktbedingungen prägen Deutschland seit längerem, besonders zwischen dem östlichen und dem westlichen Landesteil. Üblicherweise postulieren neoklassische Modelle, dass die Mobilität der Arbeitskräfte zur Angleichung regionaler Bedingungen führt. Im Gegensatz folgt aus erweiterten Modellen unter Berücksichtigung externer Effekte oder der Annahme selektiver Wanderung, dass sich regionale Disparitäten sogar durch Arbeitskräftemobilität verstärken können. Wir untersuchen den Einfluss der Arbeitskräftemobilität auf regionale Unterschiede in Deutschland zwischen 1995 und 2005. Geschätzt werden sowohl die Effekte von Wandern als auch von Pendeln auf regionale Löhne und Arbeitslosigkeit. Die Ergebnisse zeigen, dass Arbeitskräftemobilität tendenziell Disparitäten abbaut; jedoch finden wir nur signifikante Effekte für die Unterschiede in den regionalen Arbeitslosenquoten und nicht für die Löhne.

JEL classification: C23, J61, R23

Keywords: Regional disparities, migration, commuting, Germany

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1 Introduction

Regional differences in labour market performance are pronounced in Germany although economic transformation of East Germany started almost two decades ago. GDP per capita in East Germany amounts to 70% of that in West Germany in 2007. Moreover, the East German unemployment rate (15%) is about twice the rate in the western part of the country. The variation in regional unemployment rates at the county level even amounts up to 20 percentage points in 2007. Whereas some regions in Bavaria realize unemployment rates of less than 3%, several East German regions still suffer from unemployment of more than 20%. But disparities are not only marked by systematic differences between East and West Germany. The dispersion is considerable in West Germany as well.

Labour mobility is supposed to play an important role in reducing such regional inequalities though from a theoretical perspective there is no clear-cut answer to the question whether migration reduces regional labour market imbalances. According to traditional neoclassical models migration should respond to and decrease regional disparities. Labour mobility is conducive to convergence of labour market conditions since the impact of mobility on labour supply dominates. There are no significant effects on labour demand. More recent approaches, however, suggest that labour mobility might as well reinforce differences in regional unemployment and wages. Externalities and selective migration tend to cause such effects of mobility. In corresponding models, the impact of labour mobility is not restricted to labour supply. There are also repercussions on labour demand. According to new economic geography models, migration might result in diverging labour market conditions because labour mobility can, due to externalities, release a process of cumulative causation (see Südekum 2005, Epifani and Gancia 2005). Workers move to high-wage/low-unemployment regions. Labour market conditions in these prosperous regions further improve relative to the regions of origin since the inflow of labour strengthens economies of agglomeration.

Selective migration can also result in increasing regional disparities (see Burda and Wyplosz 1992, Feser and Sweeney 2003). If labour mobility is selective, migration of high-skilled workers will trigger off a process of cumulative causation even within a neoclassical framework. The inflow of qualified employees gives rise to productivity growth and increasing wages of workers in the region of destination, whereas labour market conditions deteriorate in the region of origin.[1] The incentive of skilled workers to move to high-wage regions is reinforced as a result of migration and regional differences in unemployment and income will increase because of selective migration. Thus, as regards disparities both the quantitative result of labour mobility, i.e. net migration, and the structure of the migration flows is relevant. Moreover, Elhorst (2003) argues that labour demand effects of migration might as well result from in-

[1] These effects of selective migration are due to complementarities among different factors of production in a neoclassical production function.

creased consumption expenditures or investments caused by the immigration of workers.

Our analysis aims at providing empirical evidence on the impact of labour mobility on regional disparities in Germany. To the best of our knowledge, there is no comprehensive empirical study on this issue. The striking and persistent disparities in labour market performance across regions and high internal migration between East and West Germany predestine the country for an analysis of the impact of mobility on regional disparities. We consider both effects on wages and unemployment whereas most studies focus on income convergence or on the development of unemployment disparities. An investigation of price *and* quantity effects might, however, provide new important insights since the effects of labour mobility on regional wages and unemployment are likely to differ e.g. due to wage rigidities. Moreover, in contrast to the majority of comparable analyses that pay little attention to the role of commuting we consider both the impact of migration and commuting. Finally, we allow for asymmetric effects of in- and out-migration (-commuting) as proposed in Østbye and Westerlund (2007).

Our regression results suggest that there are indeed significant effects of mobility in Germany, however robust evidence is restricted to unemployment disparities. Changes in regional labour supply caused by mobility seem to affect unemployment rather than wages. Furthermore, migration as well as commuting matter for unemployment disparities, and their effects tend to be in line with neoclassical reasoning. Evidence on asymmetric effects of in- and out-going mobility flows suggest that there might also be significant effects on labour demand which could be linked to the structure of mobility flows, externalities or changes in consumption and investment caused by mobility. These labour demand effects are, however, not strong enough to outweigh the labour supply effects.

The paper is organised as follows. Section 2 briefly outlines empirical findings on regional disparities and labour mobility. Section 3 provides information on the data. In Section 4 some descriptive evidence on regional disparities and labour mobility in Germany is presented. Section 5 contains a detailed description of the econometric models and related issues. In Section 6, we present and discuss the results of the regression analysis. Section 7 concludes.

2 Empirical Evidence in the Literature

One strand of empirical literature dealing with regional disparities and labour mobility investigates the adjustment mechanisms that region-specific shocks may trigger. Empirical evidence for the US provided in the seminal paper by Blanchard and Katz (1992) suggests that labour mobility, more than any other adjustment mechanism, is decisive in reducing regional disparities. For EU countries findings are rather different. Results by Eichengreen (1992) suggest that in Britain and Italy the elasticity of migration with respect to unemployment is only half compared to US. Puhani (2001) concludes that labour mobility is unlikely to act as sufficient adjustment mechanism to asymmetric shocks in Europe. The findings in Decressin and Fatás (1995) indi-

cate that in Europe adjustment is mainly through labour force participation whereas in the US migration effects dominate.[2] According to Baddeley et al. (2000) it is rather low labour migration than wage inflexibility that explains persistent unemployment disparities in Europe. And finally, analyses by Möller (1995) and Südekum (2004) point to persistent disparities in regional unemployment rates in Germany. Results by Südekum even suggest that in contrast to the implications of neoclassical models migration tends to reinforce differences in labour market conditions among regions. However, evidence so far is restricted to West Germany.

A second strand of literature focuses on regional differences in per capita income and, departing from the convergence hypothesis of the traditional neoclassical growth model, takes a more long-term perspective than the studies mentioned above. Starting with the seminal study of Barro and Sala-i-Martin (1991) an extensive literature has emerged that deals with the question whether poor regions grow faster than rich regions and thus catch-up in terms of per capita income. Within the framework of the neoclassical growth model migration is conducive to faster convergence. Yet, as noted by Kırdar and Saracoğlu (2008), few convergence studies have examined the impact of labour mobility on income disparities. Results in Barro and Sala-i-Martin (2004) and Kırdar and Saracoğlu (2008) suggest that taking migration into account reduces the estimated speed of convergence. Thus, ignoring the contribution of labour mobility to the decline of income disparities gives rise to upward-biased estimates of the convergence rate. Østbye and Westerlund (2007) confirm that migration has an effect on the rate of convergence in Sweden and Norway. However, whereas mobility supports the decline of income disparities in Sweden, it counteracts convergence in Norway.

The majority of empirical results suggest that labour mobility tends to reduce regional disparities, but evidence is not clear-cut. Moreover, the strength of the effect varies considerably between national contexts. Furthermore, most analyses of regional disparities tend to focus on the impact of migration flows and pay little attention to the role of commuting (see Patacchini and Zenou 2007, Elhorst 2003). However, Burda and Hunt (2001) note that migration is only one aspect of labour mobility between East and West Germany. Commuting has acted as a substitute for outmigration for East German workers. Especially workers living in a region that shares a common border with West Germany tend to commute rather than to migrate. Results by Einig and Pütz (2007) confirm the growing importance of out-commuting for less prosperous labour markets, notably for regions in East Germany. More generally, Elhorst (2003) argues that commuting should not be ignored if administratively defined regions are analysed.

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[2] This is in line with evidence provided by Bornhorst and Commander (2006) for several transition countries where internal migration flows remained low throughout the 1990s despite pronounced differences in regional labour market conditions. The authors conclude that migration is insufficient to reduce large unemployment differentials in Eastern European countries.

3 Data

The spatial units of observation in our data are the 439 German counties that correspond with the NUTS3 level. We drop counties that are affected by massive immigration of ethnic German repatriates and in addition we exclude the counties Eisenach and Wartburgkreis due to changes in demarcation. All in all the analysis comprises 430 counties, 320 located in West Germany and 110 in East Germany. Our data set covers the period from 1995 to 2004. To investigate the impact of labour mobility empirically we use different data sources. Most variables are extracted from the employment history statistic of the IAB. The employment statistic covers all employees subject to social security contributions. We exclude observations with part-time employment, incomplete vocational training and missing values on wage from our data set.

The regional wage level – as one important aspect of regional disparities to be analysed – is measured as the 40% percentile of the distribution of wages in the corresponding county. This percentile is used to avoid bias due to the fact that individual wage information is trimmed at the social security threshold.[3] In addition to the wage level we also explore unemployment rates using the official unemployment figures of the German Federal Employment Agency.

As the study aims at investigating the impact of labour mobility on regional disparities, commuting is an important explanatory variable. Commuters are identified by comparing the county of residence and the county of work-place. The definition implies that we consider only internal commuting.

The second set of independent variables of primary interest refers to migration. Migration is defined as a change of residence location, i.e. migration between counties. As information on migration is not available in the employment statistic until 1999, we use figures provided by the Federal Office for Building and Regional Planning (Bundesamt für Bauwesen und Raumordnung – BBR). In contrast to the employment statistic, these figures do not refer to employees only. The migration flows include changes of residence of the entire population. To reduce mismeasurement, we restrict the migration and population data to the age between 25 and 50, since most members of this age group should belong to the active working population. As the migration data contain no information on the educational attainment of workers, we can not investigate the effects of selective migration.

Additionally, we include a number of control variables in the regression model. Population density is used to capture agglomeration effects. In order to account for structural effects on regional disparities we incorporate indicators for the sectoral composition of the region. We measure the specialization of counties by employment shares, i.e. the percentages of regional employment in aggregated branches.

[3] With the median wage of counties 40 observations would be affected by censoring.

We differentiate between agriculture, construction, industry and services. We also control for structural change because a pronounced reallocation of jobs between industries might affect regional labour market conditions. As an indicator for structural change we apply the sum of absolute annual changes in employment shares across 26 industries. The educational attainment of the regional work force might also affect the development of regional labour market conditions. In order to approximate the qualification level, for each county we compute the shares of three different qualification groups (no formal vocational qualification, completed vocational training, university degree) in total regional employment.

To account for possible endogeneity of explanatory variables in our analysis (see Section 5), we apply – apart from GMM-type instruments – two additional external instrument variables. First, we use migration figures for the population older than 65 years. As a second instrument regarding commuting, we apply car density, measured as the number of cars per 1,000 inhabitants. Both variables are provided by the BBR and are expected to correlate with labour mobility, but should not affect labour market conditions, i.e. regional unemployment and wages.[4]

In the regression models we do not use the absolute value of migration and commuting flows. Instead we compute the following mobility variables[5]:

- Net-migration rate: difference between in-migration into region *i* and out-migration in year *t* divided by population of the region in *t* $\left(nmr_{it} = \frac{im_{it} - om_{it}}{pop_{it}} \right)$
- Net-commuting rate: difference between in- and out-commuting in *t* divided by regional employment in *t* $\left(ncr_{it} = \frac{ic_{it} - oc_{it}}{ep_{it}} \right)$
- In-migration rate: in-migration into region *i* divided by population of the region in *t* $\left(imr_{it} = \frac{im_{it}}{pop_{it}} \right)$; out-migration rate omr_{it} defined analogously to the in-migration rate
- In-commuting rate: in-commuting in year *t* divided by regional employment in *t* $\left(icr_{it} = \frac{ic_{it}}{ep_{it}} \right)$
- Out-commuting rate: out-commuting in *t* divided by number of employees living in region *i* in *t* $\left(ocr_{it} = \frac{oc_{it}}{epop_{it}} \right)$

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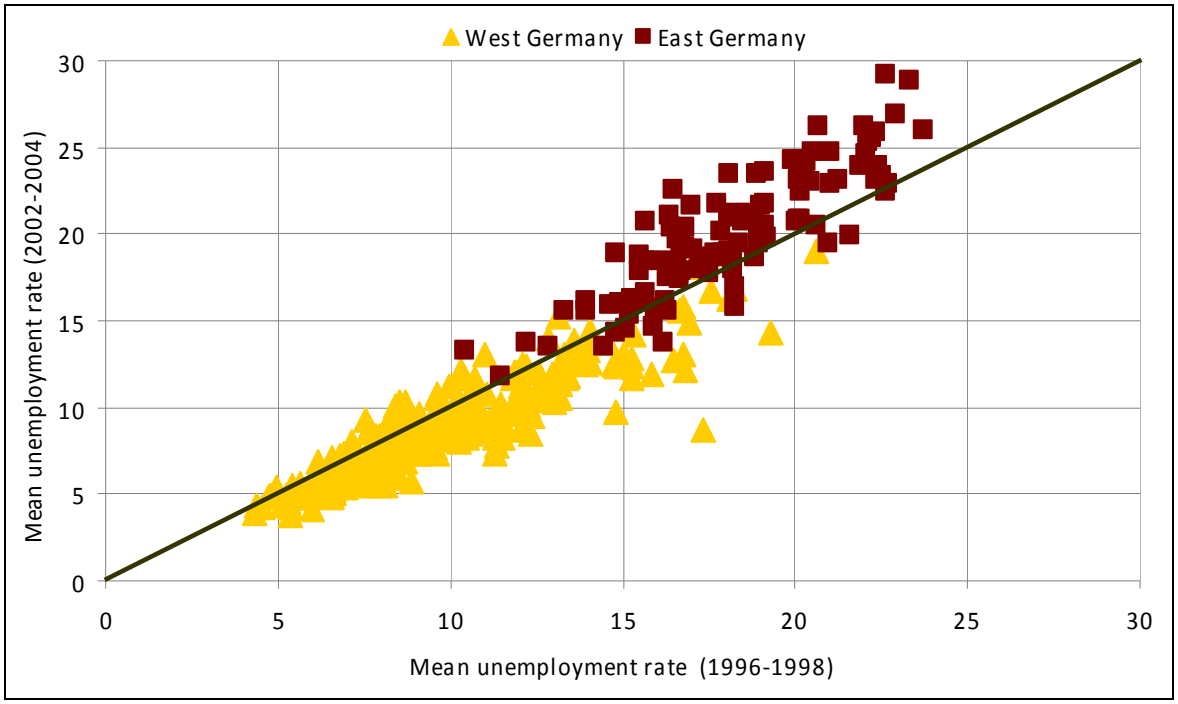
4 We also check empirically if the selected instruments are omitted variables in the basic model.

5 See also Appendix for some summary statistics.

4 Disparities and labour mobility – some descriptive evidence

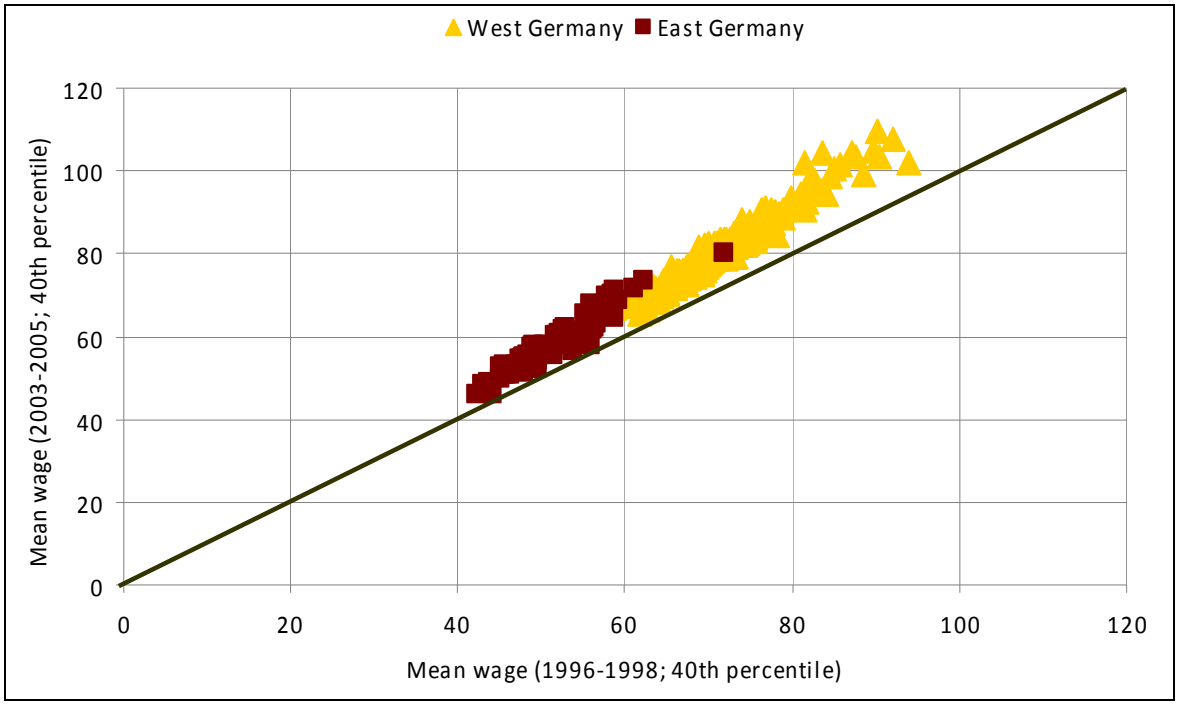
Disparities in labour market performance between German counties are substantial and have partly been increasing over recent years. The development of regional unemployment shown in Figure 1 clearly confirms these statements. Comparing East and West German counties two distinct patterns emerge. In the majority of West German counties unemployment rates have declined. In contrast to that, regional unemployment in East Germany has considerably increased over the years included in our analysis. Another very obvious finding is that all in all unemployment tends to be much higher in East Germany during the whole period.

Figure 1
Development of regional unemployment rates



The scatter plot of regional wages also indicates that labour market conditions in East Germany are less favourable than in West Germany. First of all, the wage level in the Eastern part of the country tends to be lower than in the West (Figure 2), the only remarkable exception being Berlin. In contrast to unemployment, income levels have developed similarly, i.e. they have risen in both parts of Germany. However, in the Western counties the increase has been more pronounced. Moreover Figure 2 shows that wage dispersion in the West is higher than among Eastern counties.

Figure 2
Development of regional wage levels

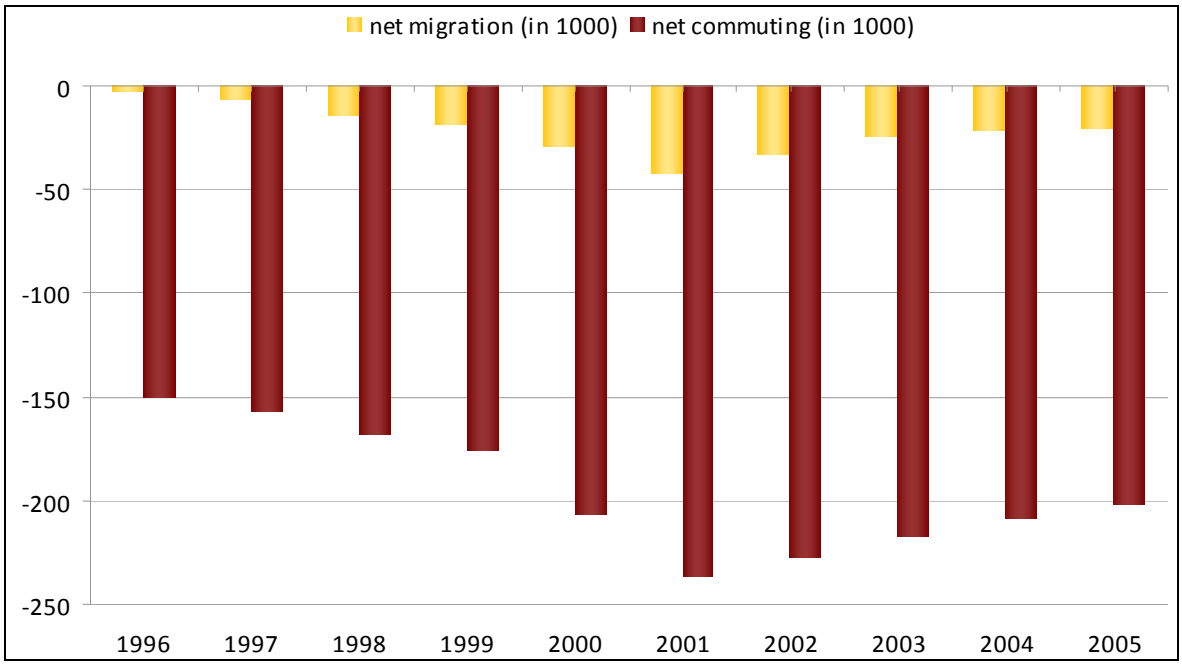


Comparing the development of disparities as indicated by the regional levels of unemployment and income two differences can be observed. First, the coefficient of variation for the regional wage level shown in Figure 3 is much smaller than the respective coefficient for unemployment. And, whereas the variation increases over time with respect to unemployment, it is rather stable with respect to wages. Although a systematic variation in regional levels of wage and unemployment exists in Germany, only the differences between unemployment levels increase over time.

Figure 3
Coefficients of variation for unemployment rate and wage level

How do the sketched developments of disparities relate to the existing mobility patterns in Germany? The picture in Figure 4 is very clear. Between 1996 and 2005 out-migration and out-commuting to Western counties have been constantly exceeding in-mobility into East Germany. Mobility losses intensified until 2001, after that a slight but constant decline starts. According to neoclassical models this out-mobility should mitigate labour market conditions in East Germany and consequently reduce regional disparities. On the other hand, new economic geography models and models on selective migration suggest, that disparities might even increase as a consequence of unbalanced mobility flows. Our descriptive findings show an increase of disparities, while mobility losses in East Germany decline but are still considerable. Persistent regional disparities despite significant migration and commuting flows between East and West Germany raise the question whether labour mobility is conducive to convergence at all. To conclude from these descriptive findings that mobility flows do not reduce regional disparities would seem rather rash, however. In order to understand the effect of mobility on regional disparities more elaborate analyses and more sophisticated methods are required.

Figure 4
Development of East-West-mobility in Germany



5 Econometric issues

Our analysis focuses on the impact of labour mobility, i.e. migration and commuting, on regional differences in unemployment and wages in Germany. The investigation is based on two basic regression models that differ only with respect to the dependent variable. The data set contains annual observations for all variables for the period 1995 to 2005 on NUTS 3 level. The basic version of the regression model for regional unemployment is given by:

$$u_{it} = \alpha_1 u_{it-1} + \alpha_2 nmr_{it-1} + \alpha_3 ncr_{it} + \sum_{n=1}^{N} \gamma_n x_{nit} + \eta_i + \varphi_t + \varepsilon_{it} \qquad (1)$$

where u_{it} is the relative unemployment rate of region *i* in year *t*. For ease of interpretation the relative unemployment rate is used, defined as the ratio of regional to national unemployment rate. The coefficient α_1 of the lagged dependent variable measures the persistence of relative unemployment, with the persistence of shocks increasing as α_1 approaches unity. $nmr_{it\text{-}1}$ and ncr_{it} are the net-migration rate of the previous year and the net-commuting rate respectively (for details see Section 3). Since the focus of this approach is on net-mobility rates we call the model described by equation (1) the net-mobility model. η_i denotes a region-specific effect, controlling for unobservable regional characteristics that are time-invariant, φ_t captures unobservable time effects and ε_{it} is the remainder disturbance. If mobility contributes to a decline of regional labour market disparities, the coefficients of net-migration and net-commuting should be positive in the model given by equation (1).

We consider control variables x_{nit} in order to avoid misspecification due to omitted variables. Control variables comprise population density to measure agglomeration effects and indicators for the sectoral composition of regional economies. Furthermore, the intensity of structural change and the qualification level of the work force are taken into account (see Section 3). The impact of other regional characteristics should be captured through inclusion of the lagged dependent variable.

The corresponding regression model for wages is given by:

$$w_{it} = \beta_1 w_{it-1} + \beta_2 nmr_{it-1} + \beta_3 ncr_{it} + \sum_{n=1}^{N} \delta_n x_{nit} + \mu_i + \phi_t + \xi_{it} \qquad (2)$$

where w_{it} is the log of the wage in region *i* and year *t* and w_{it-1} is the log of the wage level in *t*–1. This type of specification of absolute log wage level is widely used in the convergence literature. Due to the earlier mentioned censoring problem, the wage level is measured as the 40% percentile of the distribution of wages in the corresponding region. In case of neoclassical mechanisms dominating the effects of mobility on disparities, we expect the coefficient of $nmr_{it\text{-}1}$ to be negative. If we assume that commuting can be considered a substitute for migration the impact of ncr_{it} on wages should also be negative. Elhorst (2003) argues that labour supply effects of commuting more likely dominate potential labour demand effects than is the case for migration since commuters tend to spend more of their income in their home region than in their work region.

Following Østbye and Westerlund (2007) we modify the models by differentiating between in- and out-migration. With heterogeneous labour, the implied symmetrical treatment of immigration and emigration cannot be justified a priori. Because of heterogeneity among migrants, gross migration flows may lead to considerable interregional redistribution of human capital even when net migration is zero. If immigrants possess different skills than the work force in the receiving region this might give

rise to significant labour demand effects of immigration. The corresponding gross-mobility model for unemployment is given by:

$$u_{it} = \alpha_1 u_{it-1} + \alpha_4 omr_{it-1} + \alpha_5 imr_{it-1} + \alpha_6 ocr_{it} + \alpha_7 icr_{it} + \sum_{n=1}^{N} \gamma_n x_{nit} + \eta_i + \varphi_t + \varepsilon_{it} \qquad (3)$$

with gross mobility variables imr_{it-1}, omr_{it-1} and ocr_{it} , icr_{it} defined as described in Section 3. Whereas the net mobility variables nmr_{it-1} and ncr_{it} [6]are supposed to mainly capture the result of the quantity effect of labour mobility working via labour supply, results for gross mobility rates might provide additional evidence on qualitative effects of mobility via labour supply and labour demand. Findings might therefore point to the significance of heterogeneous labour mobility and a redistribution of human capital between regional labour markets.[7] If traditional neoclassical mechanisms mark the impact of mobility on regional disparities in equation (3) the outward flows (coefficients α_4 and α_6) will have negative effect on the regional unemployment whereas the inward flows (coefficients α_5 and α_7) will increase unemployment. The opposite applies to the corresponding wage model.

Moreover, symmetric effects in terms of absolute size but of opposite sign of in- and out-going labour flows indicate that labour supply effects probably dominate. In contrast, asymmetric effects, i.e. differences in size of the coefficients, or signs of the coefficients that are not in line with neoclassical reasoning might indicate significant labour demand effects of mobility that could result from composition effects, externalities, consumption or investment effects of mobility. In particular, ocr_{it} aims at effects on labour demand released by regional purchasing power and its impact on demand for non-tradables in region *i*. However, this effect might be important for East German regions only, as especially those along the former iron curtain are marked by considerable out-commuting to West Germany and a favourable development relative to the East German average. For this reason we also estimate separate models for East and West Germany.

There are several critical econometric issues in analysing the effects of labour mobility on regional disparities. The first one is the omitted variable bias that can result from the potential correlation between unobserved regional characteristics and the dependent variables, i.e. the regional wage level and unemployment. We can deal with time-invariant regional characteristics by applying a fixed effects model. Moreover, the lagged dependent variable on the right-hand side of the regression model will alleviate potential problems arising from unobserved heterogeneity.

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6 We use only the migration data with lags, because migration flows are aggregated over one year, whereas commuting data are stock data (30.6.).

7 Østbye and Westerlund (2007) note that net-mobility models as given by equations (1) and (2) can be obtained from the corresponding gross-mobility models by imposing the restriction that in- and out-migration (commuting) work symmetrically.

The second econometric issue concerns the simultaneity bias resulting from reverse causality between regional disparities and labour mobility. Due potential endogeneity of labour mobility the relationships estimated by OLS or panel approaches such as fixed or random effects models might not be interpreted as causal. The simultaneity bias can be addressed using instrumental variable (IV) estimation. In order to identify the causal impact of mobility on our dependent variables, we need a source of exogenous variation in migration and commuting. However, with a lagged dependent variable among the regressors, we have to instrument both the mobility variables and the lagged dependent variable. Therefore, we use Generalized Method of Moments (GMM) estimators to deal with predetermined or endogenous explanatory variables in our dynamic panel models. We apply the first-difference GMM estimator proposed by Arellano and Bond (1991).[8] This method is designed for panel data sets with small time dimension and large number of cross sectional observations. It accounts for presence of unobserved region-specific time-invariant effects and heteroskedasticity.

Applying the Arrelano-Bond GMM estimator implies that we estimate the models given by equations (1) to (3) in first differences to remove unobserved time-invariant county-specific effects. The differences of the endogenous explanatory variables are instrumented with suitable lags of their own levels. The application of the first-difference GMM estimator requires that there is no second order serial autocorrelation in the errors. Instrument validity is tested for by investigating serial correlation in the first-difference equation residuals. First order correlation is expected, but not higher order correlation.

We treat the lagged dependent variable, the mobility variables as well as population density as potentially endogenous variables. Apart from the GMM-type instruments, we use additional instruments for our mobility variables. Determinants of labour mobility that can be expected not to directly affect wages or unemployment, can serve as instruments for migration and commuting. In contrast, we use net and gross migration flows of people older than 65 years since these data should reflect determinants of mobility not related to economic performance and regional labour market conditions. Moreover, migration of this age group should not affect unemployment and wages because there is no effect on labour supply. Concerning commuting, car density lagged by two years is used as instrument because it reflects the most frequent means of transport on the journey to work in Germany. We test empirically if the additional instruments have explanatory power in the unemployment and wage models. In the first stage regressions the relevance of the instruments is confirmed with high significant coefficients. Results confirm there is correlation with labour mo-

[8] We also use system GMM estimators (Blundell and Bond 1998). However, we focus on the results of the first-difference estimator since the instruments of the system estimator did not pass the Sargan and Hansen tests. Moreover, the system estimator frequently did not meet assumption of no second order serial autocorrelation of residuals.

bility, but neither with regional unemployment nor wages. Our tests indicate that all instruments are suitable.

Roodman (2008) notes, that a large number of instruments might adversely affect the power of the tests of overidentifying restrictions. In order to guarantee a "parsimonious" use of instruments, we restrict the GMM-type instruments to fourth and deeper lags of levels.[9] Only using the highest lags of the endogenous variables should also reduce potential problems arising from the forward-looking nature of the mobility-disparities-relationship.

The third econometric issue refers to spillover effects among neighbouring labour markets. Labour mobility is most likely an important source of such interaction that might results in spatial dependence of wages and unemployment. However, there could be other forms of interaction such as demand linkages that cause spatial dependence in labour market conditions. In order to account for potential spatial dependence we apply spatial regression models. One possibility to introduce spatial effects is to include a spatially lagged dependent variable. The spatial lag model corresponding to equation (1) is given by:

$$u_{it} = \alpha_1 u_{it-1} + \rho \sum_{j=1}^{R} \omega_{ij} u_{jt} + \alpha_2 nmr_{it-1} + \alpha_3 ncr_{it} + \sum_{n=1}^{N} \gamma_n x_{nit} + \eta_i + \varphi_t + \varepsilon_{it} \qquad (4)$$

Thus we extend the non-spatial model by a spatial lag of the dependent variable $\sum_{j=1}^{R} \omega_{ij} u_{jt}$ where ω_{ij} is an element of the R×R spatial weights matrix Ω.[10] Taking into account the weighted sum of relative unemployment rates in neighbouring regions implies that spatial autocorrelation of the error term is caused by omission of some substantive form of spatial dependence caused by interaction among neighbouring labour markets.

A second frequently applied method is to allow for a spatially autocorrelated error term. The spatial error model will be the appropriate specification if the misspecification is due to nuisance dependence. Spatial autocorrelation in measurement errors or in variables that are otherwise not crucial to the model might entail spatial error dependence. The spatial error model for unemployment and net-mobility corresponds with equation (1) with the following expression as the spatial autoregressive error term:

$$\varepsilon_{it} = \lambda \sum_{j=1}^{R} \omega_{ij} \varepsilon_{jt} + \nu_{it} \qquad (5)$$

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[9] In practice, we start by the assumption of endogenous variables with lag of high order and test gradually the validity of instruments, based on recent lags.

[10] In order to check the robustness of results with respect to variation of the spatial weighting scheme we apply two different weighting schemes. The first specification of Ω is a binary spatial weights matrix such that ω_{ij} = 1 if the regions *i* and *j* are within one hour of travel time of each other and ω_{ij} = 0 otherwise. Secondly, ω_{ij} is set to the inverse of travel time between the capitals of regions *i* and *j*.

Including a spatial lag of the dependent variable in our regression model generates an additional endogeneity problem because the spatially-lagged dependent variable is correlated with the error term. We deal with this simultaneity by estimating fixed effects models that include a spatial lag by maximum likelihood (ML). According to Mohl and Hagen (2008) it is currently not possible to estimate a spatial lag model and simultaneously control for endogeneity of other variables within a dynamic GMM approach. Moreover, Fingleton and LeGallo (2008) note that ML estimation of a model with a spatial error process and endogenous variables would be difficult to implement. The standard estimation method for a fixed effects model including a spatially lagged dependent variable is to eliminate the region-specific effects by de-meaning the dependent and explanatory variables (see Elhorst 2004). We estimate demeaned equations (1) and (4) by ML (and corresponding models for wages).

6 Discussion of regression results

Table 1 and 2 summarize the results of the dynamic panel models applying the GMM Arellano-Bond estimator for unemployment and wages. We only report results for the mobility and the lagged dependent variables.[11] In order to investigate whether the impact of mobility on disparities differs between East and West Germany all specifications are estimated for the entire cross section of counties as well as sub-samples of East and West German regions. The tables include estimates of the corresponding net and gross mobility models.

The first differences of the lagged dependent variables and the mobility variables are instrumented by suitable lags of their own levels. Apart from these internal instruments we also apply external instruments (see Section 5) to deal with the endogeneity of the mobility variables. Since the model is overidentified, we apply Sargan test and Hansen *J* test in order to check statistically whether the used lags are valid instruments. Moreover, Arellano-Bond tests on serial autocorrelation are displayed indicating that the model is correctly specified. Altogether the tests show that for most specifications the null hypothesis of instrument validity can not be rejected. Finally we also estimate Diff GMM estimates where we include additional external instruments with robust results for the mobility variables. Difference-in-Hansen tests of exogeneity of instrument subsets (Diff Hansen test), suggest that our additional external instruments should improve the efficiency of the estimation compared to Diff GMM using exclusively internal instruments.

[11] Additional regression results are available from the authors upon request.

Table 1
GMM results for unemployment

	Germany		West Germany		East Germany	
	Net	Gross	Net	Gross	Net	Gross
u_{it-1}	.4406**	.4263**	.3786**	.5452**	.0884	.1348
	(.0611)	(.0671)	(.1154)	(.1278)	(.1224)	(.0941)
nmr_{it-2}	.0079**		.0074**		.0055*	
	(.0022)		(.0018)		(.0026)	
ncr_{it}	.0053		.0139*		-.0095	
	(.0060)		(.0057)		(.0071)	
imr_{it-2}		.0046*		.0104**		.0049*
		(.0019)		(.0019)		(.0023)
omr_{it-2}		-.0089**		-.0022		-.0055
		(.0024)		(.0020)		(.0033)
icr_{it}		-.0154		-.0046		-.0628**
		(.0136)		(.0140)		(.0199)
ocr_{it}		-.0235		-.0339*		-.0104
		(.0140)		(.0171)		(.0178)
Observation	2580	2580	1920	1920	660	660
Number of instruments	45	64	45	64	45	64
Sargan (p-value)	0.03	0.00	0.19	0.35	0.06	0.02
Hansen (p-value)	0.03	0.00	0.05	0.29	0.33	0.22
Diff Hansen (p-value)	0.29	0.12	0.24	0.24	0.33	0.42
AR(1) (p-value)	0.00	0.00	0.01	0.00	0.09	0.09
AR(2) (p-value)	0.27	0.08	0.04	0.56	0.89	0.73
Moran test	58.6**	72.1**	49.4**	49.1**	18.7**	17.0**

Notes: * significant at 5%; ** at 1%. Models include time fixed effects and control variables (see Section 5). Robust standard errors are given in parentheses.

The estimation procedure is the GMM difference approach. The reported estimates are based on the one-step version. Besides the lagged dependent variable, the mobility variables and population density are treated as endogenous and instrumented with GMM-style instruments. All other variables are assumed to be exogenous. We instrument first differences of the endogenous variables with lags of their levels restricting the lag-limit to 3 in order to ensure sparse instrumentation.

The Sargan and the Hansen test are tests of the validity of overidentifying restrictions. The Hansen J test is like Sargan, but robust to heteroscedasticity. Difference-in-Hansen test checks the validity of the subset of additional external instruments. The values reported for AR(1) and AR(2) are p-values of the Arellano-Bond tests for first and second order autocorrelation in the first-differenced residuals. The results of the Moran test for spatial autocorrelation are based on a binary weights matrix with a cut-off point of one hour of travel time.

The regression results in Table 1 indicate that migration indeed acts as an important adjustment mechanism with respect to regional unemployment disparities[12]. The coefficients of the net migration rate are positive and significant for all considered cross sections. Thus, migration of workers tends to reduce differences in unemployment rates among German regions. This result does not solely rest on disparities between East and West Germany since significant effects also mark the two sub-samples. The estimates suggest that the impact of migration on unemployment disparities is strong. The mean annual net migration rate of East Germany amounted to -3.7 between 1995 and 2005. Applying the coefficient of the net mobility model (0.0079) yields a reduction of the average relative unemployment rate in East Germany from 1.74 to 1.71.

In contrast, commuting seems to matter only for unemployment disparities among West German regions. The corresponding coefficient indicates that commuting contributes to the convergence of regional labour market conditions within West Germany. The positive effect of net commuting on relative unemployment rates is in line with findings in Patacchini and Zenou (2007). The authors conclude that commuting tends to reduce unemployment disparities in the UK. However, interaction among neighbouring labour markets is highly localised. Obviously commuting does not play a crucial role for labour market adjustment between East and West Germany.

Apart from labour mobility there seem to be other important mechanisms of adjustment on regional labour markets. The coefficients of the lagged dependent variable are far below unity, indicating a rather swift adjustment after shocks even if effects of labour mobility are controlled for. According to our results the persistence of regional unemployment after shocks is fairly low. However, corresponding evidence is restricted to the entire cross section and the West German sub-sample.

Next, we consider gross mobility flows as proposed by Østbye and Westerlund (2007) in order to investigate whether in- and out-migration (commuting) work symmetrically. The estimates point to significant positive effects of in-migration on differences in regional unemployment rates. In line with neoclassical reasoning, in-migration tends to increase the relative unemployment rate. This applies to the entire cross section and the two sub-samples. However, we do not find corresponding effects for out-migration. There is no significant impact of out-migration on the pattern of relative unemployment rates in both the East and West German sub-sample. In contrast, a strong dampening effect of out-migration emerges for the entire cross section. This suggests that the significant effect of out-migration might be primarily driven by labour mobility between East and West Germany and its favourable effect on East German labour markets. The absolute size of the coefficient almost doubles

[12] We present here the estimation results for the migration variables with lag t-2, because overall in this specification Sargan/Hansen and Arellano-Bond tests provide more robust results compared to the specification of migration variables with lag t-1.

the corresponding effect of in-migration. Thus, to sum up there is evidence of asymmetric migration effects in all cross-sections.

Findings with respect to commuting are less clear-cut in the gross mobility models. Significance is restricted to the sub-samples but with opposite effects in both parts of the country. Whereas in West Germany out-commuting decreases the relative unemployment rate of regions, in the Eastern part of the country in-commuting has this effect. Thus, contrary to our expectations we find no evidence of beneficial out-commuting effects in East Germany as e.g. discussed in Einig and Pütz (2007). At first glance the significant negative sign of the in-commuting effect in Eastern Germany is surprising: in-commuting gives rise to a decline of the relative unemployment rate. Thus, labour demand effects seem to dominate labour supply effects in this case. In order to check whether this result is solely driven by the large East German cities, we excluded Berlin, Dresden and Leipzig. However, the estimates remained basically unaffected. The result might point to significant repercussions on labour demand linked to in-commuting that could possibly be based on externalities, as emphasized by new economic geography models or selective mobility flows, i.e. a favourable qualification structure of in-commuters that positively affects growth and labour demand in the regions of destination.

Table 2 summarizes the GMM estimates for the different wages models. Altogether, evidence of mobility effects is weak for wages disparities. There are almost no significant effects of mobility on wages in Germany. The only exception is a negative influence of out-commuting in the gross mobility model for the East German cross section, however only significant at 5% level. Therefore, we should not overemphasize this result. There seem to be important adjustment mechanisms other than regional labour mobility however, since the coefficients of the lagged wage variable do not point to a strong persistence of disparities in regional wages. This applies in particular to the estimates for the entire cross section.

Table 1 and 2 also display Moran's test statistic for spatial autocorrelation of the GMM residuals. The results point to a significant spatial autocorrelation suggesting that the non-spatial models might not incorporate all channels of interaction between neighbouring regions although we considered effects of labour mobility. However, autocorrelation of the error terms does not seem to be of the substantive form. We do not report results for the spatial lag model as the spatial lag of the dependent variable is not significant in most models.[13] Moreover, log likelihood indicates that the spatial error model provides a more appropriate specification of spatial autocorrelation than the spatial lag model. This implies that apart from labour mobility there is no interaction among neighbouring labour markets that give rise to spatial dependence of wages and unemployment. This corresponds with evidence in Patacchini and Zenou (2007) who argue that spatial dependence in regional unemploy-

[13] Regression results for the spatial lag models are available upon request.

ment in the UK can be explained by labour mobility. The spatial autocorrelation of the error term is therefore likely to be caused be measurement errors.

Table 2
GMM results for wages

	Germany		West Germany		East Germany	
	Net	Gross	Net	Gross	Net	Gross
w_{it-1}	.3362*	.5232**	.8302**	.8027**	.0574	.0464
	(.1696)	(.1590)	(.2704)	(.2003)	(.1816)	(.1393)
nmr_{it-2}	-.0002		-.0003		-.0000	
	(.0003)		(.0003)		(.0004)	
ncr_{it}	.0005		.0005		.0006	
	(.0006)		(.0007)		(.0007)	
imr_{it-2}		-.0002		.0001		.0006
		(.0003)		(.0003)		(.0005)
omr_{it-2}		.0001		.0003		-.0002
		(.0002)		(.0003)		(.0004)
icr_{it}		-.0030		-.0012		-.0003
		(.0015)		(.0020)		(.0013)
ocr_{it}		.0024		-.0008		-.0038*
		(.0023)		(.0032)		(.0019)
Observation	3010	3010	2240	2240	770	770
Number of instruments	34	47	34	47	34	47
Sargan (p-value)	0.00	0.19	0.90	0.99	0.00	0.01
Hansen (p-value)	0.02	0.28	0.60	0.74	0.02	0.19
Diff Hansen (p-value)	0.76	0.37	0.97	0.72	0.99	0.85
AR(1) (p-value)	0.03	0.00	0.00	0.00	0.96	0.62
AR(2) (p-value)	0.23	0.01	0.58	0.72	0.10	0.05
Moran test	64.4**	57.4**	58.1**	54.0**	27.6**	24.9**

Notes: * significant at 5%; ** at 1%. Models include time fixed effects and control variables (see Section 5). Robust standard errors are given in parentheses. Estimation procedures see notes of Table 1.

We restrict the discussion of the spatial regression models to unemployment (Table 3) since there is no evidence on mobility effects for regional wage disparities. In the spatial error model for unemployment we apply a spatial weighting scheme that allows for spatial autocorrelation if regions are within one hour of travel time of each other.[14] The spatial autoregressive parameter λ is negative and significant in all specifications, including net and gross models. Thus there is evidence for a meas-

[14] Applying a weighting scheme based on inverse distance between the regions does not significantly change our results. Thus, the findings appear to be robust with respect to the choice of the spatial weights matrix.

urement error that is due to the delineation of regions at the county level, i.e. units of observation that do not correspond with regional labour markets. Apparently we include mobility flows between counties in our analyses that do not directly respond to disparities in unemployment and wages, but rather result from functional linkages within regional labour markets (e.g. commuting as consequence of suburbanization). The negative sign of the parameter λ might point to functional differences between cities and their hinterland that cause commuting flows irrespective of differences in unemployment and wages.

Table 3
Spatial panel error models for unemployment

	Germany		West Germany		East Germany	
	Net	Gross	Net	Gross	Net	Gross
u_{it-1}	.6548**	. 6619**	.6832**	.6816**	.5243**	.5193**
	(.0132)	(.0133)	(.0140)	(.0144)	(.0300)	(.0298)
nmr_{it-2}	.0011**		.0007**		.0001	
	(.0002)		(.0002)		(.0005)	
ncr_{it}	.0016**		.0007*		.0016	
	(.0004)		(.0003)		(.0009)	
imr_{it-2}		.0014**		.0011**		.0002
		(.0002)		(.0003)		(.0006)
omr_{it-2}		-.0003		-.0002		.0007
		(.0004)		(.0003)		(.0008)
icr_{it}		-.0019		.0019		-.0055**
		(.0010)		(.0010)		(.0020)
ocr_{it}		-.0069**		.0002		-.0091**
		(.0010)		(.0010)		(.0021)
Observations	3440	3440	2560	2560	880	880
λ	-.1227**	-.1159**	-.1655**	-.1592**	-.1491**	-.1554**
	(.0359)	(.0359)	(.0451)	(.0450)	(.0552)	(.0549)
Wald test $(H_0 : \lambda = 0)$	11.7**	10.4**	13.5**	12.5**	7.3**	8.0**

Notes: * significant at 5%; ** at 1%. Robust standard errors are given in parentheses.

Overall the significant mobility effects detected in the non-spatial model are confirmed by the results of the spatial error model. The fact, that the size of the parameters is smaller should be interpreted carefully, because the spatial error model does not account for endogeneity of the mobility variables and might therefore be biased. Compared to the results of the GMM models, we find additional significant effects - predominantly for commuting variables. However, interpreting these results we also have to keep in mind that they might be affected by reverse causality. Altogether we tend to rely more on the GMM results regarding evidence on the mobility effects on

regional disparities because with spatial dependence confined to the error term the GMM estimates should be unbiased. In contrast, we do not control for endogeneity of explanatory variables in the spatial models. Thus, corresponding results are likely biased. This is confirmed by unreported results from a fixed effects model without instrumentation that are very similar to the estimates of the spatial error model.[15] Therefore the differences between GMM estimates and spatial error models are likely due to endogeneity bias and not caused by spatial autocorrelation not captured in the GMM specifications.

7 Conclusions

Differences in regional labour market conditions are still pronounced in Germany. The disparities are mainly marked by persistent differences between the Eastern and the Western part of the country. Whereas regional disparities in unemployment have increased since the mid of the 1990s, they are rather stable with respect to wages. At the same time there are considerable interregional migration and commuting flows. In the period under consideration mobility losses of East German counties have been the most important features of labour mobility. According to neoclassical models this mobility should reduce regional disparities. This, however, is in contrast to our descriptive findings on the development of disparities since 1995. Thus the question arises whether labour mobility contributes to a convergence of labour market conditions at all.

Our regression analysis aims at investigating the impact of labour mobility on disparities in regional unemployment and wages – taking into account both migration and commuting. The regression results suggest that there are indeed significant effects of mobility on unemployment whereas evidence with respect to regional wages is rather weak. However, there seem to be other relevant adjustment mechanisms, e.g. labour market participation rate, since the results for the lagged wage variable do not point to a strong persistence of disparities in regional wages. The effects of migration on unemployment differences are more or less in line with the implications of the traditional neoclassical approach. Labour mobility seems to reduce regional disparities in unemployment. Moreover, the results suggest that commuting is less important for a reduction of labour market disparities in Germany. No significant effects emerge for the entire cross section and findings for West and East German sub-samples are rather ambiguous.

Finally, considering gross mobility flows provides additional insights. Our regression results indicate that in- and outgoing mobility flows do not work symmetrically. These findings suggest that apart from an impact of mobility on disparities via regional labour supply there are significant effects caused by repercussions on labour demand. However, the latter are not strong enough to outweigh the former. In sum neoclassical mechanisms dominate mobility effects that might be linked to external-

[15] Corresponding results are available upon request

ities, selective migration or changes in consumption and investment. Especially asymmetric effects with respect to commuting might indicate that the influence is rather via purchasing power and labour demand than directly operating through changes in labour supply.

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Appendix

Table A1
Summary statistics: relative unemployment and wage level

	Relative unemployment rate			Log of wage level		
	Total	West	East	Total	West	East
Mean	1.0	0.8	1.7	4.2	4.3	4.0
Std. Dev.	0.5	0.3	0.3	0.2	0.1	0.1
Minimum	0.3	0.3	0.9	3.7	4.1	3.7
Maximum	2.8	1.8	2.8	4.7	4.7	4.4
N	3440	2560	880	3870	2880	990

Table A2
Summary statistics: net-migration and net-commuting

	Net migration rate			Net commuting rate		
	Total	West	East	Total	West	East
Mean	0.7	2.2	-3.6	-13.1	-13.0	-13.5
Std. Dev.	10.7	8.1	15.1	34.0	37.7	19.7
Minimum	-58.2	-47.7	-58.2	-178.5	-178.5	-73.8
Maximum	81.1	40.0	81.1	69.0	69.0	33.6
N	3870	2880	990	3870	2880	990

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