What has caused regional employment growth differences in East Germany?

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Abstract

Using a regression analogue of the shift-share technique we address the explanatory power of various theories about regional differences in employment growth in eastern German districts from 1993 until 2001. We find that overly high regional wages are more important than differences in the qualification, firm-size or industrial structures. The most important source of disparities, however, is the dispersion of idiosyncratic location effects. This suggests that individual districts differ markedly in their capacity to generate employment growth and illustrates the importance of a regional perspective when it comes to the employment problem in eastern Germany in general.

Zusammenfassung

In diesem Aufsatz verwenden wir ein regressionsanalytisches Analogon der deskriptiven shift-share Methode, um die Erklärungsmacht verschiedener Theorien zur Entstehung regionaler Disparitäten im Beschäftigungswachstum zu testen. Konkret betrachten wir die Beschäftigungsentwicklung in den ostdeutschen Landkreisen von 1993-2001. Es stellt sich heraus, dass ein überhöhtes regionales Lohnniveau eine größere Rolle spielt als regionale Differenzen in der Qualifikations-, Firmengrößen- oder Branchenstruktur. Die wichtigste Quelle regionaler Wachstumsunterschiede ist jedoch die Dispersion idiosynkratischer Standorteffekte. Die ostdeutschen Landkreise unterscheiden sich signifikant in ihrer Kapazität, Beschäftigungswachstum zu generieren. Dies unterstreicht die Bedeutung der regionalen Dimension des Beschäftigungsproblems in Ostdeutschland.

Keywords: Employment Growth, Eastern Germany, Shift-Share-Analysis, Regional Disparities.

JEL Classification: J23, E2

1) Introduction

Since reunification, the economic recovery of former East Germany has proceeded more slowly than many observers expected. In many respects, certainly when it comes to labour market indicators, the economic disparities between the old and the new *Länder* have even increased since the mid-1990s. This can be illustrated, for example, by comparing the growth rates of full-time employment relationships subject to social security. In western Germany these so-called regular jobs declined by 5.31 per cent between 1993 and 2001. In eastern Germany the employment rate fell by about 20 per cent! At the same time another process evolved that has received much less attention, namely a differentiation of the labour market performance within eastern Germany. These disparities are already visible at state level (NUTS1), as the employment growth rates range from -23.4 per cent (Sachsen-Anhalt) to "only" -15.9 per cent (Thüringen). But these figures hide the even more dramatic differences at district level (NUTS3). The most depressing example is Bitterfeld, whose full-time employment rate fell by 43.25 per cent in only 9 years, whereas the most successful district in the East, Bad Doberan, has managed to increase the number of full-time jobs by a remarkable 22.5 per cent.

The aim of this paper is to shed light on the question as to what is behind these huge differences in regional employment growth rates in eastern Germany. With our available data, we can address the explanatory power of a number of possible reasons. As is described in greater detail below, we examine for example the role of the local industry structure, the qualification structure of the local workforce and the role of wages.

Our empirical analysis builds on the traditional deterministic shift-share approach developed by Dunn (1960), and on its regression-analytical analogue that was launched by Patterson (1991) and augmented by Moeller/Tassinopoulos (2000), Blien/Wolf (2002) and Blien et al. (2003). Unlike classical shift-share analysis the regression instrument can be extended to include all kinds of theoretically meaningful variables. In this paper, we extend this workhorse model of regional analysis by using the methodology proposed in Suedekum/Blien (2004) to analyse the relation between regional wages and regional employment growth. From a theoretical point of view, the effect that a wage increase has on the employment growth rate is ambiguous as both cost-push and demand-side effects can result (Jerger/Michaelis, 2003; Appelbaum/Schettkat, 1999). Most economists subscribe to the neoclassical view that higher labour costs will tend to reduce employment growth, for instance because of factor substitution, or due to production shifting to other countries. Yet Keynesian-style purchasing power arguments remain vital; according to these arguments, higher wages can actually

increase the employment growth rate (Jerger/Landmann, 2002). In order to analyse these arguments empirically, we examine how the spatial wage structure has affected employment growth in eastern Germany. It would be quite misleading, however, to use unsettled average wages directly in a regression, because labour productivity differs systematically across locations and industries, which gives rise to normal wage disparities across the single units. Suedekum/Blien (2004) therefore suggest a two-step estimation approach, where regional wages are detached from various productivity influences in the first stage. An indicator for the neutralized regional wage level is constructed, and a "high-wage region" in this interpretation is not a region with high wages *per se*, but a region whose wages are higher than they "should be", given a variety of characteristics. In the second stage of the estimation we then address the impact of this neutralized regional wage on employment growth.

Turning to the estimation results of this two-stage shift-share regression, we find some highly significant and economically intuitive determinants of differences in employment growth. For example, the local industrial structure has an impact as suggested by standard theories of structural change, where regions grow more strongly if specialized in thriving industries. With respect to labour income we find that an overly high regional wage level significantly reduces employment growth, although the effect is stronger in some industries than in others.

In this paper we not only want to test the significance of individual theories on regional differences in employment growth, however; we also want to explore the relative contribution of the different explanations to the understanding of the total variation of regional employment growth rates in eastern Germany. Do some regions grow faster than others mainly because of differences in the qualification structure? Or are wages or the industrial structure relatively more important? To answer this important question, which obviously has serious implications for policymakers, we develop a simple approach and analyse the dispersion of predicted mean growth rates when (hypothetically) only one influence factor is allowed to vary across regions. This dispersion analysis suggests that wages are far more important than the qualification structure or the industrial composition for understanding differences in employment growth at regional level. The major reason for growth disparities across districts, however, is the variation of idiosyncratic location effects. By their construction, these fixed effects represent differences in employment growth that are solely attributable to location characteristics excluding all other observable differences. Their quantitative importance suggests that individual districts differ markedly in their capacity to generate employment growth. This neatly illustrates how important it is to adopt a regional

perspective when trying to understand the employment growth deficit of eastern Germany as a whole.

The rest of this paper is structured as follows. In section 2 we describe our data set. The estimation approach is introduced in section 3, where we also discuss the theoretical basis of our explanatory variables at greater length. Regression results and the dispersion analysis are presented in section 4. Section 5 concludes.

2) Data

The data for this study are provided by the German Federal Employment Agency (Bundesagentur für Arbeit) and contains the entire population of all full-time employment relationships subject to social security (≥ 35 regular working hours per week), which excludes civil servants and the self-employed. This official information is highly reliable and by far more accurate than survey data. We focus here only on full-time employment because there are some data problems for part-time employment relationships due to the change in the data basis in 04/99, and because wages of part-time employees are measured less accurately.[1] However, in eastern Germany full-time work is by far the most dominant form of employment. Over the observation period, aggregate full-time employment in eastern Germany fell from roughly 4.1 million jobs in 1993 to 3.3 million in 2001, but with huge differences across sectors and regions.

We have annual observations about the employment level in 28 different industries at the level of the 112 eastern German districts (NUTS3 regions, "Landkreise" and "kreisfreie Staedte" excluding East Berlin).[2] Our panel thus contains (9 years * 112 districts * 28 industries) = 28224 cells, some of which are equal to zero as some possible combinations do not occur (e.g. coalmining in Mecklenburg-Vorpommern). The wage regression (the first stage of the regression, see section 3) is performed using this data set. For the employment regression (the second stage) we lose one year of observation for constructing employment growth rates. Moreover, we face the problem of infinite growth rates if the employment level in a local industry is zero for some years. In order to eliminate this problem we have excluded all local industries that were not constantly active with at least one officially reported employee in all the years of the observation period.[3]

[1] The data for part-time employees do not provide the exact number of hours worked.

[2] To construct this data set, a complicated procedure by the Federal Employment Agency was necessary to take into account various territorial reforms and redefinitions since 1993 (see Blien et al. 2003 for more details).

[3] This procedure led to the elimination of only very few "mini sectors". Even if individual industries saw a rapid decline in a district, the number of employees hardly ever fell to zero. In total, less than 0.2 per cent of the full-time employment relationships were eliminated.

For each local industry and for each year we know the qualification structure of the local workforce, and the structure of establishment sizes. Three categories of skills are distinguished (without formal vocational qualifications, completed apprenticeship, higher education). People for whom no qualification details were available were added to the group without formal qualifications, as previous research by the Federal Employment Agency has shown that they correspond closely to this group. For establishment sizes, three categories were calculated: the proportion of firms with fewer than 20 employees, with 20-99 employees, and with at least 100 employees. In addition we know the average age, and the proportion of men in the workforce of each local industry in each year.

From the employment statistics we also obtain the wage income for each full-time employee in our data set, including all bonus and extra payments subject to social security. Using this information we compute average effective earnings per employee and calendar day in each industry, region and year. Jobs are reported at the workplace location, therefore the information does not suffer from a commuter bias as would be the case with residence-based data. Two points should be noted with respect to the wage data. Firstly, income levels that exceed the threshold for social security contributions are reported with this value. Our data are therefore likely to understate the true degree of wage dispersion. Secondly, although we deflate the wages, and work with 1993 prices, we are restricted to using a common price deflator for all districts (the CPI for eastern Germany), because price level data and price indices are not available at a regional level. This is unfortunate, because high nominal wages reflect – at least partly – a high regional price level (see e.g. Tabuchi, 2001).

It should be noted that the aggregation level of our data set is finer at regional than at sectoral level, as some classified industries entail quite diverse activities. For example, the economy-related services cover high-end consulting jobs, but also numerous casual employment relationships.[4] To the extent that some regions are specialised in these very broadly defined sectors, the intra-industry variation in wages and employment growth will not be represented in the industry-specific effects, but will show up more in the location component. We will return to this issue when presenting our regression results below.

3) Estimation approach and definition of variables

Our empirical strategy is an extension of the shift-share regression approach developed by Patterson (1991), Moeller/Tassinopoulos (2000), Blien/Wolf (2002) and Blien et al. (2003). It

[4] Another example is the sector "paper & printing", which comprises the quite diverse industries of "publishing" and the "paper industry". We owe this observation to one of the referees.

builds specifically on the methodology developed in Suedekum/Blien (2004) to account for the impact of the regional wage level. The unit of analysis is a local industry i in region r. The number of observations in a shift-share regression is thus i times larger than in a regional panel model with fixed industry effects, thus all estimations can be carried out with greater precision. Blien et al. (2003) refer to additional methodological problems of panel models in which the observation unit is a region. The authors show that the results of regional panel regressions are unstable and implausible, especially with respect to the industry coefficients. An industry which is declining drastically may have a positive coefficient because two different effects can not be separated: one that is related to the development of the industry itself, and one that is associated with the location of the industry. The declining industry may be associated with a positive development of the regions where it is overrepresented. A shift-share regression approach is suited to separate these effects precisely.

In the first stage of the estimation our aim is to construct a neutralized regional wage level that is detached from various productivity influences. This indicator is then included as a regressor in the second stage, where the dependent variable is the annual employment growth rate. In the first stage, we regress the (log) average daily wage income for each sector, region and year ($\ln W_{irt}$) on all available control variables, as we expect the qualification, age and gender structures of the workforce and the firm-size structure to have an impact on productivity. As is characteristic of shift-share regressions, we also include full sets of dummy variables for each industry i and each district r, thereby controlling for a sectoral and a regional wage structure. We not only distinguish all 112 eastern German districts, but also divide them into nine different area types defined according to the common classification scheme developed by the research unit of the German Federal Office for Building and Regional Planning (BBR, see Goermar/Irmen, 1991). These area types, which capture the size and centrality of a district, are listed in table 1.

TABLE 1 HERE

Including a dummy for each area type in the wage regression has the advantage that systematic wage differences between core cities and peripheral regions are filtered out. In this way we ameliorate the problem of unobserved cost-of-living differentials between broader classes of regions. In sum, we estimate the following reduced-form equation separately for each year t.

$$\ln W_{irt} = \beta_{0,t} + W'_{rt} + \alpha'_{it} + \delta'_{yt} + \sum_{j=1}^{3} \beta'^{Q}_{j} Q_{jirt} + \sum_{z=1}^{3} \beta'^{B}_{z} B_{zirt} + \beta'^{G} G_{irt} + \beta'^{A} A_{irt} + \varepsilon'_{irt} \qquad (1)$$

The variables W'_{rt}, α'_{it} and δ'_{yt} denote the fixed effects for district r=(1,…,112), industry i=(1,…,28) and area type y=(1,…,9) in year t, respectively. Q_{jirt} is the proportion of the qualification group j=(1,2,3), B_{zirt} denotes the proportion of the establishment-size category z=(1,2,3). The proportion of men is denoted G_{irt}, A_{irt} is the average age of the employees, $\beta_{0,t}$ is a constant term and ε'_{irt} the error term.

The most important variable for our purpose is the regional fixed effect W'_{rt}, which depicts how wages in region r differ from a level that "should" prevail, given the variety of control variables included in (1). Positive (negative) values of W'_{rt} indicate that region r is a "high wage" ("low wage") region in our interpretation.

In the second stage we estimate pooled over the observation period with additional time period fixed effects. The dependent variable is the annual employment growth rate of industry i in region r at time t, i.e. $wn_{irt} = \left(N_{ir(t+1)} - N_{irt}\right) \big/ N_{irt}$. On the right-hand side we analogously use full sets of industry, region and area-type dummies (α_i, κ_r and δ_y). The industry-specific effects capture systematic differences in industry employment growth rates, as suggested e.g. by standard theories of structural change. Idiosyncratic location-specific growth differences are taken out by the district dummies κ_r. The area-type dummies δ_y control for differences in the growth performance of broader classes of regions. This is useful for analysing whether central regions gain or lose employment systematically faster than surrounding or rural areas. For western Germany, Moeller/Tassinopoulos (2000) and Suedekum/Blien (2004) find that central cities lose employment significantly, whereas surrounding area types tend to gain employment. This indicates a process of geographical employment de-concentration. Lastly, the time-period dummies λ_t control for general business cycle movements that affect employment growth equally in all units.

As in the wage regression in the first stage, we also include the information on firm-size and qualification structures in the employment growth analysis, while leaving aside age and gender since we have no theoretical priors on their impact. The theoretical basis for including the qualification structure seems straightforward, as recent growth theory has strongly emphasized the importance of human capital as a major growth engine in developed countries. We expect that a large share of highly qualified workers will stimulate employment growth, since labour productivity is likely to rise (e.g. via technological complementarities or

knowledge spillovers). Theory is less clear-cut when it comes to the relation between firm sizes and employment growth. Firm sizes have frequently been used as a proxy for the degree of market power (see e.g. Glaeser et al. 1992) and, in this respect, our analysis adds to the literature on the relation between competition and growth. On the one hand, small firm sizes might be an indicator of fierce competition on the local labour market. Since labour demand is generally higher the lower monopsony power is, we might expect a growth stimulus when firms are small. On the other hand, some growth theorists have argued that – from a Schumpetrian perspective – market power can also be an incentive for R&D (see Motta, 2004: chap. 2 for an introduction). This is highly plausible from an ex-ante perspective. But even ex-post, firms with market power (i.e. larger firms) might be able to defend innovation rents more easily than smaller firms. This trade-off has recently been explored by Aghion et al. (2005), who find that an intermediate scenario somewhere between perfect competition and monopoly is the most growth-friendly environment.

Finally, we use the (lagged) regressor $W'_{r(t-1)}$ from the first stage of the estimation. Since $W'_{r(t-1)}$ is region-specific, it depicts the influence of neutralized wages in district r on the employment growth rate of the 28 different industries in that location. It represents the trade-off between cost-push effects and countervailing demand-side effects of high wages as described in the introduction. Instead of using regional fixed effects as our measure for neutralized wages, it would alternatively be possible to use a fixed effect for each local industry.[5] With our specification we allow for local demand spillovers across industries, but we abstract from interactions across regions. The relative strength of the two effects might differ across industries, however. For example, demand-side repercussions of the regional wage level will be small for export-oriented industries, where the purchasing power of local consumers is hardly relevant. On the other hand, industries with a strong focus on local consumers might be affected much more considerably by an increase in local private spending after a general wage increase. To test this we include an interaction term X_m in the employment growth regression, with $X_m=1$ if m=i and $X_m=0$ otherwise. With this variable it is possible to analyse whether the effect of neutralized regional wages differs systematically between industries. In sum, the estimation equation in the second stage has the following form:

[5] This would reveal how the wages in each unit differ from the level that should be expected. However, this method would probably not allow a test of demand-side effects of a wage increase, as the induced repercussions of a wage increase only in the firm's own sector/region-unit will supposedly be very small.

$$wn_{irt} = \kappa_r + \alpha_i + \lambda_t + \delta_y + \sum_{j=1}^{3} \beta_j^Q Q_{jir(t-1)} + \sum_{z=1}^{3} \beta_z^B B_{zir(t-1)} + \sum_{i=1}^{28} \beta_i^W X_m W'_{r(t-1)} + \varepsilon_{irt} \qquad (2)$$

Turning to methodological issues, the employment growth regression (2) must be estimated by using weighted least squares (WLS). Since the cells are very heterogeneous in size, the same absolute change in employment implies very different changes in employment growth rates. Exorbitant jumps are possible, in particular for very small cells, which results in an inherent heteroskedasticity problem.[6] We therefore weight equation (2) with the employment of each cell (N_{irt}) divided by the total national employment (N_t) in the respective year. Technically speaking, we weight the variance-covariance matrix of the error terms with a matrix **G,** which as a diagonal matrix includes the employment proportions $g_{irt} = \sum_{r=1}^{112} \sum_{i=1}^{28} \sum_{t=1}^{8} (N_{irt} / N_t)$.

$$\text{cov}(\varepsilon) = \tilde{\boldsymbol{\Omega}} = \mathbf{G}\boldsymbol{\Omega}\mathbf{G} \qquad (3)$$

For the wage regression (1) a comparable heteroskedasticity problem does not arise because we are not estimating a growth rate. Therefore we do not have to weight the observations.

The second methodological problem is that both estimation equations, (1) and (2), are plagued by perfect multicollinearity because we use full sets of dummy variables. The usual strategy is to exclude one fixed effect in each set of dummies. The other fixed effects are then measured in relation to this excluded reference category. However, we prefer a national grand mean as the reference category so that we can interpret the estimated coefficients in common terms as percentage deviations. An elegant way to achieve this is the use of restrictions for the estimated coefficients. In particular, we use a normalisation such that the sum of the weighted coefficients is equal to zero. Consider for example the industry fixed effects in the wage regression (1). We impose the following constraint on the coefficients $\alpha'_1 - \alpha'_{28}$:

$$\sum_{i=1}^{28} g_i \cdot \alpha'_{it} = 0 \qquad \text{for each year t} \qquad (4)$$

[6] This is also known as the "shipbuilding in the midlands" problem. A weighted estimation approach similar to the one used in this paper was proposed initially by Buck/Atkins (1976), and was later extended by Moeller/Tassinopoulos (2000).

The weight g_i in (4) should be time-invariant, and therefore we use the employment proportions for the year 1997 (the middle of the observation period), i.e. we have for example $g_{i=1} = N_{i=1,t=1997} / N_{t=1997}$. The coefficient α_i' can then be interpreted as a percentage deviation of the wage level in sector i from the national average wage. Analogously, the industry fixed-effects in the employment growth regression (2) are also estimated subject to the constraint that the weighted sum of the coefficients is equal to zero

$$\sum_{i=1}^{28} g_i \cdot \tilde{\alpha}_i = 0 \tag{5}$$

The tilde indicates that the coefficient α_i is weighted according to (3) in order to cope with the heteroskedasticity problem. In a similar way we restrict the coefficients for the three skill categories and the three establishment-size classes to sum up to zero in the employment growth regression,

$$\sum_{j=1}^{3} g_j \tilde{\beta}_j^{Q} = 0, \qquad \sum_{j=1}^{3} g_z \cdot \tilde{\beta}_j^{B} = 0 \tag{6}$$

and analogously for the wage regression

$$\sum_{j=1}^{3} g_j \beta_{jt}'^{Q} = 0, \qquad \sum_{j=1}^{3} g_z \cdot \beta_{jt}'^{B} = 0 \tag{7}$$

The weights g_j and g_z denote the respective national employment share for 1997. For the district fixed effects W_{rt}' and $\tilde{\kappa}_r$ and the area-type fixed effects δ_{yt}' and $\tilde{\delta}_y$ we use a slightly different restriction. For the employment growth regression we impose

$$\sum_{r=1}^{112}\sum_{y=1}^{9} g_r \tau_y \tilde{\kappa}_r = 0 \qquad \sum_{y=1}^{9} g_y \tilde{\delta}_y = 0 \tag{8}$$

and analogously for the wage regression

$$\sum_{r=1}^{112}\sum_{y=1}^{9} g_r \tau_y W_{rt}' = 0 \text{ for all t} \qquad \sum_{y=1}^{9} g_y \delta_{yt}' = 0 \text{ for all t} \tag{9}$$

In (8) and (9), $\tau_y = 1$ if district r belongs to area type y, and $\tau_y = 0$ otherwise. The estimated district fixed effects therefore sum up to zero not only for all 112 districts, but also for all districts of area type y. We can then interpret the coefficients W'_{rt} and $\tilde{\kappa}_r$ as percentage deviations from the mean wage and, respectively, from the mean growth rate in the respective area type y. The coefficients δ'_{yt} and $\tilde{\delta}_y$ are percentage deviations of area type y from the eastern German average. This is a meaningful normalisation, since it thoroughly disentangles area-type-specific from purely district-specific fixed effects. The selected econometric procedure, the constrained estimation of (1) and (2), leads to a restricted weighted least squares estimate of a regression model without an intercept (see Greene/Seaks, 1991).

A final problem that needs to be discussed is endogeneity. One could argue that employment growth drives wages rather than the opposite. This concern is ameliorated to some extent by the finding of Blanchflower/Oswald (1994), which shows that wages are predominantly affected by unemployment rather than employment growth. In (eastern) Germany, this "wage curve" is even weaker than in other countries (see Baltagi/Blien 1998, Baltagi/Blien/Wolf 2000) and one would therefore expect the impact of employment growth on wages to be particularly weak. Note further that the wage indicator W'_r is included with a time lag of one period in (2), which implicitly defines a recursive system with a clear direction of causality, $\hat{N}_{irt} = f(W'_{r(t-1)}, Z)$ and $W'_{rt} = f(\hat{N}_{irt}, Z)$, where Z denotes the other exogenous variables. Nonetheless, robustness checks with IV estimation (2SLS), where covariates with an additional time lag have been used for instrumenting the wage indicator, suggest that our original approach is not flawed by endogeneity problems (Suedekum/Blien, 2004). We therefore keep to the formulation of our shift-share regression because the constrained estimation greatly eases the interpretation of the fixed effects.

4) Results

In the presentation of the regression results we focus our attention on the second stage of the estimation, the employment growth regression, since the wage analysis is mainly of interest because of the neutralized regional wage indicators W'_{rt}. The second part of this section is then devoted to the dispersion analysis.

4.1. Regression results

Looking briefly at the wage regression, we obtain highly significant and intuitive results with respect to the determinants of the spatial wage structure in eastern Germany. In particular, wages are higher the larger the share of qualified workers in a local industry is, the larger the employment share in large firms is, and the larger the proportion of men is. There is a pronounced wage premium in core cities (area type 1) of about 5.8 per cent above the mean, whereas wages in rural and (particularly) in surrounding area types (e.g. area types 2, 3 and 6) range significantly below the eastern German average. Systematic wage differences across industries are also visible. For example, the finance and insurance sector pays particularly well, whereas agriculture, gastronomy and household-related services pay particularly little.

The most important set of results for our purposes, the district-fixed effects W'_{rt}, are presented in map 1. The darker the shading of a district is, the lower its respective idiosyncratic location-specific effect in the wage regression is. In our definition, the darkly shaded districts are eastern Germany's "low wage regions". Recall that the district-specific effects are measured in relation to the mean of the respective area type. Thus, the map does not reflect systematic wage differences between central and peripheral districts. Moreover, the regression results underlying map 1 refer to a pooled estimation of (1) over the entire observation period. The distribution of the district effects across space reveals some regularities. Districts on the eastern and southern borders often tend to pay wages that are lower than in other comparable regions. The opposite is true for districts on the border with western Germany and those surrounding the biggest cities in eastern Germany (Berlin, Leipzig, Dresden, Rostock).

MAP 1 HERE

Turning to the results for the second stage of the estimation, we address the central question of this paper: what factors have influenced employment growth in eastern Germany? We divide the presentation of the estimation results into five parts, namely (i) the industry-specific effects, (ii) the area-type effects, (iii) the workforce characteristics (qualification structure and firm sizes), (iv) the effect of neutralized wages differentiated by industries, and (v) the idiosyncratic district-specific effects.[7] The first set of results, the industry-specific effects $\tilde{\alpha}_i$, is presented in table 2.

TABLE 2 HERE

[7] We omit the results for the time-period fixed effects λ_t, since they are of minor interest for our purposes.

Some industries have grown significantly faster than the eastern German average, even after controlling for the variety of other impacts. The majority of these rapidly growing industries are service industries (e.g. economy-related services, gastronomy, health care). But also certain manufacturing sectors have grown more rapidly than the average, e.g. automobile production, synthetic materials and (somewhat surprisingly) the agricultural sector. Rapidly declining industries in eastern Germany are mining, machinery, leather, building and the public sector. This industry-specific growth pattern reflects fairly well the rapid structural change after reunification and the decline of many heavy industries that were kept alive artificially in the GDR. Note, however, that the relatively broad sectoral classification of our data set may conceal some disparate developments at a higher digit level that occurs within industries.

In table 3 we present the regression results for the area-type dummies. Contrary to the findings for western Germany, we do not find support for geographical employment de-concentration in eastern Germany. Core cities have grown moderately, but significantly more strongly than the average. In fact, there seems to be no general growth pattern associated with the different area types. As mentioned above, Moeller/Tassinopoulos (2000) and Suedekum/Blien (2004) find different results for western Germany, where large cities (type 1) lose employment significantly. A plausible interpretation is that city externalities seem to be relatively more important in the catching-up process of the economically backward eastern part of Germany.

TABLE 3 HERE

It is interesting to set this statistical finding in relation to a descriptive observation reported in Suedekum (2006), who uses the same data set as the present paper. He finds a rapid decline in the geographical concentration of industries in eastern Germany since 1993, measured by standard indices such as the locational Gini coefficient. The estimation results reveal, however, that central cities have grown systematically more strongly than other area types. A plausible hypothesis to reconcile the two findings is that the degree of spatial concentration of employment in the GDR was artificially high. Some sectors such as the chemical industry, automobile production etc. were concentrated almost entirely in one single region. After reunification these industrial monostructures rapidly fell apart, so that the overall degree of

concentration fell. This de-concentration did not affect central cities like Leipzig or Dresden, however, but rather medium-sized and highly specialized cities such as Zwickau or Halle.

The results for the variables related to the workforce characteristics are presented in table 4, all of which are significant at the 1% level. As expected, employment growth in the east was more rapid in local industries with a large share of qualified workers. With respect to firm sizes, we find that a large share of medium-sized firms with 20 to 100 employees significantly increased job creation.

TABLE 4 HERE

Neither a structure with very small firms, nor a structure with very large firms seems to be the most growth-friendly environment. The medium-sized firm is apparently a good compromise between the competition and market-power forces described above, and is well in line with the findings of Aghion et al. (2005) on the relation between market power and innovation. Moreover, the results concerning qualification and firm-size structures are consistent with the findings for western Germany.

Turning to the impact of the neutralized regional wage level, table 5 reports the estimation results for the regressors W'_{rt} differentiated by the 28 industries.

TABLE 5 HERE

The first important observation is that we do not have a single significantly positive coefficient. In 22 of the 28 cases the employment growth effect of neutralized wages is negative, although it is significant (at least at the 10% level) only in 14 cases. Some sectors such as the chemical industry, mining, automobile production, leather/apparel, electronics and metal manufacturing seem to be extremely sensitive with respect to wages. Employment growth in some service industries also responds significantly negatively in the case of a regional wage increase. But by and large the effect is less adverse than in manufacturing. A plausible reason is that service industries have a stronger focus on local markets, whereas most manufacturing industries are export-oriented. Demand-side repercussions might therefore be more relevant for service industries. Nevertheless, the estimation results reveal that an aggressive wage policy does not seem to be a viable strategy for increasing employment growth. Although the strength of the effect differs across industries, the general

picture is that relatively high wages have reduced employment in eastern Germany.[8] This is again consistent with the respective findings for western Germany.

The final set of results concerns the pure location effects, i.e. the district dummies $\tilde{\kappa}_r$. The coefficients can be interpreted in the following way: by what percentage did district r grow faster than comparable regions (of the same area type) because of idiosyncratic effects solely attributable to this specific location? The origin of these regional differences can not be resolved with our data. It could be general geographical conditions, the "local business climate", the quality of local institutions etc. that drive these differences. On the other hand, the district effects do not represent growth disparities due to agglomeration effects since they are taken out by the area-type dummies. The estimations reveal that these "residual" regional effects are quite important. In total, 24 of the 112 coefficients for the individual districts r are significantly positive, and 24 are significantly negative at the 10% significance level.[9] Map 2 illustrates their spatial structure.

MAP 2 HERE

The belt between Dresden and Berlin as well as the districts scattered around West Berlin tend to be high-growth areas. Many districts that are located along the borders with Poland or the Czech Republic seem to grow significantly more slowly than other comparable regions. The same is true for the old industrial locations around Leipzig and Halle, which were home to the heavy industry in the GDR. There is no general pattern for the district-fixed effects for the regions located on the former border with West Germany. The area around Schwerin in the north-western part reveals positive coefficients, as does the belt from Erfurt to Eisenach. On the other hand, most regions on the borders with Bavaria and Lower Saxony in the south and the south-west tend to grow significantly more slowly. Note that this spatial pattern of the district-specific effects has quite a few similarities with the district effects from the wage analysis that are presented in map 1. For example, the districts around Dresden and Berlin tend to have systematically higher wages and employment growth rates. In the statistical analysis, however, we found that high regional wages tend to depress employment growth. These two findings can be reconciled by noting that the estimated response to the neutralized

[8] Of course, wages are examined only with respect to the employment problem. It is not assessed whether the incomes allow a sociably acceptable or satisfying life.

[9] These significance levels are of limited importance, however, since our data set is not a sample but the full population of employment relationships in eastern Germany. Therefore, we do not need inference on significance levels to transfer estimation results from the sample to the population. Instead, the tests show the systematic nature of the effect.

regional wage level is a partial effect. Our analysis suggests that the high-growth areas around Dresden and Berlin would grow even more strongly without the overly high wage level.

4.2. Dispersion analysis

The regression analysis is viable for testing the significance of individual theories on intra-national differences in employment growth. In this section we want to go one step further and explore the contribution of the explanations to the understanding of the total variation of regional employment growth in eastern Germany.

For this purpose we will investigate the distribution of predicted mean regional growth rates when (hypothetically) only one component of regional growth differences is allowed to vary. The predicted growth rates are obtained by multiplying the estimated model coefficients with the respective observation for each local industry, summing over all industries within a district and taking geometric means over the estimation period. For example, the predicted qualification component of the model is computed as

$$\widehat{wn}_{r,q} = \sqrt[8]{\prod_t \left[\sum_{i=1}^{28} \left(\sum_{j=1}^{3} \tilde{\beta}_j^Q \cdot Q_{jirt} \right) \right]} \qquad (10)$$

The predicted variable $\widehat{wn}_{r,q}$ is the employment growth rate that would prevail if the considered district r differed from the eastern German mean only with respect to its qualification structure and were identical with respect to all the other variables of the model. The exercise (10) is performed for each district r and analogously for the other groups of explanatory variables in our model.[10] By construction, the predicted growth rate is a partial effect for district r and can be interpreted as a deviation from the mean growth rate of all eastern German districts.

However, we are not interested in the individual predicted growth rates, but in their dispersion. We consider two measures: the total range of the predicted growth rate across the r districts, and the interquartile range. The total range is computed as the difference between the highest and the lowest predicted growth rate, and the interquartile range as the difference between the predicted growth rate of the district located at the 75% and the 25% percentile. Compared with the total range, the interquartile range has the advantage of being more robust

[10] These are the predicted growth rates when we only allow for differences in the firm-size structure, the industry structure, wages, or in the "location effect" which is obtained by combining the estimated coefficients for the district-specific dummy with the respective area-type dummy.

against single outliers. Since the partial effects are combinations of model coefficients and the local values of the regressors, both contribute to the dispersion of predicted growth rates. This implies for example that a low dispersion of the qualification component may be caused by small coefficient values as well as by similar endowments of districts with respect to the qualification structure. In principle we could analyse the dispersion of the coefficients and the local endowment variables separately. However, a crucial advantage of our approach is that the predicted effects have same scale (employment growth rates) and can therefore be compared directly. Note, however, that since the effects are not orthogonal, it is not possible to split the growth rate into the components and conclude results of the type "x percent of the gross dispersion of employment rates can be attributed to local disparities of the qualification structure". Table 6 reports the results for the dispersion analysis.

TABLE 6 HERE

At a glance, the ordering of variables with respect to their power to generate employment growth dispersion is clear: most regional disparities are generated by the location effect, i.e. by a component that represents the regional dimension of differences in employment growth that are not attributable to structural factors. Wages are the second most important source of growth differences in eastern Germany. Depending on which measure is used (total or interquartile range) the qualification and the firm-size components come in third and fourth. The industry composition of a region seems to be least important for explaining differences in employment growth at regional level.

With respect to the low importance of the industry composition, the broad classification scheme with only 28 different industries must be taken into account. With a deeper industrial decomposition, differences in the economic structure might have a greater impact. In other words, the individual eastern German regions might look more similar with respect to their industry composition in our data than is actually the case. Parts of the industry-structure effect may thus be hidden in the residual district-specific location component. The high quantitative impact of the location effect should therefore be treated cautiously. Nonetheless, our result still highlights the importance of taking regional trajectories into account when trying to understand the labour market performance of eastern Germany.

The relatively high importance of the regional firm-size structure has to do in our view with the artificialities of the economic structure in the GDR. After reunification, especially the remainders of the large establishments of the socialist era are negatively correlated with

employment. These establishments were closed or diminished rapidly, which generated direct and indirect negative effects on total employment. If individual regions were not have these extremely large establishments, they were not subject to this erosion process.

The relatively strong contribution of the wage component is also remarkable. In eastern Germany productivity was generally lower than wages during the entire observation period of our data set. As is widely accepted nowadays, the wage increase after reunification contributed considerably to the breakdown of employment in the east. Now this process can also be seen to have a non-negligible regional component. Looking at the process of wage formation in eastern Germany, it is notable that the influence of unions is lower in eastern than in western Germany (Kohaut/Schnabel, 2003). Since in Germany collective bargaining usually takes place at sectoral level with little or no regional differentiation, it is quite natural for there to be more geographical wage dispersion in eastern Germany. Taking this into account, our statistical analysis suggests that regions with a relatively high wage level are likely to experience quite substantial employment losses, exceeding the degree that generally prevails in eastern Germany.

Given that we can not say directly what is behind the dispersion of the location effects, which is the strongest source of differences in regional employment growth, we take one final step and aggregate the individual location effects according to a political dimension (the state level, "NUTS1") and according to the area types. In other words we calculate the location effect for the five eastern German states or *Länder*, and for the nine different area types. Afterwards we look at the dispersion of these effects. If the dispersion across Länder is greater than across area types, this would be an indication that the location-specific differences in employment growth are due more to political than to purely geographical differences. However, the number of categories in the two dimensions is not the same (5 Länder versus 9 area types), and thus the dispersion is not really comparable. To cope with this problem we also consider a third aggregation, where we combine similar area types (1+2, 3+9, 5+7 and 6+8) and obtain five categories of "meta-areas". As measures of dispersion we again consider the total range and the interquartile range of the predicted growth rates. The results are reported in table 7.

TABLE 7 HERE

The total range of dispersion is roughly the same for all three aggregations. When looking at the entire distribution of the aggregated location effects, the political dimension generates the

same degree of total dispersion as the geographical dimension ("area types" and "meta-regions"). However, when abstracting from the extreme values and focussing on the interquartile range, we see that the dispersion is greater between Länder than between area types or "meta-regions". This suggests that political differences between the individual Länder are somewhat more meaningful than purely geographical differences for understanding the dispersion of the location effects, and thus for understanding the variation of regional employment growth rates in eastern Germany.

5) Conclusion

Regional employment growth disparities in eastern Germany are caused by differences in the industry structure, the qualification structure, and the firm-size structure of a district, as well as by regional wage differences. *Ceteris paribus*, employment growth is stronger the larger the share of qualified workers in a local industry is and the higher the share of medium-sized firms is. Specialisation in thriving industries (mainly services) increases employment growth, whereas an overly high regional wage level significantly reduces it. The adverse wage effect is by and large stronger in manufacturing than in services. On top of that, there are pronounced location-specific growth differences across districts.

The origins of these location effects can not be disentangled with our data, as they entail all sorts of unobservable district-specific differences. The dispersion analysis suggests that these effects are an important source of regional differences in employment growth in eastern Germany, however. Differences in wages, qualification structures, firm sizes and the industrial composition contribute less to the understanding of the total variation of growth rates. This illustrates how important it is to adopt a regional perspective when approaching the employment problem in eastern Germany.

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Table 1: Area types according to BBR classification

Regions with large agglomerations	Regions with conurbational features	Regions of rural character
1 Core city	5 Central city	
2 Highly urbanised districts		
3 Urbanised districts	6 Urbanised districts	8 Urbanised districts
4 Rural districts	7 Rural districts	9 Rural districts

Map 1: Wage analysis – district-fixed effects

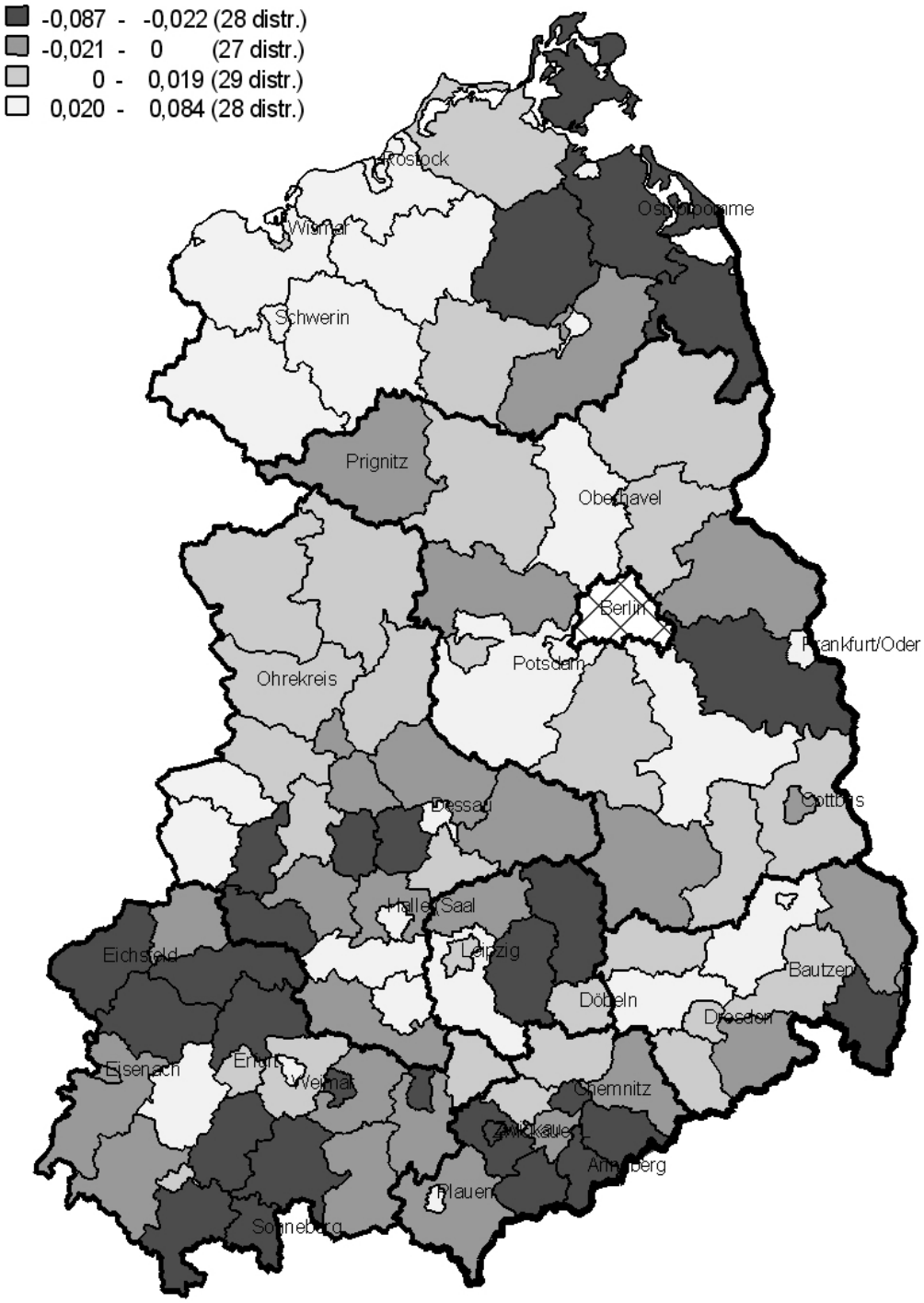

Table 2: Employment growth regression – industry effects

	Industry	Coefficient	P-value
1	Agriculture & Forestry	0.034***	0.000
2	Utilities & Electric Industry	-0.001	0.905
3	Mining	-0.073***	0.000
4	Chemical Industry	-0.067***	0.000
5	Synthetic Materials	0.085***	0.000
6	Non-metallic Mineral Mining	-0.017	0.305
7	Glass & Ceramics	0.002	0.936
8	Primary Metal Manuf.	0.012*	0.094
9	Machinery	-0.074***	0.000
10	Motor Vehicles	0.032***	0.000
11	Office Supplies, IT & Optics	0.008	0.118
12	Musical Instrum., Jewellery, Toys	-0.001	0.991
13	Wood-working	0.004	0.748
14	Paper & Printing	0.014	0.594
15	Leather & Apparel	-0.040**	0.014
16	Food & Tobacco	0.013	0.123
17	Building & Construction	-0.035***	0.000
18	Commerce	-0.007**	0.035
19	Information & Transportation	-0.008***	0.006
20	Finance & Insurance	0.030***	0.000
21	Hotels & Gastronomy	0.078***	0.000
22	Health Care & Social Assistance	0.054***	0.000
23	Economy-Related Services	0.057***	0.000
24	Education	0.005	0.463
25	Leisure-Related Services	0.054***	0.000
26	Household-Related Services	0.037	0.157
27	Social Services	0.014**	0.024
28	Public Sector	-0.051***	0.000

Table 3: Employment growth regression - area type effects

Variable	Coefficient	P-value
Agglomeration region - Core city	0.006***	0.001
Agglomeration region – Highly urbanised distr.	0.003	0.687
Agglomeration region - Urbanised districts	-0.002	0.395
Agglomeration region – Rural districts	0.020***	0.000
Conurbational region - Central city	0.001	0.344
Conurbational region - Urbanised district	-0.009***	0.000
Conurbational region – Rural district	-0.002	0.282
Rural region - Urbanised district	-0.010***	0.001
Rural region - Rural district	-0.004	0.104

Table 4: Employment growth regression- workforce characteristics

Variable	Coefficient	P-value
Firm size 1-19	-0.039***	0.000
Firm size 20-99	0.128***	0.000
Firm size > 100	-0.075***	0.000
Low qualification level	-0.204***	0.000
Medium qual. level	0.026***	0.000
High qualification level	0.071***	0.000

Table 5: Employment growth regression – wage effect by industry

	Industry	Coefficient	P-value
1	Agriculture & Forestry	-0.375	0.251
2	Utilities & Electric Industry	-0.986***	0.002
3	Mining	-4.779***	0.000
4	Chemical Industry	-2.555***	0.000
5	Synthetic Materials	-0.042	0.954
6	Non-metallic Mineral Mining	-0.640	0.315
7	Glass & Ceramics	0.244	0.733
8	Primary Metal Manuf.	-0.940***	0.001
9	Machinery	-0.610**	0.021
10	Motor Vehicles	-1.532***	0.000
11	Office Supplies, IT & Optics	-0.371*	0.071
12	Musical Instrum., Jewellery, Toys	-0.894	0.782
13	Wood-working	-0.868*	0.084
14	Paper & Printing	-0.789	0.429
15	Leather & Apparel	-1.337**	0.015
16	Food & Tobacco	-0.341	0.279
17	Building & Construction	-0.438***	0.000
18	Commerce	-0.310***	0.002
19	Information & Transportation	-0.279**	0.016
20	Finance & Insurance	0.002	0.993
21	Hotels & Gastronomy	-0.620**	0.049
22	Health Care & Social Assistance	-0.562***	0.000
23	Economy-Related Services	-0.486***	0.000
24	Education	0.253*	0.094
25	Leisure-Related Services	0.616	0.269
26	Household-Related Services	0.001	0.998
27	Social Services	0.104	0.654
28	Public Sector	-0.172*	0.071

Map 2: Employment growth analysis – district-fixed effects

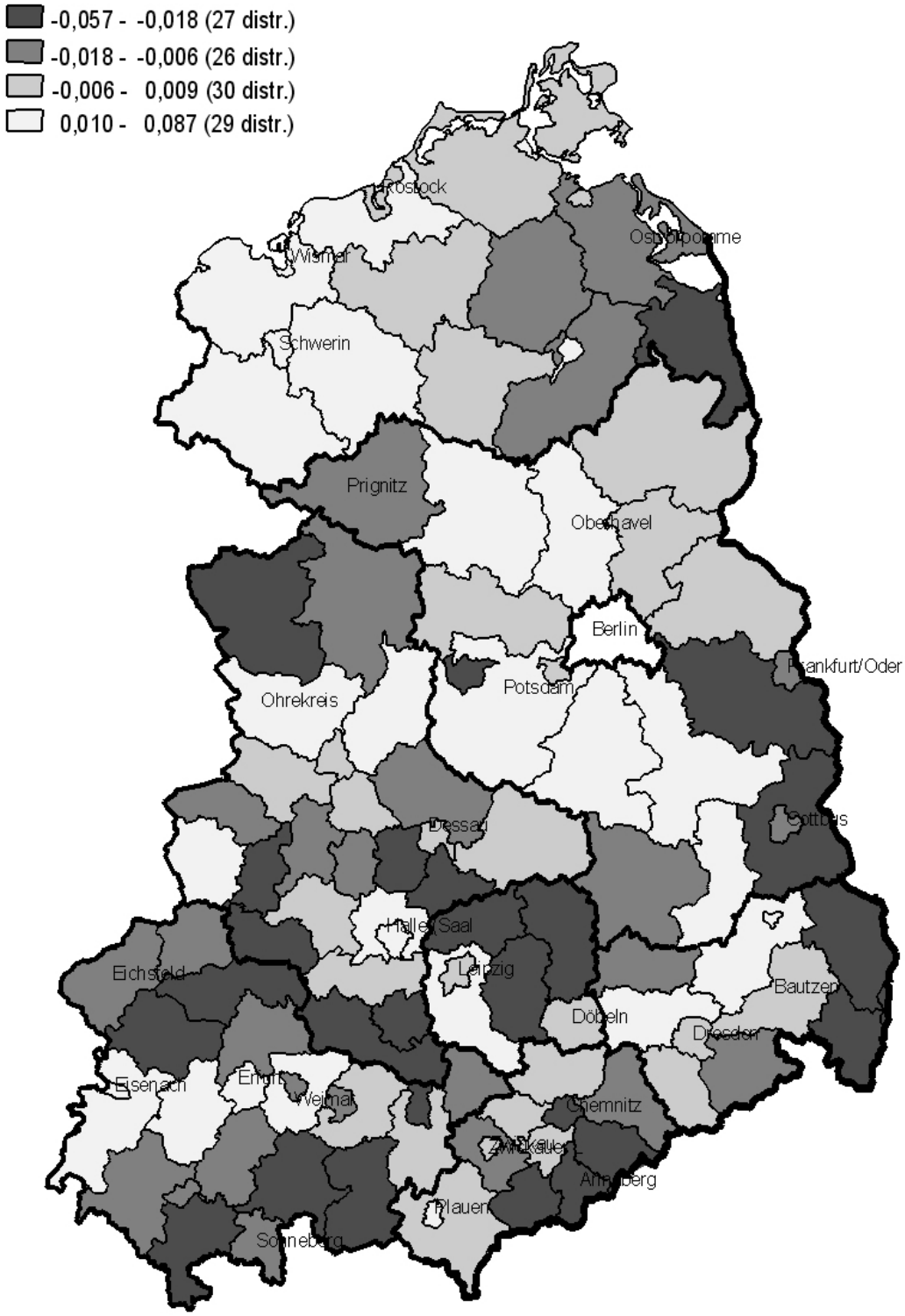

Table 6: Results for the dispersion analysis

	Location effect	Wages	Qualification	Firm sizes	Industry composition
Maximum value	5.28	3.60	1.96	2.07	1.43
Minimum value	-5.50	-3.46	-3.37	-2.55	-2.21
Total range	10.78	7.06	5.33	4.62	3.64
25% percentile	-1.93	-0.82	-0.38	-0.86	-0.32
75% percentile	1.25	0.94	0.54	0.92	0.21
Interquartile range	3.18	1.76	0.93	1.77	0.54

Table 7: Dispersion of aggregated location effects

	Eastern German Länder (5)	"Meta-regions" (5)	Area types (9)
Maximum value	-1.13	-0.95	-1.02
Minimum value	1.86	1.94	1.94
Total range	2.99	2.89	2.96
25% percentile	-0.49	-0.42	-0.42
75% percentile	0.91	0.53	0.52
Interquartile range	1.40	0.95	0.94