Regional Development of Employment in Eastern Germany.

An analysis with an econometric analogue to shift-share techniques [*]

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Abstract. An approach introduced by Patterson and suggested by Möller/Tassinopoulos is extended for the analyses. This approach uses a generalisation of an econometric analogue of the common shift-share method, which is suggested here as a new "workhorse" for regional analyses.

The results obtained with this "shift-share-regression" and with very differentiated data from the employment statistics of eastern Germany show that processes of deconcentration play a role in explaining regional disparities, since inverse localisation and positive urbanisation effects are visible. The relevant processes can be understood with approaches of "New Economic Geography", of structural change, and of endogenous growth theory.

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1 Introduction

A standard approach for regional analyses, especially with respect to the employment variable, is the *shift-share method*. Many applications have been presented since Dunn (1960). Numerous extensions have been developed, partly in response to the many criticisms of the method. Here, a further step is carried out, since the shift-share method is substituted by an analogue, which is based on a regression model. The basic approach was developed by Patterson (1991), (cf. Berzeg 1978, 1984, Knudsen, Barff 1991) and applied with data for western Germany by Möller, Tassinopoulos (2000). In this paper an extension is presented, which shows that methods of this kind have a very broad spectrum of possible applications and can be related to many theoretical meaningful hypotheses.

The empirical problem which is the motivation for the analysis is the development of all 113 NUTS III regions in eastern Germany. Apart from the special research question the case is of gen-

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eral interest, since the structure of regional disparities on labour markets developed anew after the unification of Germany in 1990. Starting with a transformation crisis, the processes of differentiation have been very rapid. The main difference to other countries is that the development is financed by western Germany with net rates of about 80 billion Euro every year. The money is used to improve the infrastructure and give subsidies for investment. A large part is used for consumption purposes in the form of unemployment benefits and pensions for retired people. If it were not cynical, the whole process of German unification and its consequences could be regarded as a social experiment, which is a test for many hypotheses about regional development.

Consequently this paper deals with the internal differentiation of eastern Germany's labour markets and endeavours to find causal factors for it. Here the *development of employment* is regarded as an indicator for the general change in the activity of the eastern German economy and in its structure. The factors considered important for the growth and the shrinkage of employment are the regional industry and qualification structures, genuine regional factors, the distribution of establishment sizes and the concentration of the industries in the regions. The variables included are discussed in the following section against the background of economic theory.

2 Background and theory

With regard to key labour market indicators, the eastern part of the Federal Republic of Germany continues to be characterised by a large *discrepancy to western Germany*. In April 2001, the underemployment rate, which in addition to unemployment also includes the participants in employment and training measures, is more than twice as high in eastern Germany, at 2.3 %, than it is in western Germany, where the figure is 9.5 %. In eastern Germany in 1998, income from employment subject to social security was only 72 % of the level in western Germany. The productivity gap was even greater, as in the manufacturing industry the median of the eastern German establishments was only 57 % of the corresponding value in western Germany (Bellmann, Brussig 1999). For an overview of the unification process in Germany and of the prospects of convergence and catch-up cf. Lange, Pugh (1998: 135ff.) and for details about regional developments, including case studies cf. Blien et al. (2002)

A trend connected with the regional concentration of industries is prominent in the analyses. The GDR showed a *large degree of regional specialisation*, for many regions it was almost possible to recognise monostructures (Rudolph 1990). When this specialisation was reduced in the course of the nineties, industries experienced more intensive decline processes in the places where they were particularly heavily concentrated than they did elsewhere. The break-up of the state-owned industrial groupings ("Kombinate") had a parallel effect.

Processes of concentration and *deconcentration* are emphasised in many theoretical approaches which look at general constellations of conditions irrespective of the special situation of eastern Germany as a (post) transformation country. The classical approaches of location theory (for a modern version cf. Puu 1997) take into account agglomeration advantages, transportation costs and natural advantages of location to explain a concentration of economic activities. Decisions of firms about

locations are affected by urbanisation effects, which apply to firms of all industries, and localisation effects, which affect only one industry (cf. Stahl 1995).

Agglomeration effects also play an important role in "new regional economics", which goes back above all to Krugman (1991) and for which the monograph by Fujita et al. (1999) can be consulted as a reference. These papers start from the assumption of an economy in which monopolistic competition prevails and the factor of labour is highly mobile. The lower the transport costs and the higher the returns to scale in production are, the more likely it is that a differentiation between centre and periphery is developed. With suitable parameter constellations it is worthwhile for a firm to select a central location and to deliver to all customers in spatially decentral locations from there. For the case of localisation effects, Krugman (1991: 35ff) cites three effective factors: the advantage of a joint pool of labour, technological spillover effects and the utilisation of intermediate products.

If the conditions change, for example if the costs for starting up a firm fall, a reverse development towards lower rates of concentration can occur. This seems to be the case empirically, at least Krugman (1991) for the USA, Molle (1997) for Europe and Möller, Tassinopoulos (2000) for western Germany each reach this result. Instead of the localisation effects, agglomeration disadvantages have an effect at least at the level of individual industries. At present the question as to how far the modern communication technologies – in particular the Internet – lead to a re-evaluation of classical location factors is a very interesting one. Where direct face-to-face contact used to be necessary for the mentioned spillovers, today it may already be sufficient to have an e-mail connection.

The present results for deconcentration developments refer to the significance of the industries for the analysis of the development of employment. Industries seem to be appropriate aggregates for portraying heterogeneous developments on products markets and integrating product-specific productivity developments. This was one of the motivations for numerous analyses of the shift-share type (Dunn 1960, cf. for applications to German regions amongst others Bröcker 1989, Tassinopoulos 1996, 2000, Blien, Hirschenauer 1995, 1999) in which the heterogeneity of the regional development of employment is related to the regional industry structures.

The approach is orientated towards models of *structural change*. According to these models, industries are subject to specific business cycles, pass through relatively separate developments and are characterised by specific supply and demand conditions: they are affected by specific shocks which spread across the various markets. More recently Appelbaum & Schettkat presented a theoretical approach which permits a good understanding of the dynamics of the different industries. According to their argumentation the effects of technological progress on the development of employment depend on the elasticity of demand on the industry-specific products market. If it is high, productivity increases lead to more employment, whereas if it is inelastic, the demand for labour falls (cf. Appelbaum, Schettkat 1993, 1999, further to this Blien 2001). With this approach it is possible to understand the relevance of regional industry structures. If industries are distributed differently according to regions – which is to be assumed in particular for eastern Germany – they will experience different developments.

The significance of the *qualification structure* for regional development arises from the approaches of endogenous growth theory. For models constructed following Lucas (1988), the concentration of human capital in an economy is closely connected, via an external effect, with the 'en-

gine' that drives economic growth. Although a connection from here with employment growth has yet to be made, this is possible by assuming that one production factor, labour, is not being used to full capacity and that growth is then connected with an adjustment process in which higher rates of employment are built up.

The relevance of the *establishment size structure* for development of employment is more characterised by empirical arguments which have repeatedly confirmed a connection when it has been shown that small establishments grow more than large ones (c. f. for eastern Germany e. g. Blien et al. 2000). This fact has another specific significance in eastern Germany, since the large state-owned firms ("Kombinate"), which were characteristic of the socialist period raised the average establishment sizes to a higher level than is optimal under the conditions of a market economy. In this respect the relative advantage of smaller firms is a hint that a certain problem inherited from the transformation period is being overcome.

In conventional shift-share approaches, regional development of employment is split up into (at least) two components: a structural component, the proportional shift, that reflects the effects of the industry structure and a locational component, the differential shift, that incorporates all the 'rest' but is usually identified with genuine regional effects. Also in the context of this paper such *regional effects* that can not be explained by other variables are examined. However, a model based approach is used that controls for more such variables than is possible in the conventional shift-share analysis. The regional effects can be explained by the restricted mobility of the factors of production and by the regional segmentation of labour markets. Studies for the USA (Blanchard, Katz 1992) and for western Germany (Möller 1995b) showed that labour is more mobile than is capital.

The regional effects can be broken down somewhat further as different regions embody different *types of area*, each of which experience specific developments. Suburbanisation effects for example are known from descriptive observations: the large cities lose employment to a greater extent than the periphery of conurbations. In part it is again possible to assume developments associated with catching up processes, if a trend that has already been running for some time in western Germany becomes established in a relatively short time.

3 Data

The employment statistics of the Federal Employment Services (Bundesanstalt für Arbeit – BA) are appropriate for analysing development of employment. These statistics include all employment relationships subject to social security. A new record is stored for each year up to 31 December and for every change of firm. There are several versions of the employment statistics; this type falls back on so-called quarterly statistics, which include cross-sections for 30 June each year.

There is, however, a problem here. In order to be able to conduct regional analyses on the basis of the employment statistics, in this case for 113 districts (NUTS III regions "Landkreise" and "kreisfreie Staedte"), the data had to be classified into uniform regional units. This is not a trivial task as every year considerable restructuring is carried out in the context of territorial reforms. In problematic cases it is unclear whether for a given region a change in the employment figure is a result of a change in the boundaries of an area or a change in the labour market situation. Such problems were solved by reverting to individual data with co-operation between the statistics of the Federal Em-

ployment Services and the IAB (Institute for Employment Research) in a complicated procedure. The data represent the territorial situation of 1999 for eastern Germany. West Berlin was not included in the analyses. There is considerable variation in the size of the regions. The largest unit (East Berlin) represents (in 1999) 382 865, the smallest (Wismar) 17 014 employees.

The dependent variable of a regression analysis was the change in employment calculated as an annual growth rate per region and per industry, which was obtained by means of aggregation across all the workers of one region and one industry in one year. In order to achieve a high level of differentiation, 27 industries were examined. For the data, which therefore constitute a panel, 37 251 728 individual records about employment relationships in eastern Germany in the period from 1993 to 1999 were evaluated. The maximum figure resulting from the basic dimensions of the analysis is:
6 years * 113 districts * 27 industries = 18306
In fact 18198 observations were available, since some of the possible combinations of dimensions do not occur. The time span of seven years, which is our period of observation, is relatively short for identifying the main factors of development.

In the employment statistics a number of variables are available which are important as determinants for the development of employment. What was included were qualification structures, and establishment sizes. These exogenous variables could be incorporated by calculating the proportion of workers with represent the respective category in the individual observation. The independent variables are each measured for the reference date of 30 June, the change in employment as the dependent variable refers to the subsequent period of one year.

The qualification details represent the proportions of employment taken up by people without any formal qualifications, with skilled worker qualifications (or the equivalent schooling qualifications) and with higher education qualifications. People for whom no qualification details were available were added to the group without any qualifications, as it is known from tests that in their structure they correspond closely to those without formal qualifications. For establishment, three categories were calculated: the proportion of firms with fewer than 20 employees, those with 20-99 employees and those with at least 100 employees. Only these three categories were used in the regressions, since there is a scarcity of large establishments in eastern Germany in the second half of the nineties – in most industry/ region combinations there are no establishments with over 500 employees. In addition the typology of the districts according to a common classification into nine types by the BBR (Böltken, Irmen 1997) was also included among the exogenous variables:

Type of district (within larger regions) 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

4 Econometric approach

The conventional shift-share method is still generally used for analysing regional change of employment. It is split up into several components (cf. slightly changed after Dunn 1960):

$$
\begin{aligned}
N_{ir}^{t+1} - N_{ir}^{t} = \\
& N_{ir}^{t}\left(\frac{\sum_i\sum_r N_{ir}^{t+1}}{\sum_i\sum_r N_{ir}^{t}} - 1\right) + && \text{national component} \\
& + \sum_i N_{ir}^{t}\left(\frac{\sum_r N_{ir}^{t+1}}{\sum_r N_{ir}^{t}} - \frac{\sum_i\sum_r N_{ir}^{t+1}}{\sum_i\sum_r N_{ir}^{t}}\right) + && \text{proportion al shift} \\
& + \sum_i N_{ir}^{t}\left(\frac{N_{ir}^{t+1}}{N_{ir}^{t}} - \frac{\sum_i\sum_r N_{ir}^{t+1}}{\sum_i\sum_r N_{ir}^{t}}\right) && \text{differenti al shift}
\end{aligned}
\qquad (1)
$$

In this complicated looking, but in fact rather simple expression N is employment in industry i and region r. The so-called proportional shift (corresponds to a structural component) shows how a region would develop if all the industries located there were to grow at the rates that they show in a superordinate reference area (in this case eastern Germany). It is corrected for national employment. A business cycle component (or national component) incorporates fluctuations in the global growth rate of the reference area. The differential shift (corresponds to a locational component) finally represents the entire ‘rest’ of the development as far as it is not reflected in the other two components. The users of the approach then expect the development of employment to be split up into effects resulting from the industry structure and those resulting from the regions themselves.

Though many interesting analyses have been carried out with the shift-share method and many extension have been developed (cf. among others Haynes, Dinc 2000) conventional shift-share method has often been criticised (Knudsen, Barff 1991). It does not permit a model-assisted procedure, the observation of causality is problematic and it is difficult to incorporate additional exogenous variables. A further problem is the deterministic design of the procedure, which excludes the testing of hypotheses. A short reflection shows that above all the dominance of the differential shift, which is a typical result, is at least in part an artefact of the approach. Assume that the regional development occurs completely at random and that there are no formative effects at all on the development of employment which are connected with industries or regions. Then the structural component, the proportional shift in the shift-share analysis will correctly be calculated at being zero. For the locational component, i. e the differential shift, on the other hand, it will be calculated that it contributes to 100 % of the development, since with the shift-share method random effects can not be separated from the region effects.

It would be important to develop an analytical instrument which retains the advantages of the shift-share method but integrates it in a statistical framework. In doing this a regression approach is used which was presented by Patterson (1991):

$$\hat{N}_{irt} = \alpha_i + \lambda_t + \kappa_r + \varepsilon_{irt} \qquad (2)$$

A first extension was applied to western Germany in analyses by Möller, Tassinopoulos (2000). Here, the regional development is described as follows:

$$\hat{N}_{irt} = \alpha_i + \lambda_t + \delta_y + \kappa_r + \mu_i (a_{ir,93} - a_{i,93}) + \varepsilon_{irt} \qquad (3)$$

Where:

$\hat{N}_{irt} = \dfrac{N_{ir(t+1)} - N_{irt}}{N_{irt}}$, the regional employment growth in the industry i

α_i: the effect of the industry i

λ_t: the period effect at the point in time t

δ_y: the effect of a specific region type y (y = 1...9)

κ_r: the locational effect adjusted by effect of a specific region type for district r

μ_i: the parameter for the structural adjustment for industry i

$a_{ir, 93}$: the proportion of the workers of the i-th industry in r in the starting year 1993

$a_{i, 93}$: the proportion of overall employment of the i-th industry in the starting year

ε_{irt}: a stochastic error term

A value of $\mu_i < 0$ shows the occurrence of a deconcentration process. The industry i develops worse in those regions where it is present with higher proportions in the basic year 1993. This process is not necessarily associated with a reduction in the variance of the location proportion of industry i.

In an extension of the chosen approach of the shift-share-regression, variables are included, which are considered important in economic theory, like in endogenous growth approaches, which were discussed in section 2 above. An alternative model is given by equation (4a):

$$\hat{N}_{irt} = \alpha_i + \lambda_t + \delta_y + \kappa_r + \sum_{j=1}^{3} \beta_j^Q Q_{jirt} + \sum_{z=1}^{3} \beta_z^B B_{zirt} + \varepsilon_{irt} \qquad (4a)$$

If we also include the structural adjustment variables (of equation 3), we have the most general model:

$$\hat{N}_{irt} = \alpha_i + \lambda_t + \delta_y + \kappa_r + \mu_i (a_{ir,93} - a_{i,93}) + \sum_{j=1}^{3} \beta_j^Q Q_{jirt} + \sum_{z=1}^{3} \beta_z^B B_{zirt} + \varepsilon_{irt} \qquad (4b)$$

with:

Q_{jirt}: Proportion of the qualification group j among all workers of the industry i, the region r and at the point in time t

B_{zirt}: Proportion of the establishment size of category z among all workers in irt

β: regression coefficients

All the estimates must be calculated as weighted least squares. Two reasons are important for this: firstly exorbitant jumps are possible in the growth rates in the case of industries that are very small in a region, which results in an outlier and a heteroskedasty problem. Secondly the growth rate of global quantities can not simply be gained by aggregating sub-units. Therefore, a weighting is needed:

$$\mathrm{cov}(\varepsilon) = \tilde{\mathbf{U}} = \mathbf{GWG} \qquad (5)$$

The variance-covariance matrix of the error terms is weighted with a matrix **G,** which as a diagonal matrix includes the employment proportions $g_{irt} = N_{irt} / N_t$.

The Models (2) – (4b) are, however, plagued by perfect multicollinearity. Usually a fixed effect in each set that refers to the regions, industries etc. is excluded. Since the fixed effects are then measured in relation to this excluded reference category, it is then necessary to recalculate not only the effects (like Krueger, Summers 1998) but also the level of significance, if the grand mean is to be used as a reference (Haisken-DeNew, Schmidt 1997, Möller 1995a). A comparatively 'elegant' alternative is the use of identifying restrictions:

$$\sum_{r=1}^{113}\sum_{i=1}^{27} g_{ir}\kappa_r = 0 \qquad (6)$$

$$\sum_{r=1}^{113}\sum_{i=1}^{27} g_{ir}\alpha_i = 0 \qquad (7)$$

$$\sum_{r=1}^{113}\sum_{i=1}^{27} \tau_y g_{ir}\kappa_r = \delta_y \qquad (8)$$

$$\sum_{j=1}^{3} \beta_j^Q = 0 \qquad (9)$$

$$\sum_{z=1}^{3} \beta_z^B = 0 \qquad (10)$$

The effect of these restrictions is that the incorporated fixed effects can each be given with reference to the grand mean. No further recalculations for the parameters or for the standard errors are necessary. The weights g_{ir} are set here as constant with respect to the reference year 1996 in the middle of the observation period. τ_y is a selector variable that assumes the value 1 for a certain type of region y and is always zero otherwise. For the variables B and Q, which are also included, analogous restrictions were defined

The selected procedure leads to a restricted weighted least squares estimate of a regression model without an intercept. One can follow Greene & Seaks (1991) as regards to the numerical calculations. Compared with the unweighted estimate two more equations for each set of fixed effects arise than with the usual strategy, which consists of excluding dummies. Firstly one parameter more is to be determined. Secondly a restriction is to be incorporated to which a Lagrange multiplier is associated.

One of the special features of the shift-share regression is the unit of the analyses, which is the industry within the region. Often, with panel data, regions are regarded as the units of the analysis and proportions of the industries with respect to all employment of the region are treated as exogenous variables. Equation (10) describes a fixed-effects panel model:

$$\hat{N}_{rt} = \beta_0 + \lambda_t + \kappa_r + \sum_{i=1} \beta_i^I I_{irt} + \sum_{z=1} \beta_z^X X_{zrt} + \varepsilon_{rt} \qquad (11)$$

Here, I_{irt} represents the employment proportion of industry i of all employment in region r and X_{irt} represents all additional variables. Experiments with models of this kind (Blien et al. 2001) show that the results are unstable and implausible especially with respect to the coefficients of the industries. An industry which is drastically shrinking may have a positive coefficient. With the panel Model (11) 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 shrinking industry may be associated with a positive development of the regions where it is located with high rates. To separate these effects the shift-share regressions of the Models (2) – (4) are adequate.

Another advantage of the shift-share regression (4) is that the number of observations is i times larger than with the panel model. Therefore, in the former case all estimations can be carried out with greater precision.

For some of the determinants of employment growth it might be argued that there is an endogeneity problem, e. g. for the qualification structure. A region's better qualification structure might be - at least partly - the result of a better employment growth and not its cause, since the more active regions might be a focus for selective mobility. These problems are taken into account by the fact that the employment growth is measured for the time period which follows the cross-section that represents the exogenous variables. To be completely sure, tests with higher time lags were carried out, which showed no substantial change in the results.

5 Results

For comparison purposes, the results of a conventional deterministic shift-share analysis are shown in Table 1. Due to a lack of space only the first twenty regions are shown. The several components are normalised by the size of the regions. Therefore a decomposition of growth rates is presented, which can easily be used as a reference for the results of the econometric analyses. The last two columns of the table include the results for the shift-share regression of Model (2). A comparison of the results of the deterministic method and of the model that includes a random component show that they are similar but not identical.

Table 2 & 3 show the results for three models estimated in shift-share-regressions, corresponding to the equations (3), (4a) and (4b). A negative coefficient μ_i of the adjustment variables – indicated by "Conc_..." - suggests that a deconcentration process is occurring in the industry concerned. Model (4a) does not include any structural adjustment effects μ_i, but includes the continuously varying variables for qualification levels Q_j and establishment sizes B_z. Model (4b) is estimated with both groups of variables. The period effects (year93... year98) give the estimated values for global employment growth directly only in Model (3). In the other two models the corresponding value has to be calculated by using the values of the variables indicating qualifications and establishment sizes.

In Table 3 Model (4b) is used for a break-down of the estimated development for individual regions. The actual values of the variables are multiplied by the coefficients. Summing up for all the industries in a region gives a table which is a close analogue to the results of the conventional shift-share technique. The values determined for the establishment size and for the human capital were left

out for reasons of space. The column "structural effect" shows the combined (added) effect of all the industries in a region, which is analogous to the "proportional shift" of the traditional shift-share analysis. The structural effect S of an r the result is given by:

$$S_r = \sum_t S_{rt} = \sum_t \sum_i \alpha_i a_{irt}$$

The concentration effect shows the consequences of industry concentrations analogously. The adjusted structural effect is the sum of the structural effect and the concentration effect. The adjusted regional effect results from the effect of the type of region δ_y and the regional effect κ_r (which may be interpreted as an adjusted differential shift from the shift-share analysis). The global effect shows the effect of the overall development for the region concerned. The generally very small difference between the estimated development and the actual development shows that the model fits well whereas a standard R^2 is not available for this type of analysis.

In Model 4b only two of the regression coefficients μ_i, which express the effects of the concentration/deconcentration of an industry, are positive, but eight are negative significant. This is a hint for the dominance of deconcentration processes. To have an additional check on the concentration/deconcentration process by the regression coefficients μ_i, it is interesting to use a descriptive measure of concentration (and its development), whether it corresponds to the regression results or not. On a more descriptive level, following Molle (1997), the concentration of industries within regions can be described by the specialisation coefficient SC. The concentration of industries within regions is described by the location coefficient LC.

$$SC_r = \frac{1}{2} \sum_i \left| \frac{N_{ir}}{N_r} - \frac{N_i}{N} \right| \qquad LC_i = \frac{1}{2} \sum_r \left| \frac{N_{irt}}{N_i} - \frac{N_r}{N} \right|$$

On the basis of these coefficients the trend towards deconcentration is also visible. Concentration as measured by the specialisation coefficient SC fell in 76 of 113 districts in the period from 1993 until 1998. The maximum value of the coefficient decreased from 0.35 to 0.28. The location coefficient decreased in 17 of 27 industries. Table 4 includes a repetition of the concentration coefficients of Table 2 (Model 4b). In addition it shows the LC values for 1993 and 1998. The respective direction of change corresponds pretty well to the signs of the coefficients. Therefore the conclusion is correct, that the employment losses in Eastern Germany are closely connected to a process of deconcentration. A yearly comparison of the LCs reveals that the deconcentration process is strongest in the year 1993. The deconcentration processes can be attributed to a tendency to overcome the monostructures of the former GDR. Partly they are parallel to similar processes in western Germany (Möller, Tassinopoulos 2000), which are not so strong as they are in the East.

For the distribution of establishment size in a region there are relatively strong effects which show a better development for regions with many small firms. However, it is not possible to separate completely the structural adjustment and the establishment size. The formerly state-owned industrial groupings and in some cases also their descendants were still comparatively large in 1993. Their shrinkage is mainly reflected in the negative coefficients of the highest category of establishment size, but may be partly contribute to the deconcentration process. Strong deglomeration effects are visible, since new firms are more decentralised located with respect to their industry structure.

A better qualification structure has a predominantly positive effect on the development of employment. Whereas the effect of the proportion of highly qualified workers, i. e. workers with university and polytechnic qualifications, is not significant and is close to zero, the proportion of qualified employees with a vocational degree has a positive effect on the development of employment. This finding indicates the effectiveness of factors pointed out by the endogenous growth theory: A better qualification structure is important for a better development of regions. The lack of an effect for employees with university degree might be due to the fact, that in many enterprises with more than one establishment research/ development and management functions are placed not in the regions of eastern Germany, but in the West.

The development of the industries differs greatly. Individual industries show a development of employment which is equivalent to a "free fall". This applies for example to the chemical industry and to engineering. In contrast, for other industries, especially in the service sector, it is possible to recognise positive development patterns. The banking and insurance sector is being built up, business-related services and education are growing rapidly. At regional level, in the case of the structural effect in Table 2 these differences show only to a lesser extent. As some of the industries in a region show opposite developments, the increase and reduction of employment partly offset each other. This is the reason why the proportional effect does not catch on more intensively in the classical shift-share analysis.

The results for the region types show structures which diverge clearly from western Germany. Whereas Möller & Tassinopoulos were able to identify an actual trend in favour of rural areas in western German, here they mainly receive a negative sign. The diagnosis of unfavourable developments in eastern Germany's rural areas, which was already made in Blien & Hirschenauer (1995) and in Blien & Hirschenauer (1999), can be confirmed once again here.

It is interesting to see the change in the coefficients of the dummy variables indicating the types of the regions. Whereas the core cities have a negative coefficient in the analyses with Models (2) and (3), they are positive after including more controlling variables in Models (4a) and (4b). The negative value in Model (3) is due to the predominance of large establishments in these locations, which were closed down or shrank to a large extent. This finding does not confirm the trends with regard to sub-urbanisation effects which were determined on the basis of univariate developments. The univariate trend is obviously explained entirely by the unfavourable structure of employment in the core cities. The consequences of this structure conceal the positive urbanisation effects, which show up in a multivariate analysis. The change in the results show the value of a richer model structure that is available with the shift-share regressions, which can take care of theoretically important variables.

Limitations of an analysis of the kind presented here are that spill-over effects between regions (e. g. in the form of regional autocorrelation) and cross-over effects between different industries are not taken into account. However, some of the effects are represented by the multitude of the variables included. For example the general relationship between a core city and the surrounding areas is mapped by the types of the regions.

6. Conclusions

The present results for the regions of eastern Germany are consistent with a point of view that describes the differing paths of employment development as at least partly caused by a deconcentration process. Employment is decreased to larger extent if an industry is locally concentrated. Therefore the process can be described as caused by *reverse localisation effects*, whilst weaker *urbanisation effects* continue to be effective. The individual effects in "New Regional Economics" as started by Krugman are not predicted as to their direction, no test of the theory can take place here. The various effects can, however, be interpreted in the sense of economic theory.

According to this it can be argued that with the development of new communication and information technologies, in particular with the Internet, a re-evaluation of location factors occurs which is associated with the post-transformation process in the eastern German economy. The new communication technologies, but also other new technological developments, permit a more decentralised organisation of production. Regional monostructures, which were typical for the old GDR, are no longer functional. The costs involved in setting up an additional new location for a certain production are falling. Over and above that the break-up of the formerly state-owned industrial groupings and in part the collapse of their successors have a parallel effect.

On the other hand, the occurrence of urbanisation effects and of problems of the rural areas can be attributed to deficits of the peripheral regions of eastern Germany in the infrastructure. The disadvantaged regions fall below a certain critical mass of impulses in economic development, which is associated with low population densities and the lack of cores for the development (cf. Steiner et al. 1998: 172ff.).

Considerable effects of the industry structure are visible. The structural change occurring as a consequence of the transformation is burdened with severe problems. A general feature of the process is that the whole manufacturing sector loses employment to a large extent, whereas the service sector and the construction industry gain employment. This is at least partly due to the special shape of the transformation and the post-transformation process in eastern Germany. The manufacturing industries produce for a large market, the direct competitor of a firm assembling machines in Halle might be a firm located in South Korea. After opening the East German economy to the world market all these firms were exposed to this competition, their productivity was low and there was no shelter of a separate currency (… and there was no separate currency to provide protection ?). Though high investment subsidies were paid in the nineties all these industries collapsed. The services sector and the construction industry of eastern Germany, however, are oriented towards the local market. They are effectively assisted by the high consumptive transfers paid. Therefore these industries stabilize their employment (for more details cf. Blien et al. 2002).

The qualification structure of the workers is of considerable importance for the development of employment. In particular large proportions of qualified employees with apprenticeship training and with equivalent qualifications are associated with higher employment growth rates. This is consistent with theories of endogenous growth.

With respect to the method used, it can be seen that many explanatory variables could be integrated into the framework of the shift-share regression. It is important to treat individual industries within regions as the units of the analyses, as is done in this method. The results are completely different from those obtained by a simple panel model with fixed effects, which treats regions as the

units of observation. In the latter case it is not possible to separate the effect of industry development from the effect of the location of these industries.

With the shift-share regression many theoretical meaningful variables can be included; a test of hypotheses is provided. And it is possible to separate the effect of the specific location from random perturbations – which seems to be essential for all regional analyses. Therefore regressions of this kind could be a new 'workhorse' in the regional sciences and a substitute for the deterministic conventional shift-share technique.

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Table 1: Decomposition of employment development according to a conventional deterministic shift-share analysis (formulated in growth rates)
(20 regions of 113 regions)

		Deterministic Shift-Share Method			Shift-Share-Regression (Model (2))	
	Employment growth 1993-1999	Component of national development	Proportional Shift	Differential Shift	Structural Component	Regional Effect
11200 Berlin-Ost, Stadt	-0,161	-0,074	0,027	-0,114	0,018	-0,085
12051 Brandenburg a.d.H.	-0,279	-0,074	-0,003	-0,202	-0,007	-0,272
12052 Cottbus, Stadt	-0,201	-0,074	-0,041	-0,087	-0,044	-0,070
12053 Frankfurt (Oder), Stadt	-0,162	-0,074	0,016	-0,104	0,003	0,015
12054 Potsdam, Stadt	-0,227	-0,074	-0,037	-0,116	-0,008	-0,196
12060 Kreis Barnim	-0,070	-0,074	-0,003	0,007	0,012	-0,034
12061 Kreis Dahme-Spreewald	0,146	-0,074	0,007	0,212	0,005	0,278
12062 Kreis Elbe-Elster	-0,106	-0,074	-0,026	-0,007	-0,040	0,062
12063 Kreis Havelland	0,109	-0,074	-0,024	0,206	-0,058	0,251
12064 Kreis Maerkisch-Oderland	0,039	-0,074	-0,006	0,119	-0,001	0,068
12065 Kreis Oberhavel	0,058	-0,074	-0,004	0,135	-0,037	0,194
12066 Kreis Oberspreewald-Lausitz	-0,167	-0,074	-0,080	-0,013	-0,169	-0,133
12067 Kreis Oder-Spree	-0,062	-0,074	0,013	-0,001	-0,003	0,015
12068 Kreis Ostprignitz-Ruppin	0,043	-0,074	0,007	0,109	0,015	0,073
12069 Kreis Potsdam-Mittelmark	0,186	-0,074	0,032	0,228	-0,004	0,297
12070 Kreis Prignitz	-0,081	-0,074	-0,018	0,011	-0,028	-0,028
12071 Kreis Spree-Neisse	-0,209	-0,074	-0,132	-0,003	-0,137	-0,275
12072 Kreis Teltow-Flaeming	0,114	-0,074	0,004	0,183	0,000	0,165
12073 Kreis Uckermark	-0,066	-0,074	-0,025	0,033	-0,053	0,019
13001 Greifswald, Hansestadt	-0,133	-0,074	0,054	-0,116	0,061	-0,304

Table 2: Shift-share analogous regression models:

Model of equ. (3): with structural adjustment variables

Model of equ. (4a): with establishment sizes and qualification structures

Model of equ. (4b): with structural adj. variables, establishment sizes and qualification structures

(regional fixed effects shown for only 20 of 113 regions, which were all included)

Endogenous variable: Growth rate of employment	**Model of Equation (3)**		**Model of Equation (4a)**		**Model of Equation (4b)**	
	coefficients	**t-values**	**coefficients**	**t-values**	**coefficients**	**t-values**
Year93	0,0018	0,80	-0,0350	-6,57	-0,0304	-5,52
Year94	0,0066	3,00	-0,0404	-7,40	-0,0348	-6,15
Year95	-0,0138	-6,25	-0,0615	-11,27	-0,0563	-9,98
Year96	-0,0385	-17,46	-0,0875	-16,26	-0,0827	-14,81
Year97	-0,0138	-6,26	-0,0641	-11,88	-0,0595	-10,61
Year98	-0,0127	-5,70	-0,0631	-11,60	-0,0591	-10,44
Agriculture and forestry	-0,0258	-2,43	-0,0604	-7,83	-0,0304	-2,81
Energy industry and mining	-0,0345	-3,80	-0,0174	-2,14	0,0420	4,24
Chemical industry	-0,1276	-5,07	-0,1446	-10,64	-0,0847	-3,36
Manufacture of rubber and plastic products	0,0359	0,83	0,0592	1,83	0,0293	0,68
Stones and earth	-0,0082	-0,25	-0,0091	-0,39	-0,0208	-0,64
Man. of glass and ceramic prod's	-0,0194	-0,32	-0,0144	-0,45	0,0183	0,30
Manufacture and processing of metals	0,0057	0,49	-0,0150	-1,51	-0,0093	-0,80
Man. of machinery and equipment	-0,0833	-6,68	-0,0907	-9,74	-0,0785	-6,27
Man. of motor vehicles	0,0146	1,27	0,0111	1,15	-0,0031	-0,27
Man. of office machinery, EDP, electronics	-0,0292	-4,54	-0,0288	-5,40	-0,0305	-4,76
Manufacture of jewellery, toys	-0,0204	-0,14	0,0201	0,25	-0,0336	-0,23
Man. of wood and wooden prod's	0,0046	0,20	-0,0252	-1,40	-0,0447	-1,99
Paper, paper products, printing	-0,0274	-0,71	-0,0267	-0,84	-0,0438	-1,15
Leather and textile industry	-0,0691	-2,08	-0,0290	-1,71	-0,0816	-2,48
Manufacture of food products and tobacco products	-0,0097	-0,95	-0,0117	-1,19	-0,0255	-2,49
Construction	-0,0102	-5,55	-0,0262	-10,24	-0,0296	-11,06
Commerce	0,0052	2,36	-0,0378	-10,85	-0,0394	-10,18
Transport and telecommunications	-0,0455	-11,68	-0,0298	-9,33	-0,0353	-8,05
Banking and insurance	0,0456	3,71	0,0570	6,89	0,0540	4,36
Hotels and catering	0,0596	7,21	0,0555	6,36	0,0417	4,46
Health and social work	0,0563	21,30	0,0692	24,66	0,0636	20,70
Business-related services	0,0703	16,96	0,0647	21,90	0,0578	12,06
Education	0,0507	13,51	0,0918	16,40	0,1049	15,49
Leisure-related services	0,0172	0,70	0,0678	5,61	0,0411	1,68
Household-related services	0,0252	1,24	-0,0052	-0,26	-0,0125	-0,61
Other social services	0,0530	6,79	0,0410	7,33	0,0643	8,24
Regional/local authorities and social insurance	-0,0743	-35,89	-0,0350	-10,68	-0,0356	-8,82
Conc_agriculture and forestry	-0,5055	-2,09			-0,8466	-3,53
Conc_energy industry and mining	-0,9314	-17,09			-0,6629	-11,64
Conc_chemical industry	-0,4030	-3,82			-0,3054	-2,92
Conc_manufacture of rubber and plastic products	-0,5501	-0,19			2,5523	0,88
Conc_stones and earth	-0,4396	-0,20			1,1930	0,53
Conc_man. of glass and ceramic	-1,0081	-0,93			-0,7755	-0,72

products						
Conc_manufacture and processing of metals	-1,1305	-4,33			-0,3500	-1,33
Conc_man. of machinery and equipment	-1,5969	-3,72			-0,7700	-1,80
Conc_man. of motor vehicles	-0,4716	-1,80			0,3847	1,45
Conc_man. of office machinery, EDP, electronics, precision eng.	-0,6922	-3,32			-0,1335	-0,64
Conc_man. of jewellery, toys	0,5346	0,19			1,1894	0,44
Conc_man. of wood and wooden products	0,1484	0,10			1,8809	1,29
Conc_paper, paper products and printing	-0,6630	-0,25			1,5065	0,58
Conc_leather and textile industry	0,4041	0,71			1,0200	1,82
Conc_man. of food products and tobacco products	0,9006	1,23			2,2591	3,10
Conc_construction	0,0346	0,54			0,2340	3,48
Conc_commerce	-0,8782	-5,69			-0,6563	-4,20
Conc_transport and telecommunications	-0,6143	-5,15			-0,1619	-1,33
Conc_banking and insurance	-0,4559	-0,28			-0,1849	-0,12
Conc_hotels and catering	0,1190	0,28			0,3707	0,87
Conc_health and social work	-0,8521	-4,48			-0,4469	-2,34
Conc_business-related services	-0,1734	-1,58			0,0388	0,35
Conc_education	-0,9909	-6,69			-0,9294	-6,25
Conc_leisure-related services	0,2225	0,13			1,4703	0,88
Conc_household-related services	-4,9722	-0,46			0,5157	0,05
Conc_other social services	-3,0260	-5,15			-3,0593	-5,25
Conc_regional/local authorities and social insurance	-0,2445	-5,22			-0,2856	-5,97
Core cities	-0,0080	-9,78	0,0049	5,07	0,0054	4,83
Highly urbanised districts in regions with large agglomerations	0,0073	1,45	-0,0047	-0,93	-0,0060	-1,19
Urbanised districts in regions with large agglomerations	0,0044	2,25	-0,0046	-2,37	-0,0042	-2,11
Rural districts in regions with large agglomerations	0,0074	5,09	0,0080	5,52	0,0061	4,19
Central cities in regions with conurbational features	-0,0044	-3,81	0,0031	2,66	0,0042	3,28
Urbanised districts in regions with conurbational features	-0,0002	-0,13	-0,0056	-4,01	-0,0066	-4,57
Rural districts in regions with conurbational features	0,0030	1,97	-0,0015	-0,99	-0,0011	-0,71
Urbanised districts in rural regions	-0,0034	-1,77	-0,0058	-3,04	-0,0074	-3,91
Rural districts in rural regions	-0,0013	-0,39	-0,0036	-1,07	-0,0043	-1,25
Employees without qualifications			-0,1188	-13,60	-0,0934	-9,97
Qualified employees			0,1092	12,92	0,1029	11,76
Highly qualified employees			0,0096	0,88	-0,0095	-0,83
Establishment size 1-19			0,0813	7,64	0,0835	7,23
Establishment size 20-99			0,0216	2,17	0,0098	0,95
Establishment size >99			-0,1029	-19,35	-0,0933	-15,21
11200 Berlin-East, Stadt	-0,0088	-6,64	0,0142	9,02	0,0128	7,32
12051 Brandenburg, Stadt	-0,0574	-3,93	-0,0294	-2,02	-0,0318	-2,19
12052 Cottbus, Stadt	-0,0080	-1,06	0,0087	1,18	0,0070	0,95
12053 Frankfurt (Oder), Stadt	-0,0034	-0,28	0,0107	0,89	0,0146	1,21
12054 Potsdam, Stadt	-0,0155	-2,44	-0,0145	-2,71	0,0028	0,43
12060 Kreis Barnim	-0,0173	-1,81	-0,0115	-1,21	-0,0142	-1,50
12061 Kreis Dahme-Spreewald	0,0290	2,94	0,0414	4,21	0,0382	3,91
12062 Kreis Elbe-Elster	0,0021	0,19	-0,0129	-1,17	-0,0163	-1,49

12063 Kreis Havelland	0,0235	1,82	0,0188	1,46	0,0162	1,27
12064 Kreis Maerkisch-Oderland	-0,0004	-0,05	0,0076	0,94	0,0056	0,69
12065 Kreis Oberhavel	0,0195	2,07	0,0295	3,15	0,0252	2,70
12066 Kreis Oberspreewald-Laus.	-0,0181	-2,04	0,0384	4,18	0,0372	4,03
12067 Kreis Oder-Spree	-0,0052	-0,62	-0,0026	-0,32	-0,0042	-0,50
12068 Kreis Ostprignitz-Ruppin	0,0120	0,93	0,0028	0,22	0,0055	0,43
12069 Kreis Potsdam-Mittelmark	0,0297	3,78	0,0247	3,20	0,0190	2,42
12070 Kreis Prignitz	-0,0021	-0,14	-0,0200	-1,26	-0,0156	-0,99
12071 Kreis Spree-Neisse	0,0043	0,47	-0,0221	-2,61	0,0144	1,57
12072 Kreis Teltow-Flaeming	0,0130	1,23	0,0079	0,75	0,0064	0,61
12073 Kreis Uckermark	-0,0013	-0,13	0,0028	0,27	0,0014	0,13
13001 Greifswald, Hansestadt	-0,0155	-0,81	-0,0372	-2,09	0,0009	0,05
13002 Neubrandenburg, Stadt	-0,0158	-1,38	0,0039	0,34	0,0043	0,37
…						
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Table 3: Shift-share analogous decomposition of the employment development for individual regional units, according to Model 4b (only 20 of 113 regions are shown)

District	actual develop-ment	estimated develop-ment	structural compo-nent	Concentra-tion effect	Adjusted structural component	Regional effect	Region type effect	Adjusted region effect	Global effect
11200 Berlin-Ost, Stadt	-0,161	-0,158	0,040	-0,027	0,013	0,069	0,030	0,099	-0,072
12051 Brandenburg a.d.H.	-0,279	-0,337	0,001	-0,017	-0,016	-0,166	0,032	-0,134	-0,068
12052 Cottbus, Stadt	-0,201	-0,207	0,034	-0,035	-0,001	0,038	0,023	0,061	-0,072
12053 Frankfurt (Oder), Stadt	-0,162	-0,084	0,056	-0,044	0,012	0,084	0,035	0,120	-0,078
12054 Potsdam, Stadt	-0,227	-0,234	0,034	-0,054	-0,020	0,015	0,029	0,044	-0,071
12060 Kreis Barnim	-0,070	-0,110	-0,006	0,011	0,005	-0,083	0,036	-0,047	-0,079
12061 Kreis Dahme-Spreewald	0,146	0,178	-0,040	0,005	-0,035	0,255	0,041	0,296	-0,094
12062 Kreis Elbe-Elster	-0,106	-0,072	-0,069	0,010	-0,059	-0,097	-0,007	-0,103	-0,081
12063 Kreis Havelland	0,109	0,078	-0,040	-0,006	-0,046	0,104	0,040	0,144	-0,090
12064 Kreis Maerkisch-Oderland	0,039	-0,023	-0,026	-0,012	-0,039	0,036	0,040	0,076	-0,094
12065 Kreis Oberhavel	0,058	0,053	-0,053	0,007	-0,045	0,158	0,038	0,197	-0,088
12066 Kreis Oberspreewald-Lausitz	-0,167	-0,218	-0,007	-0,092	-0,098	0,223	-0,007	0,216	-0,082
12067 Kreis Oder-Spree	-0,062	-0,099	-0,017	-0,014	-0,031	-0,025	0,036	0,011	-0,080
12068 Kreis Ostprignitz-Ruppin	0,043	0,000	-0,005	-0,028	-0,034	0,035	-0,027	0,008	-0,089
12069 Kreis Potsdam-Mittelmark	0,186	0,148	-0,033	0,000	-0,033	0,129	0,042	0,171	-0,096
12070 Kreis Prignitz	-0,081	-0,145	-0,031	-0,038	-0,068	-0,093	-0,026	-0,119	-0,082
12071 Kreis Spree-Neisse	-0,209	-0,251	0,013	-0,165	-0,152	0,082	-0,006	0,076	-0,074
12072 Kreis Teltow-Flaeming	0,114	0,048	-0,042	0,015	-0,027	0,041	0,040	0,081	-0,092
12073 Kreis Uckermark	-0,066	-0,125	-0,039	-0,022	-0,061	0,008	-0,025	-0,017	-0,081
13001 Greifswald, Hansestadt	-0,133	-0,189	0,124	-0,155	-0,031	0,048	-0,024	0,024	-0,074

Table 4: Shift-share analogous regression models:

Results of the concentration variables in comparison with Molle's location coefficients

	Model 1 coefficients	t-values	Model 3 Coefficients	t-values	Location Coeff.1993	Location Coeff.1998
Conc_agriculture and forestry	-0,5055	-2,09	-0,8466	-3,53	0,371	0,317
Conc_energy industry and mining	-0,9314	-17,09	-0,6629	-11,64	0,431	0,327
Conc_chemical industry	-0,4030	-3,82	-0,3054	-2,92	0,606	0,506
Conc_manufacture of rubber and plastic products	-0,5501	-0,19	2,5523	0,88	0,376	0,395
Conc_stones and earth	-0,4396	-0,20	1,1930	0,53	0,337	0,334
Conc_man. of glass and ceramic products	-1,0081	-0,93	-0,7755	-0,72	0,684	0,629
Conc_manufacture and processing of metals	-1,1305	-4,33	-0,3500	-1,33	0,296	0,249
Conc_man. of machinery and equipment	-1,5969	-3,72	-0,7700	-1,80	0,273	0,237
Conc_man. of motor vehicles	-0,4716	-1,80	0,3847	1,45	0,276	0,226
Conc_man. of office machinery, EDP, electronics, precision eng.	-0,6922	-3,32	-0,1335	-0,64	0,247	0,216
Conc_man. of jewellery, toys	0,5346	0,19	1,1894	0,44	0,565	0,633
Conc_man. of wood and wooden products	0,1484	0,10	1,8809	1,29	0,300	0,298
Conc_paper, paper products and printing	-0,6630	-0,25	1,5065	0,58	0,349	0,306
Conc_leather and textile industry	0,4041	0,71	1,0200	1,82	0,439	0,488
Conc_man. of food products and tobacco products	0,9006	1,23	2,2591	3,10	0,173	0,206
Conc_construction	0,0346	0,54	0,2340	3,48	0,085	0,104
Conc_commerce	-0,8782	-5,69	-0,6563	-4,20	0,057	0,062
Conc_transport and telecommunications	-0,6143	-5,15	-0,1619	-1,33	0,186	0,141
Conc_banking and insurance	-0,4559	-0,28	-0,1849	-0,12	0,136	0,200
Conc_hotels and catering	0,1190	0,28	0,3707	0,87	0,135	0,128
Conc_health and social work	-0,8521	-4,48	-0,4469	-2,34	0,090	0,088
Conc_business-related services	-0,1734	-1,58	0,0388	0,35	0,198	0,206
Conc_education	-0,9909	-6,69	-0,9294	-6,25	0,178	0,151
Conc_leisure-related services	0,2225	0,13	1,4703	0,88	0,378	0,386
Conc_household-related services	-4,9722	-0,46	0,5157	0,05	0,086	0,078
Conc_other social services	-3,0260	-5,15	-3,0593	-5,25	0,206	0,162
Conc_regional/local authorities and social insurance	-0,2445	-5,22	-0,2856	-5,97	0,109	0,138