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Conference Paper

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55th Congress of the European Regional Science Association: "World Renaissance: Changing roles for people and places", 25-28 August 2015, Lisbon, Portugal

Provided in Cooperation with:

European Regional Science Association (ERSA)

Suggested Citation: Möller, Joachim; Blien, Uwe; thi Hong Van, Phan; Brunow, Stephan (2015) : Long-lasting Labour Market Consequences of German Unification, 55th Congress of the European Regional Science Association: "World Renaissance: Changing roles for people and places", 25-28 August 2015, Lisbon, Portugal, European Regional Science Association (ERSA), Louvain-la-Neuve

This Version is available at:

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Long-lasting Labour Market Consequences of German Unification

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Keywords:

German Unification, Regional Unemployment, Regional Wage Dynamics, Wage Inequality, Wage Curve, Regional Development, Innovation, Industrial Structure, Patents

JEL-classification: J31, R23, P31

Abstract

This article shows how the impulses of the transformation process in eastern Germany have spread through the economy and the labour market. The form of transformation has long-term effects on the form of control over the economy; it is managed largely from western firms. This fact has manifold consequences for the innovation behaviour of plants, among others, which in turn is further related to productivity and thus to the labour market. We argue that this transfers further to persistently lower wages and higher unemployment rates in eastern compared with western Germany.

Acknowledgement: Very valuable support by Michaela Fuchs, Stefan Fuchs, Thomas Rhein, and Antje Weyh (all IAB) and Joachim Ragnitz (ifo Dresden) is gratefully acknowledged. Any responsibility for the analysis remains with the authors.

1. Introduction

Although one generation has passed since the unification of the country, substantial differences remain between labour market outcomes in eastern and western Germany (see also Schnabel, in this issue). In this article, we look for explanations of these differences. We trace the determinants of the current situation in the “New Länder” (Neue Bundesländer – New Federal States). The situation in eastern Germany presents itself as relatively positive when compared with eastern European countries going through a parallel transformation process (Snower/ Merkl 2006). In particular, incomes in eastern Germany are substantially higher today than in those countries that had shown similar preconditions at the end of the eighties. However, if western Germany is used as a benchmark, the new federal states remain markedly lagging behind as is revealed by basic labour market indicators.

To date, earnings in the East are considerably lower and unemployment is substantially higher than in the West. A quarter of a century after unification, this is rather astounding, particularly because it has been shown that the characteristics of people in East Germany are very similar to those of people in the West. Smolny and Kirbach (2011) examined migrants between East and West and ascertained that wage differences could not be attributed to the characteristics of workers. The question is then, what locational conditions and characteristics of firms produce these differences, if they cannot be related to workers.

We develop a new explanation for the link between the shape of the transformation and later developments, affecting even the current labour market situation. Our basic hypothesis is that this situation must be understood by referring to the initial conditions of unification and to the transformation of eastern Germany, which followed. Therefore, we begin with the fall of the Berlin Wall and analyse the massive institutional changes which were the consequence of unification. There is a chain of effects starting with the transformation of the economy and its industrial and ownership structure, leading to innovation and productivity performances and propagating to the labour market, thereby influencing (un)employment and wages.

In the first part of the paper, we exploit the literature addressing the specific post-unification situation to understand precisely the institutional changes and specifics of the transformation process. Following this background, we present new empirical material on the labour market situation in the second part of the paper. Emphasis is also placed on the heterogeneity of the regions of eastern Germany.

2. The transformation of eastern Germany and its consequences

2.1 The transformation process

At the end of the eighties, the economy of the German Democratic Republic (GDR) found itself in an acute crisis. The backing of the Soviet Union collapsed and the international debt of the economy left hardly any space for movement. The crisis was characterised by scarcity, stagnation, low productivity and international debt. Therefore, the government had to appeal

for support in the West, e.g., with respect to the debt situation. The economic crisis fuelled political protests among the citizens of the GDR – together with the political situation and the restrictions on individual mobility. Whereas initially only a small group of brave dissidents were active in the protests, soon a broad movement led to a rapid social transformation (see the overview in Burda/ Hunt 2001).

In the political protests at the end of the GDR, demonstrators primarily demanded two measures to remedy the economic problems: first, the opening of the iron curtain to the West, and second, the introduction of the D-mark, which was assumed to embody economic success and to ensure that wealth would be brought to eastern Germany. “If the D-mark doesn’t come to us, we’ll go to the D-mark” was one of the standard slogans at demonstrations, which simultaneously placed western politics under (time) pressure because of the considerable streams of people migrating to the West (Hoffmann 1993: 9). At the time, approximately 2000 people left the former GDR every day. The concept of a monetary union – although originally developed in the West – was quickly adopted in the eastern regions and soon taken over by the Kohl government (Ludewig 2015, Laabs 2012).

Subsequently, things moved very fast; in no other country was the economic transformation performed at the speed that it was in eastern Germany. The consequences of the economic and monetary union introduced on July 1, 1990, were far-reaching; whereas the GDR had been integrated in the economic territory of the Council of Mutual Economic Assistance (COMECON), eastern Germany’s businesses now had to assert themselves on global markets. This turned to be extremely difficult under the given circumstances. Not only were the quality and design of their products hardly marketable but also, according to an appraisal by Ragnitz (2001), productivity in the former GDR stood at only 35 % of the West German level at the time of unification. Except for firms producing for the local market, East German firms were not competitive. Moreover, wages and other costs increased markedly (Burda/Hunt 2001: 37ff). All of the above resulted in a deep transformation crisis, with a drastic drop of over 40 % in GDP in the years 1990 and 1991 (Hoffmann 1993: 26) and an employment slump of more than 35 %, which was practically unique for peacetime. From 1989–1993, employment fell from 9.8 million to 6.2 million (Blien/Hirschenauer 1994).

This slump was cushioned by the use of West German resources for transfers dedicated to social policy measures and for measures intended to foster building up a competitive economy in eastern Germany. The pre-condition for this was the unification of the two German states. The eastern German *Länder* (Federal States) joined the Federal Republic of Germany on October 3, 1990. In this phase and later, the German Federal Employment Services played an important role in supporting the masses of people who had lost their jobs. Additionally, labour market policy measures were crucial for adjusting the qualifications to the new market-based conditions. Later, it was shown that these measures had additional effects on employment (Blien et al. 2003).

In contrast to the situation in other countries, which saw substantial currency rate adjustments, the companies in the GDR were exposed to sharp competition on the world market after the monetary union and had no protection against it at all. High investments were neces-

sary to lift production to a globally competitive level. The eastern German population lacked the necessary capital. Therefore, the *Treuhandanstalt* (Trust Agency) was entitled to sell entire enterprises. The new owners typically were companies from the West, particularly from western Germany. The idea behind these transactions was to procure capital, market access and technology for the eastern German companies.

Subsequently, an enormous amount of capital was transferred to eastern Germany, which was additionally supplemented by a large assignment of public funds. If the sale of the eastern German companies was initially expected to be at least partly profitable, this soon turned out to be a misapprehension. Instead, advance investments were necessary to attract investors. According to Windolf et al. (1999), the Trust Agency had debts of 256 billion DM at the event of its voluntary liquidation at the end of 1994. This mirrors the huge expenditures being used for numerous measures to render the companies marketable (e.g., redundancy packages, assumptions of debt, and ecological measures). Therefore, Brücker (1995) drew the conclusion that it “was not companies that were sold, but investors that were bought”. However, this is only a small proportion of the funds used to build up the East because the total amount of public transfers from West to East was estimated at approximately € 1000 billion through 2005, according to a calculation by Blum et al. (2009), which was extrapolated by the research institute ifo Dresden to approximately 1670 billion through 2014. Whereas transfers in later times could no longer be considered (direct) costs of unification, the international literature on transformation considers the German approach to privatisation to be very expensive (Aslund 2013: 181).

As the example of other transformation countries shows, alternatives to this privatisation policy existed (see, among others, Sinn/Sinn 1993). For instance, there were strategies of issuing share certificates to the employees or to small investors, strategies of management buy-outs and others. Although it was not possible to apply these strategies to the same extent as in other countries, they could have played a role in the transformation process of eastern Germany. Additionally, there had been the option to extend the span of privatisation beyond four years it actually lasted. In this case, the period of excess supply of investment objects would have been avoided and better prices received. A prolonged process could have offered more space for people in eastern Germany. Instead, the privatised companies in the East were predominantly taken over and later managed from the West. Windolf et al. (1999) report on the results of a survey from 1995, according to which only 25 % of 1247 companies were owned by individuals or firms with their seat in eastern Germany.

The traces of the form of privatisation are visible even today. In the year 2013, according to own calculations with data of the IAB Establishment Panel, only the vast majority of small East German establishments had East German owners. This was different, however, for medium-sized and large establishments as shown in Table 1: 32 % of those of at least 200 employees had an East German owner, 33 % were in West German ownership, and the remainder were owned by foreigners or there was no majority owner.

Table 1: Ownership structure and establishment size

Number of employees	<25	25-199	200+
	in percent		
West Germany			
West German owners	91.8	85.4	71.3
East German owners	0.1	0.2	0.2
Foreign ownership	3.6	7.6	17.7
Public ownership	3.3	4.9	7.0
No ownership majority	1.1	1.9	3.8
East Germany incl. Berlin			
West German owners	11.4	30.7	32.9
East German owners	78.4	50.0	31.5
Foreign ownership	2.2	8.0	17.3
Public ownership	6.9	8.5	12.1
No ownership majority	1.1	2.7	6.1

Data base: IAB Establishment Panel (weighted by inverse probability of sampling) linked with data from Employment Statistics

In a first phase after unification, the concept of privatisation pursued by the Trust Agency certainly bore fruit because the investments did actually render many firms competitive. At some locations, even a re-industrialisation process could be observed. From as early as 1991, the economy in eastern Germany grew substantially, initially at high rates. This development was largely driven by fast productivity growth and was not accompanied by employment growth. In contrast, re-structuring of the economy led to a significant loss of workplaces and unemployment climbed to unsustainably high levels.

One can argue that because of the specific privatisation and transformation process in eastern Germany, a sort of “dependent economy” was generated. Because a surprising extent of the production in the East was controlled from owners or headquarters in the West, an industry structure tended to develop that can be described as “extended workbenches” (Paqué 2009a: 23, see also Paqué 2009b). Extended workbenches stand for business units that primarily fulfil an executing function within the company (for instance, producing and assembling) but have hardly any capacity for disposition and little or no resources for research and development (R&D). The latter can have unfavourable long-term consequences for economic growth. Additionally, there are distributional effects. Western owners often transfer profits realised by establishments in the East to the western part of the country. At least, there are good motives to assume that the probability that profits are reinvested in the East is lower than in the case of East German owners. The reason is that because of information and transaction costs, investors are inclined to invest in close-by areas. The home bias of investments is

shown by a bunch of papers using variants of the gravity approach, for instance (for a recent application see Schäffler et al. 2014).¹

2.2 Operational and regional structures in eastern Germany

In the new millennium, eastern Germany developed similarly to western Germany, but did not catch up. Although the overall performance of eastern companies was increasingly improving, the convergence process of the nineties came to a stop. According to national accounting systems data (VGR der Länder), productivity per person in gainful employment was 79 % of the level in western Germany in 2013. When calculated per working hour, the figure decreases to 74 % because the working day is longer in the East.

To date, the headquarters and development departments of many companies active in the East remain located in western Germany and not in eastern Germany (Burda 2012: 95). Of the 30 large-scale enterprises registered in the German share index DAX, only Siemens has one of its headquarters in eastern Germany (in Berlin, a second one is in Munich). Of the 500 largest firms in Germany, only 34 have their headquarters in the East, among them 20 in Berlin (IWH 2014: 26).

Many well-paid highly qualified jobs are located in these headquarters. Furthermore, other firms locate close to the headquarters, providing the large companies with consulting and support services. These are primarily services that are close to the interests of the companies and are particularly important for the productivity and development of regions in general. All of these firms and the corresponding categories of well-qualified employees are relatively seldom found in eastern Germany, as Brenke (2014) shows. This scarcity motivates outmigration, particularly of qualified workers.²

Moreover, the locations of R&D departments of the large firms are also disproportionately frequent in the West because R&D is often organised to be close to the company headquarters. The Volkswagen Company, for instance, has a large development centre in Wolfsburg, near its headquarters, whereas the focus of the plants in eastern Germany (Zwickau-Mosel, Chemnitz and Dresden) is primarily on production. Of course, there are significant exceptions among the firms in eastern Germany that are also world leaders in development, such as the optical goods industry in Jena, but this part of the country is generally underequipped with innovative capacities. Regional data from the *Stifterverband für die Deutsche Wissenschaft* (Kladroba 2013) show that the share of expenditures and of research and development personnel is lower in the East. In 2011, the share of research and development in GDP was 4.10 % in Baden-Württemberg (no. 1 in the West) and 1.39 % in Berlin (no. 1 in the East).

¹ In several East European countries, there were people called “oligarchs” by the media (see Aslund 2013). These people became very rich in the course of the transformation process because they were able to appropriate substantial amounts of formerly public assets. In East Germany, there were no “oligarchs”.

² In the spirit of Krugman’s (e.g., 1991) New Economic Geography, outmigration weakens the market potential of regions and reduces therefore their prospects for economic development. Arguments from New Economic Geography were applied to eastern Germany by Brakman and Garretsen (1994) in an early paper.

When an economy is developing, one can expect urban centres to act as “engines” to promote development. However, there were two obstacles in eastern Germany in this respect. First, there are only a few large agglomerations; in particular, the northern parts of eastern Germany are only sparsely populated. Second, the tenet of “restoration before compensation” (Ludewig 2015: 93) concerning property (real estate) claims led to a delay in building up economic centres due to the necessity of clarifying ownership structures. It frequently took years for these structures to be legally settled (Ludewig 2015). As Lehmann (1994) showed, the consequence was that the rate of businesses established in many larger towns and cities was lower than in their urban hinterlands (Potsdam, Leipzig, Halle, Erfurt, Chemnitz and Cottbus, for example), although one would have expected the opposite.

There is a much greater proportion of sparsely populated rural areas in eastern Germany than in western Germany, and the role of the few agglomerations was further weakened by the policies described. Berlin remains an exception among the cities of Europe because the average income lies below the national average. The city has not yet fulfilled its potential role as a locomotive driving regional development, although it would be a convenient location for trade with eastern European economies. The linkages with the Polish economy, which reveals high rates of growth, have not been very distinct so far.

2.3 Innovations and growth in eastern Germany

A consequence of the developments described above is that the rate of innovation among eastern German firms is currently significantly lower than among western German firms as shown by the regional distribution of R&D investment and personnel (Kladroba 2013). The lower rate of innovation is also evident from the distribution of patents because the *Deutsches Patent- und Markenamt* (German office of patents and brands) provides data on the location of “inventors”. Table 2 shows that in general, the frequency of patents in eastern Germany is below average. However, one must consider that three Federal States from the east show a better performance than the Federal State in the West, with the lowest patent rates (Schleswig-Holstein).

Table 2: Patents filed per 100,000 inhabitants (2013)

West Germany				East Germany	
Baden-Württemberg	138	Bremen	26	Berlin	27
Bavaria	118	Rhineland-Palatinate	26	Thuringia	25
Hamburg	43	Saarland	24	Saxony	24
North Rhine-Westphalia	40	Schleswig-Holstein	17	Brandenburg	13
Lower Saxony	38			Mecklenburg-West Pom.	11
Hessen	36			Saxony-Anhalt	10
Germany				59	

Source: Deutsches Patent- und Markenamt (German office of patents and brands) 2014:7.

The data from the patent office show high stability in these regional structures. Very similar distributions are recorded for earlier years. An analysis of process and product innovations (which are broader than are those defined by patents) by Bellmann et al. (2013) with the data of the IAB Establishment Panel also yields lower values for eastern Germany.³ However, the differences are smaller than for patents, as shown by an own structural analysis using the IAB Establishment Panel of product and process innovations in the East and in the West (Figure 1).

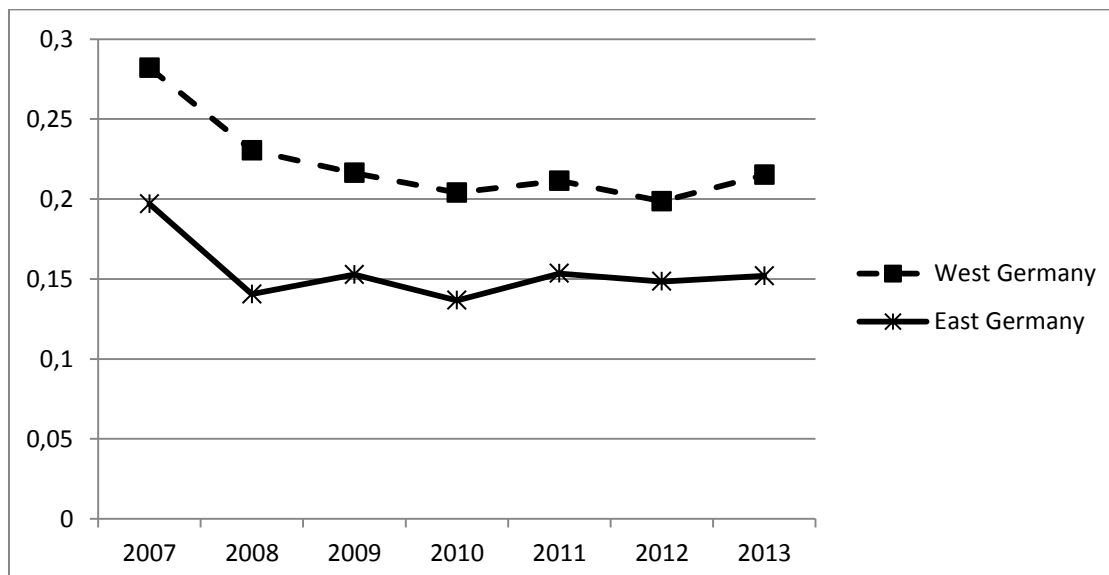


Figure 1a: Process innovation on the basis of the IAB Establishment Panel

³ The IAB Establishment Panel is a general-purpose panel survey with annual waves. Details are shown in the data appendix.

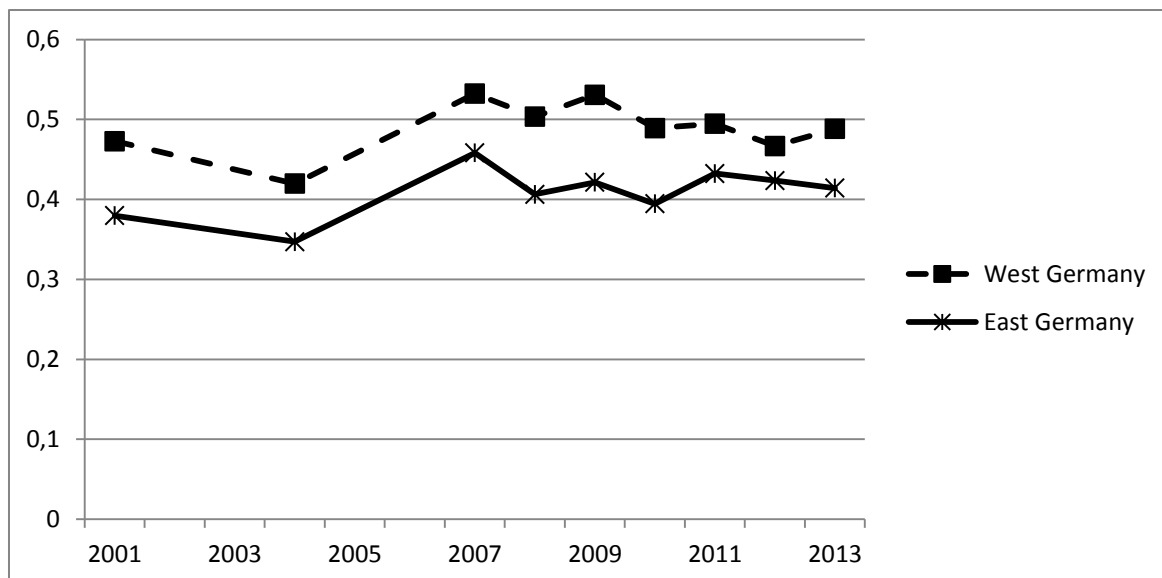


Figure 1b: Product innovation on the basis of the IAB Establishment Panel

It is remarkable that establishments in the East, which have a West German owner, do not perform better than their counterparts owned by eastern inhabitants. This appears in a multivariate analysis (not shown here) with innovations as the response variable. A dummy variable indicating West German ownership is not significant.

It should be stressed that the lower frequency of innovation in eastern Germany (see also Alecke et al. 2010) cannot be ascribed to any notion of the Germans in the East being less inventive than are those in the West. It is rather that the industrial structures that emerged because of unification are decisive with regard to the different frequencies of patents because the company headquarters and R&D departments are primarily located in the West. A further aspect is visible in the age structure. Because the average age of East German workers is higher than in the West and innovation activities fall with age, innovation in the East is negatively affected (see Gregory/Patuelli 2015). However, the effect is largely caused by out-migration of young well-educated workers who expect better working careers in the West.

Technical progress is generally the driving force behind economic growth. The frequency of patents serves as an indicator that regions play a certain active role in this growth. In the last decade, the western Federal States of Baden-Württemberg and Bavaria show the highest rates concerning the growth of labour productivity. This corresponds to their high frequency of innovations, measured by the indicator of the number of patents filed. In contrast, the rates of productivity growth of the eastern German economy are only roughly on the same level as those in the West, despite cost advantages with regard to wages. Since the turn of the millennium, East and West have scarcely converged with respect to productivity and average income. Consequently, consumption and investment activity in eastern Germany remain supported largely by transfers from the West – almost 20 %. As Ragnitz (2014) shows, the gap between the national product generated in eastern Germany and the buying power in this part of the country amounted to €54 billion in 2011.

It is possible to substantiate the connection between innovation and productivity by analyses with the IAB Establishment Panel. Figures 1a and 1b show the development of product and process innovations according to ownership for the two parts of the country. The rates for the East are globally lower than in the West. However, it appears that western ownership is favourable for being innovative.

The regression analysis documented in Table 3 supports this view. Here, we use labour productivity as the dependent variable. The general approach follows the one chosen by Brunow and Blien (2015) in their analyses of the productivity effects of agglomerations. The IAB Establishment Panel is linked with data from the Employment Statistics to form a rich employer-employee database. Several variables are used for excluding alternative explanations. The estimated coefficients mostly show the expected signs according to theoretical considerations. Table 3 shows that, even after controlling for many further influences, a significant effect in favour of western German establishments remains.

The results show that the level of product and process innovations has positive effects on the productivity level of establishments. Because the innovation rates are below average in the East (Figures 1a and 1b), a negative effect on productivity in the East relative to the West is visible. However, there is no special productivity disadvantage for innovations by eastern establishments, as is made clear by the interaction effect. Differences in innovation rates cumulate as time passes and contribute to the global location effect of the East. The variable indicating innovation is related to only one year. It cannot be expected that the complete productivity difference could be attributed to this short term influence. It is not possible to measure the complete effect (only its direction), since most establishments are regarded for only a few waves. Western ownership is advantageous for eastern establishments (as is foreign ownership), according to the corresponding coefficient. This can be seen as the result of knowledge transfers to the East, among others.

In the last two columns of Table 3, wages are treated as endogenous by instrumenting this variable with a one-year lagged value of the same variable and additionally with the average wage paid in the region in the year before. The details of the IV analysis are in the appendix. In general, the results are not at variance with the OLS estimates.

To summarise, the microanalyses with the linked employer-employee data confirm that innovation rates are structurally lower for eastern plants. The rates are related to lower productivity growth. Hence, the evidence corroborates the view that the specific approach to privatisation in the East had consequences for innovation behaviour of firms and for the lower level of productivity.

In recent years, the GDP growth rates in both parts of the country are at approximately the same level (Maseland 2014). Therefore, in contrast to the development in the early 1990s, the East/West gap is not getting smaller. The eastern German regions do not develop an endogenous growth potential sufficiently strong to converge to the level of the West. This is the case although wage and real estate cost levels are lower and significant transfers of public funds continue to occur.

Table 3: Regression analysis of labour productivity (1996-2010) with linked employer-employee data

Response variable: log labour productivity				
	(1)	(2)	(3)	(4)
log(average daily wage)	0.698*** (0.02)	0.770*** (0.02)	0.748*** (0.02)	0.815*** (0.02)
share intermediates	0.774*** (0.02)	1.221*** (0.02)	0.769*** (0.02)	1.219*** (0.02)
share of employees in complex occupations	0.311*** (0.03)	0.104*** (0.03)	0.289*** (0.03)	0.084*** (0.03)
... and interaction effect with East Germany	-0.051 (0.04)	0.012 (0.04)	-0.055 (0.04)	0.008 (0.04)
Innovations in previous year	0.046*** (0.01)	0.033*** (0.01)	0.043*** (0.01)	0.030*** (0.01)
... and interaction effect with East Germany	0.009 (0.01)	0.002 (0.01)	0.015 (0.01)	0.007 (0.01)
Dummy for East Germany	-0.175*** (0.02)	-0.180*** (0.02)	-0.162*** (0.02)	-0.169*** (0.02)
Dummy foreign ownership	0.169*** (0.02)	0.189*** (0.03)	0.166*** (0.02)	0.186*** (0.03)
Dummy: establishment in East and owner in West	0.066*** (0.01)	0.042*** (0.01)	0.066*** (0.01)	0.043*** (0.01)
Dummy: establishment in East and foreign owner	0.073 (0.05)	0.032 (0.05)	0.075 (0.05)	0.035 (0.05)
Constant	1.963*** (0.25)	1.815*** (0.10)	1.801*** (0.30)	1.807*** (0.11)
Industry FE included	yes	no	yes	no
Estimation method	OLS	OLS	2SLS	2SLS
Adj. R^2	0.410	0.315	0.412	0.316
# observations	93811	93811	91816	91816
# establishments	26094	26094	25639	25639
Sargan test statistics (p-value)			19.807*** 0.000	2.275 0.131
Hansen J-Test (p-value)			n.a.	0.644 0.422
Kleinbergen-Paap LM statistics			3092.9***	3385.8***

Notes: Linked employer-employee data: Establishment Panel data linked to Employment Statistics; robust standard errors in parentheses at establishment level. * $p < 0.1$. ** $p < 0.05$. *** $p < 0.01$; time fixed effects and 2 digit NACE Rev 1.1 industry fixed effect included; Additional (dummy) control variables include: sole trader, private partnership, branch office, head-quarter, establishment age of 5-14 years and 15 years and more, new/ older/ out-of-date equipment, size of workforce.

2.4 Direct labour market consequences

Despite the strong public funding, particularly in the initial period of transformation, unemployment was at least twice as high in the East as it was in the West for a long time (see Figure 2). Unemployment was one of the main social evils affecting many people in eastern Germany, particularly in the first few years after transition. Many of those who participated in toppling the SED-regime with great courage had severe problems with earning a living thereafter. Those who had hoped for “flourishing landscapes” were disappointed because of this apparent stagnation.

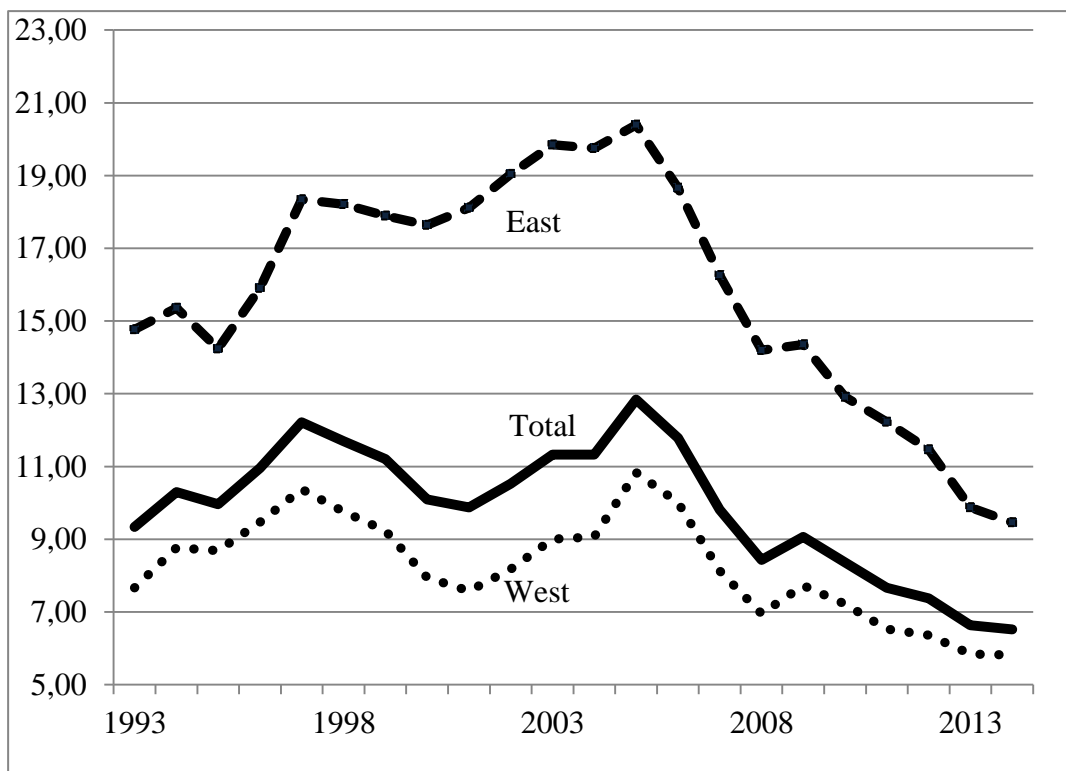


Figure 2: German Unemployment rates by region 1993 to 2014

In the first phase after unification, hardly any firms could compete with the highly productive establishments in the West despite the lower wage level. Employment in the East broke down and high unemployment resulted. In 1991, unit labour costs were over 150 % of those of the West due to low productivity. Then, wages stabilised below the western level, productivity increased, and unit labour costs fell (Brenke 2014: 944) in the course of a painful adjustment processes. The productivity gap was markedly reduced in the 1990s, but thereafter economic growth was not sufficiently strong to initiate a powerful catching-up process. The relatively low rates of GDP growth led to relatively low rates of employment growth in the East at the millennium and in the years thereafter. Only after the labour market reforms in the years 2003 to 2005 did the situation gradually improve to parallel the one in the West.

According to the employment statistics of the Federal Employment Agency, the gain in employment has been of approximately 10.9 %, or approximately 600,000 employees, between the years of 2004 and 2014. Although this expansion was largely from the increase of part-time work, together with other factors this contributed to a pleasant reduction of the level of unemployment in recent years (for details of the connection between employment and unemployment see Section 4). Starting in 2005/6, the decrease in the East even exceeded that in the West. Unemployment in the East fell by 54 % from 2005–2014, but by only 46 % in the West. In August 2014, the unemployment rates stood at 6.0 % (West) and 9.4 % (East). According to the Social Code Book II (SGB II) rate, social assistance stood at 3.9 % (West) and 7.0 % (East) in August 2014 (data according to statistics of the BA, the German Federal Employment Services). The reduction of unemployment in eastern Germany can partly be attributed to the mentioned employment development in the last few years and can partly be attributed to demographic factors (for an analysis of these two components see Fuchs/Weyh 2014). Out-migration from the East was especially important in the first few years after unification.

3. A comparison of earnings and wage inequality in western and eastern Germany

3.1 East/West earnings gap

With respect to incomes of full-time employees subject to social security, a nominal gap of approximately 23 % remains between the median values in the West and in the East in 2011.⁴ However, as calculations of Kawka et al. (2009) indicate, the price level in eastern Germany is somewhat lower, so that the difference in real terms is approximately 18 %. Correspondingly, low incomes and poverty occur more frequently in the East. Wage development was limited due to the low productivity and high regional unemployment. The latter could be described as a “wage curve effect”, which will be analysed in Section 4 in more detail.

It can be argued that eastern Germany should not only be compared with the West but also with the transformation countries in Eastern Europe, which were initially in a similar position when the iron curtain fell. From such a perspective, eastern Germany performs significantly better because the average incomes are far higher than in other transformation countries. According to information from the World Bank, subject to purchasing power parities, the annual income in 2012 was 38 % lower in Poland than in eastern Germany, and 27 % lower in the Czech Republic. In the countries observed, the unemployment rate was roughly comparable to that in eastern Germany; unemployment rates calculated using the data from the Labour Force Survey come to 8.5 % for eastern Germany, 7.0 % for the Czech Republic and 10.3 % for Poland (2013).⁵

⁴ Source: Own calculations using the 2011 Employment Statistics of the IAB.

⁵ These rates are defined according to ILO Standards and differ from those of Figure 2, which correspond to the standards of the German Federal Employment Agency (BA).

Furthermore, a possible line of argument could be that the lower productivity in eastern Germany is due to human capital depreciation because of the transition from a socialist system to a market economy. At least a part of the knowledge and abilities acquired in the education and training system of the GDR were no longer demanded in a western-style market economy. This effect should show up particularly for older cohorts of workers in eastern Germany. This will be investigated in the next subsections and supplements former research on a similar topic (Orlowski/Riphahn 2009, Smolny/Kirbach 2011).

3.2 Comparative analysis of the wage structure

Before analysing the relationship between employment, unemployment and wages in more detail, we examine some properties of the distribution of wages in both parts of Germany. Our database for the following analyses is the SIAB, a large micro-panel dataset of the IAB (see Data Appendix).

We essentially restrict our analysis to the wage distribution of men in full-time employment. The reason for excluding female workers here is that we do not have precise information on hours worked. The incidence of part-time work is substantial for female workers, whereas the proportion of men in part-time employment is relatively low in both parts of the country. Because one can expect a certain share of misreporting with regard to the part-time variable in the dataset, this might bias the results toward wage inequality for female workers.

Nominal gross earnings increased in both parts of the country, although this occurred significantly faster in the East than in the West in the first few years after unification. However, Figure 3 shows that the gap between the median earnings of men in full-time employment in the East and the West has not grown any narrower since the middle / end of the 1990s. In the year 2000, the median gross monthly earnings of employees in full-time employment who were liable for social security was € 2,679 in the West. In the East, the comparable figure was € 1,840, or almost € 840 lower. On average, eastern German employees received a good two-thirds (68.7 %) of the earnings in the West. In 2010, the absolute difference stood at € 987. Median earnings in eastern Germany stood at € 2,073, which was equivalent to 67.7 % of the level achieved in the West (€ 3,060).

Figure 3 makes differentiations according to the position in the wage distribution. It shows that the growth path observed in the upper ranks of the wage distribution (the 85th percentile was selected here) in both parts of the country is steeper than the one observed at the median. The opposite is visible in the low-earnings bracket (measured here at the 15th percentile). Even when examining nominal wages, there have hardly been any increases in the last 15 years.

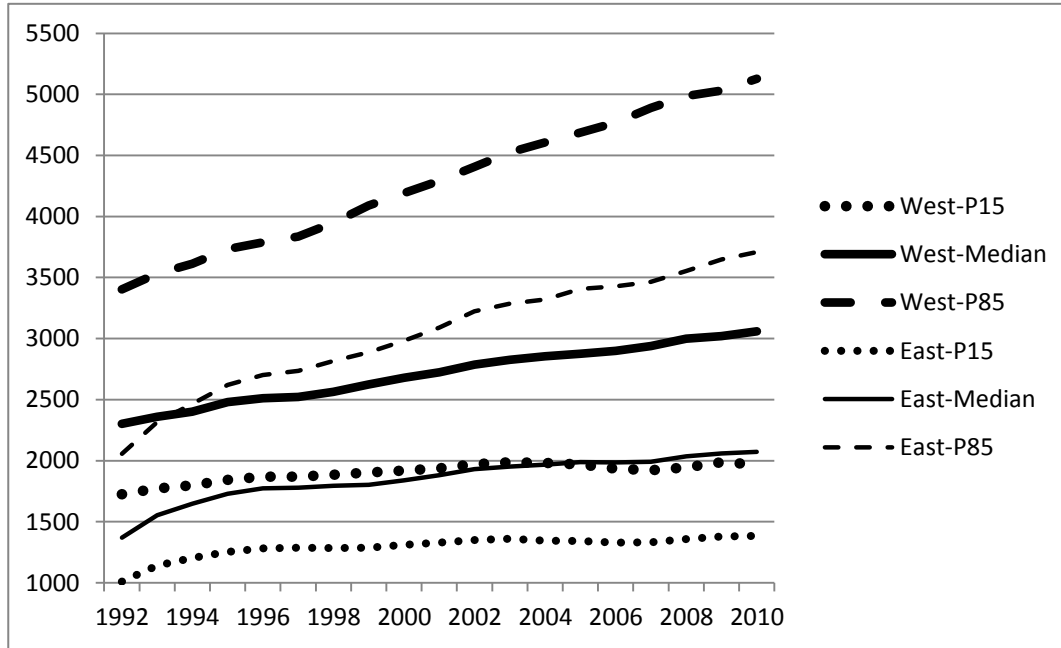


Figure 3: Development of monthly nominal gross earnings of full-time male workers by region and percentile of the wage distribution in €, 1992 to 2010

Notes: Data Source: SIAB, own calculations; P15 (P85) stands for the 15th and 85th percentile of the distribution of monthly gross earnings; monthly values were calculated by multiplying the daily earnings in SIAB with the factor 365/12 and 366/12 (in leap years), respectively; DM values before 2001 were converted into Euro values.

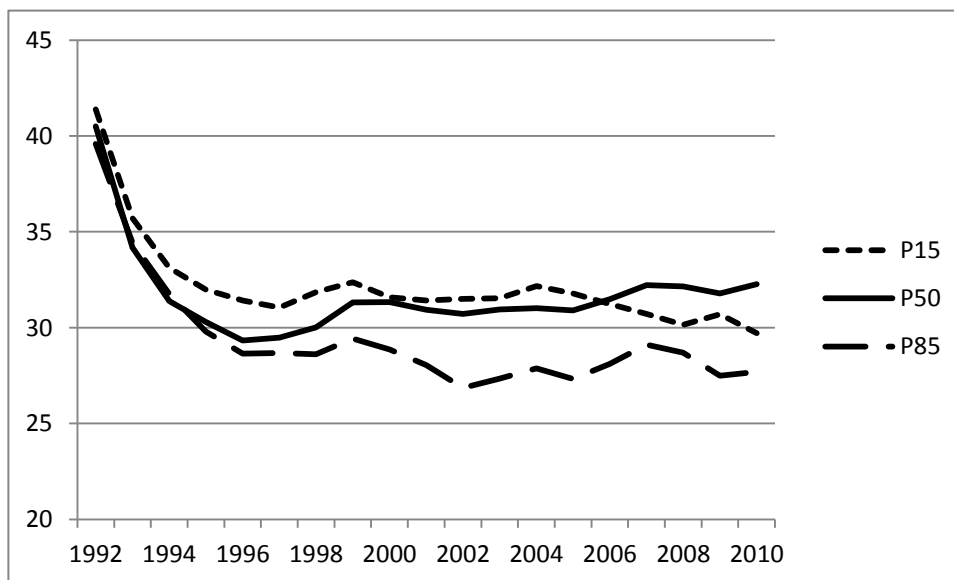


Figure 4: Earnings gap of full-time employed male workers in East Germany in relation to West Germany by percentile in the earnings distribution (1992 to 2010, in percent)

Notes: Data Source: SIAB, own calculations; P15 (P85) stands for the 15th and 85th percentile of the distribution of monthly gross earnings.

The substantial difference between the levels of earnings in the two parts of the country can also be demonstrated by the fact that the median of earnings in eastern Germany corresponds to approximately the 15th percentile of the distribution in the West. Figure 4 provides more information on this topic. Here, the gap between the percentages of the earnings of full-time employees subject to social contributions in eastern Germany relative to their western German colleagues is shown explicitly for the lower, middle and upper ranges of the wage distribution. Earnings in eastern Germany fell short of the level in western Germany by approximately 40 % in 1992 across the entire range of the wage distribution. By the mid-1990s, the gap, measured by the median, had been strongly reduced by approximately 10 percentage points. The reduction was slightly smaller in the lower range of the wage distribution and slightly greater in the upper range. After this substantial decrease in the first five years after unification, the convergence process of wages more or less stagnated. The average earnings in eastern Germany lagged behind those of western Germany by less than 30 % in the mid-1990s, and the discrepancy between the two parts of the country even tended slightly to increase again. If anything, a certain tendency towards a closing of the gap can only be established for the top salaries (measured here at the 85th percentile) and for the lower margin of the distribution.

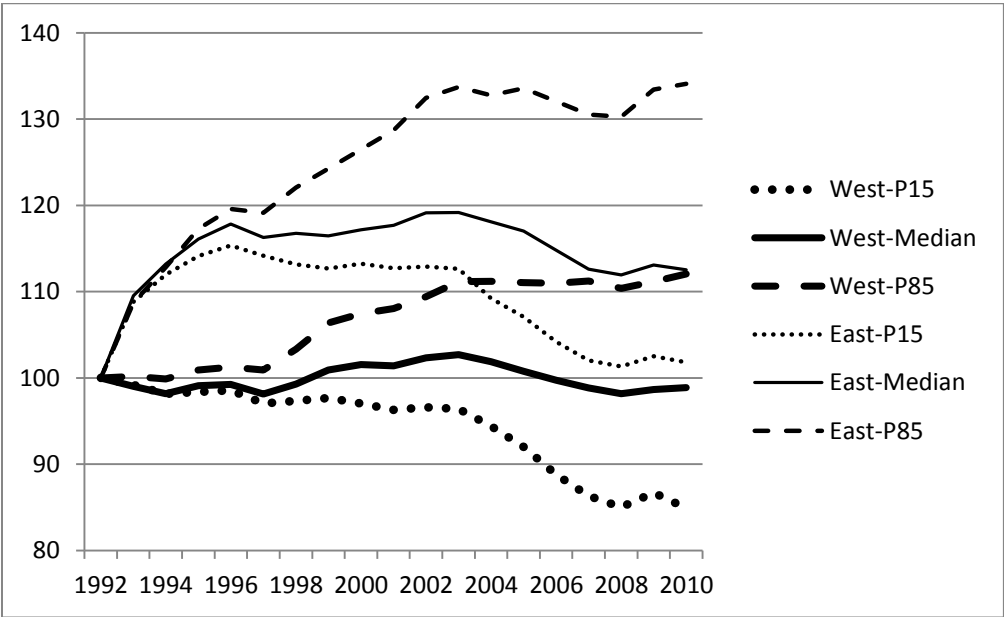


Figure 5: Index of real earnings of full-time employed male workers by region and percentile of the earnings distribution (1992 to 2010, 1992=100)

Notes: Data Source: SIAB, own calculations; P15 (P85) stands for the 15th and 85th percentile of the distribution of monthly gross earnings.

Figure 5 shows an index of the nominal earnings deflated by the harmonised consumer price index (Basis 2005) for the group of employees considered here. Clear differences can be ascertained in the development of the percentile of the wage distribution in both parts of the country. In western Germany, earnings adjusted for inflation have not risen since 1992 on average, and in the lower range of the wage distribution, they have even fallen. At the top of the wage distribution (measured at the 85th percentile), conversely, accruals of approximately 10 % can be found. This development implies that the German wage structure is spreading, as has been described by various authors (Dustmann et al. 2009; Card et al. 2013). What is less known is that the phenomenon for eastern Germany is even more pronounced. Although the purchasing power gains that arose after unification have shrunk again largely at the lower tail of the wage distribution, the median incomes remain higher at slightly more than 10 %. For top incomes, i.e., at the 85th percentile, conversely, the ensuing increase lies significantly higher at more than 30 %.

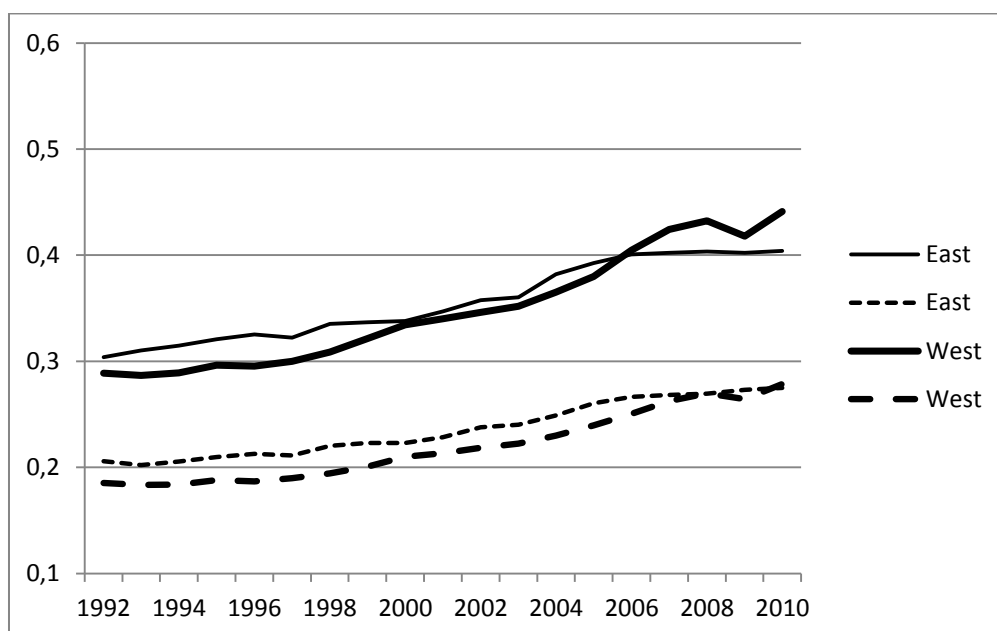


Figure 6: Relative difference between the median and the 15th and 25th percentile of the earnings distribution of full-time employed male workers by region (1992 to 2010, in log percent)

Notes: Data Source: SIAB, own calculations; P50, P15, P25 stand for the median, the 15th and 25th percentile of the distribution of monthly gross earning, respectively.

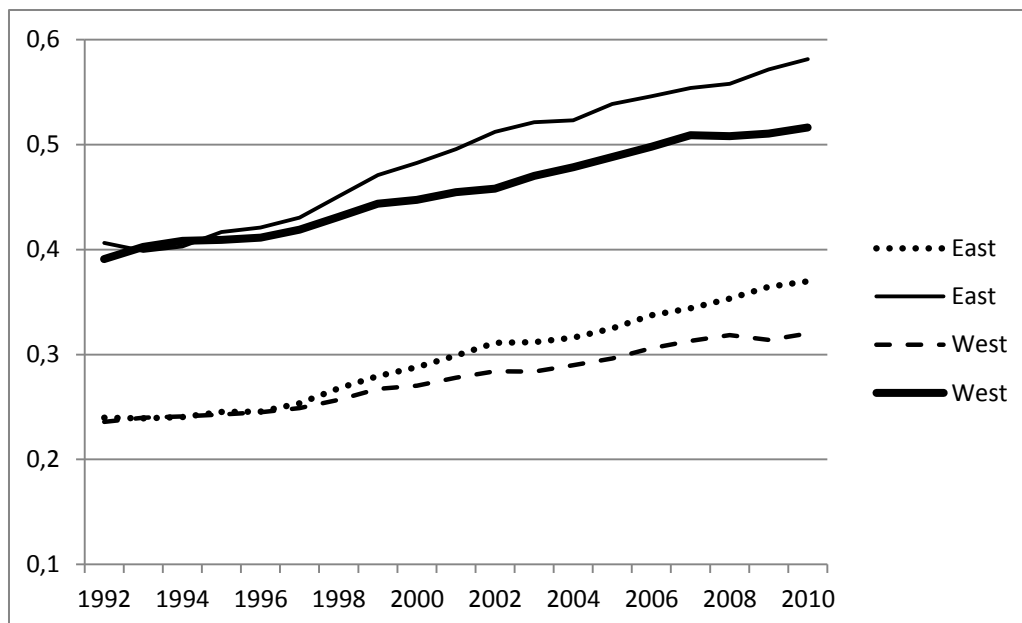


Figure 7: Relative difference between the 85th and 75th percentile of the earnings distribution of full-time employed male workers by region (1992 to 2010, in log percent)

Notes: Data Source: SIAB, own calculations; P50, P75, P85 stand for the median, the 75th and 85th percentile of the distribution of monthly gross earning, respectively.

Figures 6 and 7 allow a direct comparison of the wage inequality between eastern and western Germany and the development of differences over time. Figure 6 refers to the lower range of the distribution, whereas Figure 7 refers to the upper range. In the lower range, the measured inequality between East and West with respect to the earnings of the group observed here develops largely parallel at almost the same level throughout the entire period. The logarithmic difference between the corresponding percentiles of the wage distribution is shown. Here, it can be established that the curves are initially flat until near the middle or end of the 1990s and hence reveal no change. Thereafter, the inequality of the incomes in the two parts of the country increases significantly. Although the development in the West continues until the end of the observation period – apart from a brief interruption in 2009, the year of the Great Recession – it slides into a sideways movement in the East from approximately 2005. Therefore, the inequality does not continue to increase. This results in the relative difference between the 15th percentile and the median on the current margin presenting itself because it is smaller in the East than in the West. This could be connected to the fact that the lower ranks of the wage distribution in the East come close to basic social security, which serves as an implicit minimum wage.

Figure 7 shows measures for the relative wage inequality in the upper range of the distribution. A significant increase can also be established here, particularly from the mid-1990s; it even surpasses the increase in the lower range. The same applies to both parts of the country because the spread of the income distribution is greater in the upper range than in the lower one. However, there are also striking differences. The relative wage inequality between the

upper percentiles of the earnings distribution and the median is obviously much more pronounced in the new *Länder*. This explains why, in comparison to the median earners, the top earners in the East exhibit a smaller earnings disadvantage than do those in the West.

3.3 East/West comparison of skill wage differentials

A reliable comparison of the skill wage differentials for different age cohorts in the two parts of the country requires an econometric analysis. To this end, we use an extended Mincer wage function that is estimated separately for both parts of the country and for every period available. The estimating equation for the gross earnings w_{it} of person i at time t is as follows:

$$(3.1) \quad \ln w_{it} = a_0 + a_1 \text{age}_{it} + a_2 \text{age}_{it}^2 + \sum_2^7 QD_{ijt} + \text{Interaction Terms} + \varepsilon_{it}$$

Here, the QD_{ij} stand for (0, 1) dummy variables that indicate the qualification types that can be identified in the dataset and for the interaction terms between age and age-squared and the qualification types.

In the estimation, the censoring of the data at the social security income threshold is addressed by a Tobit estimation procedure.⁶ Based on the estimates, we calculate the earnings of full-time employed workers at different ages (30, 40, and 50) for three skill groups (low skilled, vocational training completed, and graduates from universities of applied science). For these different groups, the relative wage disadvantage of workers in eastern Germany compared with their colleagues in western Germany is determined.

We present the results in graphical form in Figure 8. For all skill groups, one can observe a catch-up process in the first half of the 1990s. For low-skilled workers, this development stopped at a value of approximately 75 to 80 %. There are no striking differences between age groups. For the intermediate skill group, the catch-up process stops at a somewhat lower level of between 65 and 70 % of the level in the West. There is now a larger difference between age groups. It can be observed that the wage disadvantage of workers with vocational training completed is markedly higher for older workers. This phenomenon is even more striking for the highest skill category considered here (see the bottom panel of Figure 8). Young, high-skilled workers in eastern Germany receive approximately 80 % of the wages of their colleagues in the West, whereas those who are 50 years old only obtain approximately two-thirds.

⁶ An alternative would have been to use imputed wages for those beyond the social security contribution threshold. Both methods rely on a distributional assumption and are comparable.

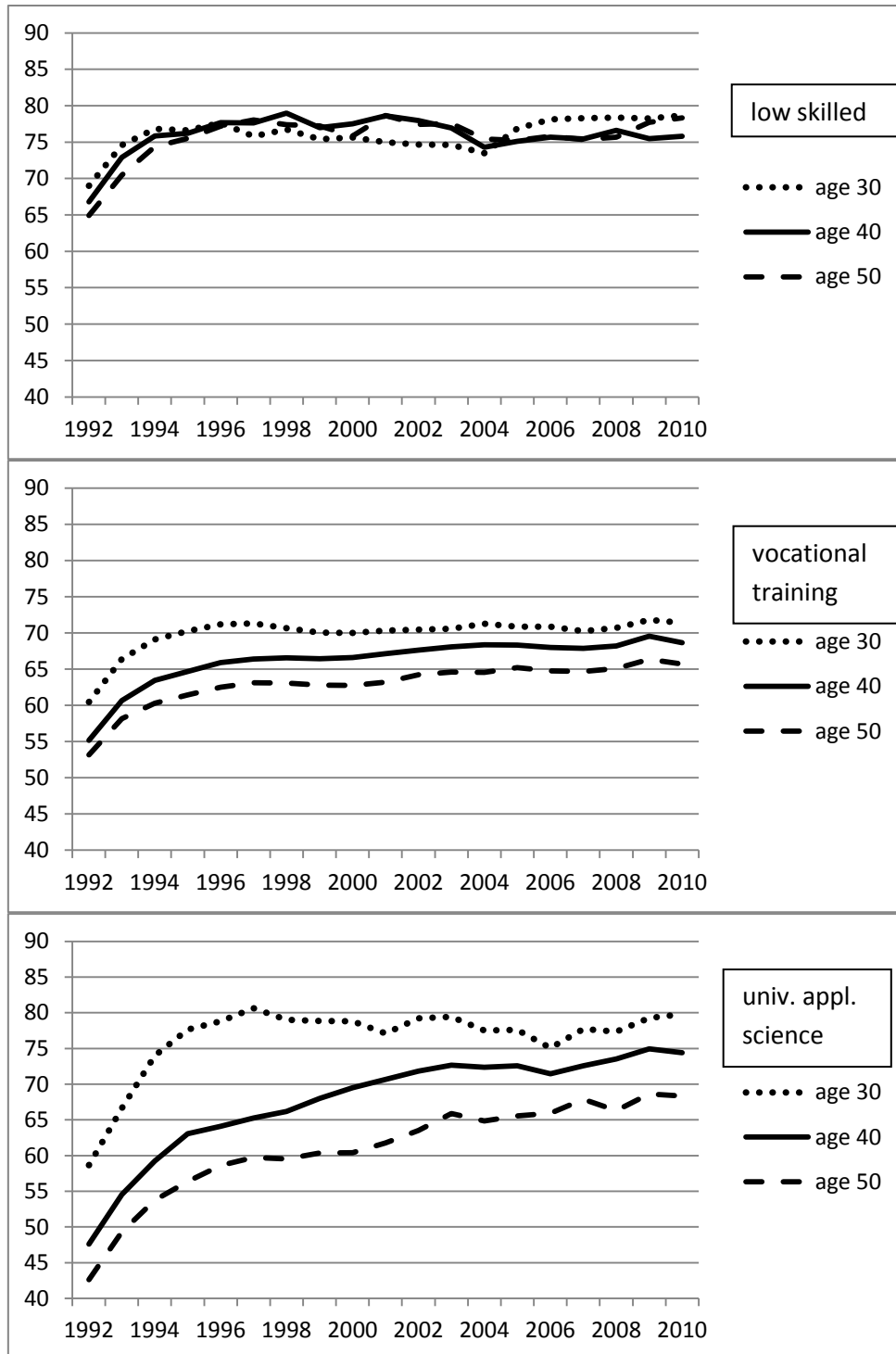


Figure 8: Relative earnings gap East/ West for full-time employed male workers by skill level and age (1992 to 2010, in percent)

Notes: Data Source: SIAB, own calculations; 30, 40 and 50 stand for the age of workers; univ.appl.science: degree from a university of applied science; vocational training: vocational training completed; low skilled: workers with neither vocational training completed nor higher secondary school leaving certificate.

The conclusion we can draw from these analyses is that cohort effects are present, particularly for qualified and highly qualified workers. The skills of the workers who acquired their knowledge and first experience in the time of the GDR have less value compared with that of younger cohorts of the same age. Hence, the hypothesis that investment in human capital in the old system became obsolete is in general confirmed by our analysis (see also Brunow/Hirte 2009). This is not to say that obsolescence of human capital of older cohorts of workers in eastern Germany explains the East/West wage gap. Even when considering only younger cohorts of workers who were approximately ten years old at the time of unification, the wage disadvantage compared with the West is clearly visible.

To assess the contribution of all individual-level variables to the West/East wage gap, we compare the results of two regressions for the years 2005–2010. One uses only a binary variable to indicate the difference. The other one includes all of the exogenous variables available in the employment statistics (a complete list can be viewed in the notes of Table 4). The coefficient in the univariate regression is -0.290. If all available exogenous variables of the SIAB in a regression analysis are used, the coefficient of the east dummy reduces to -0.224. In other words, the many characteristics of workers (gender, age, occupation, occupational status, education) and of establishments (industry and establishment size) contribute only to one-fourth of the wage differential. The rest must be explained by other characteristics of the situation in the East

The results we obtain on individual-level variables are not at variance with the literature. Orłowski and Riphahn (2009) used GSOEP data in an extended approach that allows disentangling the effects of tenure (seniority) and experience. Considering various possibilities of bias in the estimates, they find East/ West differences not in returns to seniority, but in experience. This is the case although only individuals who started their labour market career after the fall of the Berlin wall were considered. The authors interpret their results by pointing to heterogeneity of work experience gathered in both parts of the country without analysing the underlying factors of this heterogeneity any further. At first glimpse, this result seems to be somewhat at odds with the findings of Smolny and Kirbach (2011), who are not able to detect differences in personal characteristics being relevant for labour market outcomes when workers migrate from eastern to western Germany. In our view, however, both studies complement one another. The differences in remuneration do not stem from unobserved characteristics of workers in the different parts of the country if their labour market entry is after the transition period. Rather, these differences are due to the working environment of the firm and/ or the location. This insight corroborates our own empirical findings.

4. The labour market situation with a regional focus

4.1 Employment and unemployment

For the next steps of the analyses, we exploit the regional differentiation of the East German labour market. Our aim is to show the further spreading of the impulses from German unification through the labour market and its main dimensions. If we disaggregate the domestic

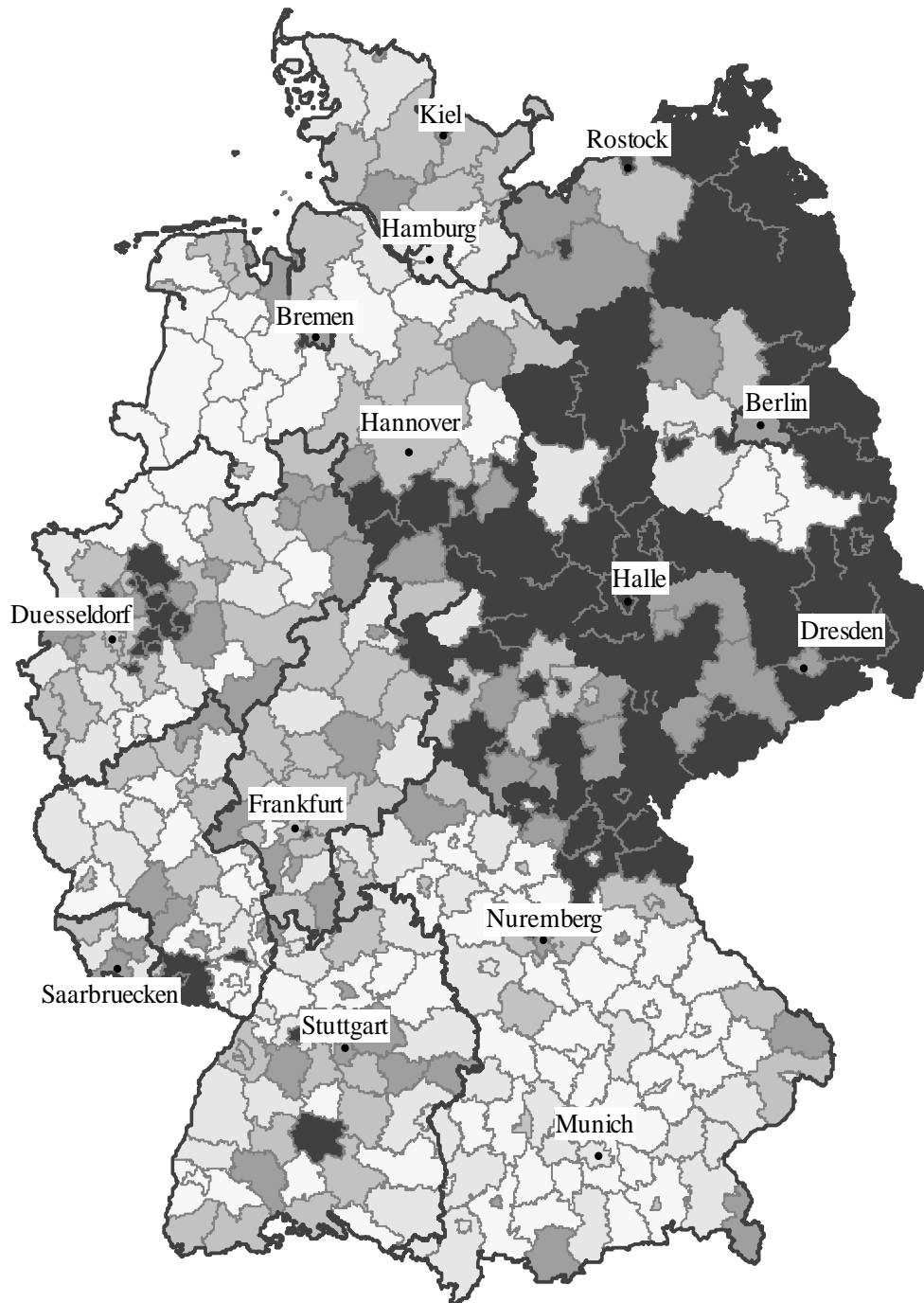
product at the level of regions (done with the Regional GDP Accounts “*VGR der Länder*”), nearly all districts (“*Kreise*”) show a productivity level below the German average. Although there is considerable regional heterogeneity, for the various areas of eastern Germany, the processes described in the first parts of this article dominate. The deficit of productivity affects nearly all regions. This has consequences for the labour market that are presented in Map 1, which shows regional employment development over the span of twenty years in detail.

The main employment loss in eastern Germany happened before the observation period of Map 1 (before 1993) in the phase directly after unification. However, even thereafter, there is a significant divide between East and West. Most of the regions in the East were affected by severe employment losses. The very few exceptions include some regions near Berlin and some that are part of Thuringia.

Of course, further indicators of the regional labour market situation in Germany must be considered. Regional employment development transfers itself up to a certain degree into regional unemployment as a simple comparison of Maps 1 and 2 reveals. Map 2 presents the regional distribution of unemployment. Many studies (see the survey in Elhorst 2003) show that there is a relatively close relationship between employment development and unemployment.

A univariate regression of unemployment for the year 2013 on employment development shows that in fact regional employment is important for the response variable. The database is a fusion of the unemployment statistics of the Federal Employment Services and of the Integrated Employment Biographies of the IAB (see Data Appendix) for the years 1993–2013, obtained by aggregation at the district level. The coefficient of the rate of employment development (from 1993–2003) is -0.094 and statistically highly significant. The R^2 of this model is 0.37, which is relatively high for a univariate regression. This regression is available on request from the authors. It confirms the contribution of employment development to the level of unemployment in East Germany.

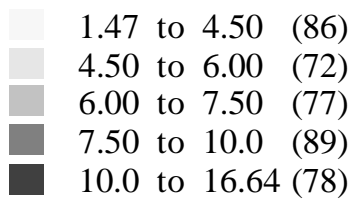
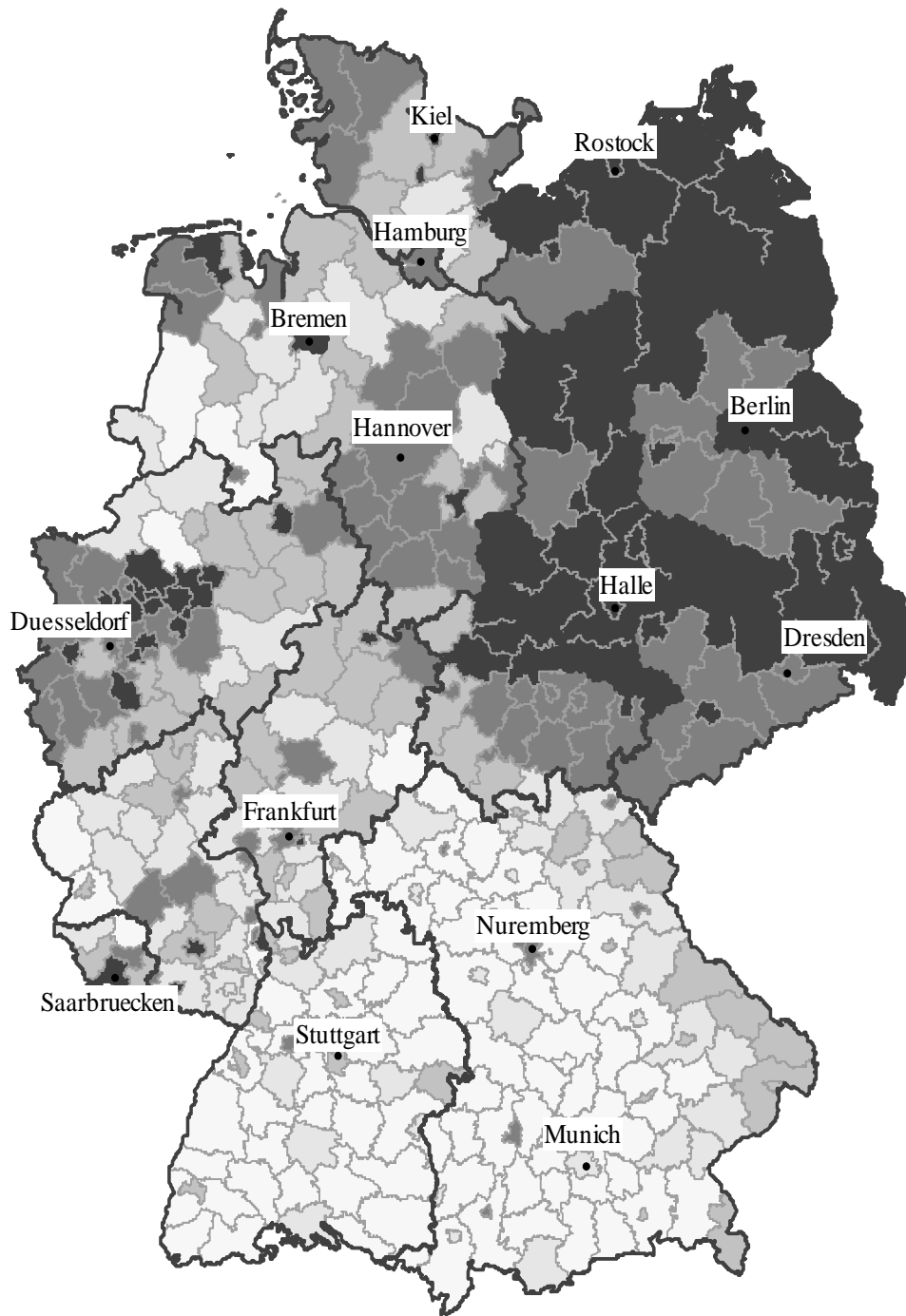
Map 1: Employment Development 1993-2013



■	-42,5 to -9,0	(86)
■	-9,0 to 0,0	(69)
■	0,0 to 8,0	(84)
■	8,0 to 17,0	(77)
■	17,0 to 64,5	(86)

Changes in percent; number of regions in parentheses.

Map 2: Unemployment Rate April 2015



West: 6.54
East: 10.65

Changes in percent; number of regions in parentheses.

Conversely, unemployment is also affected by commuting and by other supply-side factors such as (out-)migration. The regression is not intended to offer a complete analysis of the regional structure of unemployment development in East Germany. However, it is important that the regression results show, that the deficit in employment development in the East is transmitted to the relatively high rates of unemployment there.

A reverse development has occurred in recent times; there has been a strong decline of unemployment in the East since 2005. Main factors behind this phenomenon are the employment gain of approximately 10 %, increasing commuting to the West and the shrinkage of the working population due to demographic developments (see the discussion of the relevant factors in Fuchs/Weyh 2014). However, the gain in employment is largely a product of more part-time work, whereas full-time employment increased only very slightly from 4.01 (2005) to 4.07 (2014) million employees.

4.2 Unemployment and Wages

The analyses of Section 3 show that there are significant differences between East and West in the effects of individual level variables. However, they leave most of the wage gap unexplained. Is it possible to refer directly to the mentioned difference in productivity between East and West for an explanation?

A profit-maximising firm would not organise a production process with a productivity level below normal because this would operate at the expense of the firm's profits. It would hire workers under these circumstances only if wage costs were below normal to compensate for the productivity disadvantage. However, there is no direct transmission of productivity to wages in a capitalist economy. Workers are induced or even forced to accept lower wages, if they are not able to find a job at an expected level. The information about this is normally transmitted by the unemployment rate. If it is high, workers are inclined to be rather "modest" in their wage demands.

There are several theoretical approaches modelling the relationship between unemployment and wages, particularly wage negotiation and efficiency wages approaches. Recent approaches introduce the existence of various types of unions (some unions negotiate at the industry level, others at the level of individual firms) in these theoretical models. Some of these are integrated in recent approaches of macroeconomics (Layard et al. 2005, Carlin/Soskice 2015). In these models, there is a "wage-setting curve" (see the empirical application by Brücker/Jahn 2011) relating the unemployment level (or rather its reverse, the employment level) and real wages.

The wage-setting curve is defined for the labour markets of whole countries. It has a counterpart, intended for regions, which was developed by Blanchflower and Oswald (1994, 2005). The so-called "Wage Curve" is a decreasing function of wages on regional unemployment rates. Again, Blanchflower and Oswald argue that high unemployment rates increase the workers' risk of being laid off or alternatively decrease their chances of finding a new job if they are laid off. This weakens their bargaining position and increases the incentives to devote more effort to their work. Therefore, according to efficiency wage or bargaining approaches,

firms in regions with higher unemployment rates might be inclined to pay lower wages. Productivity is also part of the theoretical concept of the wage curve; Blanchflower and Oswald assume that a region-specific labour demand curve is the complement to the uniform wage curve. The intersection of both curves yields the regional unemployment rate. Labour demand is related to productivity.

In their empirical analyses for more than a dozen countries, Blanchflower and Oswald found that the elasticity of wages with respect to unemployment was close to -0.1. According to their results, the effect was so stable that the authors dared to call it an “empirical law of economics”. A meta-analysis of their results and of other authors, obtained later by Nijkamp and Poot (2005), showed considerable variation of the results and an average coefficient close to -0.07. The wage curve in Germany has been analysed repeatedly; among the seminal papers was Wagner (1994). However, most of these papers were about western Germany; one of the rare exceptions is Baltagi et al. (2000).

As far as we know, there have been no papers trying to estimate a Wage Curve for the complete labour market of Germany. However, this is required because we are interested in identifying the wage differential between the two parts of the country. In line with the argumentation on the wage curve, the hypothesis is followed, i.e., that high unemployment rates in the East keep wages down.

In the present context, the wage curves are estimated with micro-data from the SIAB, a 2 % Sample of the Integrated Labour Market Biographies of the IAB (see Data Appendix). Because the response variable is the log of individual wages, an augmented Mincer-type earnings function is estimated. The response variable (the individual wage) and the most important exogenous variable (the regional unemployment rate) are both in logs. The heterogeneity of the workers and workplaces is controlled by several variables, for example, gender, age and industry (see the notes of Table 4). Most variables included in the analyses are not shown here due to lack of space. Regional fixed effects represent eastern Germany region types, which are defined according to an often-used classification developed by the *Bundesinstitut für Bau-, Stadt- und Raumforschung*. (BBSR) is based on a cross-classification of population density and centrality; see Görmar und Irmen (1991).⁷ Region Type 9 (rural regions in the periphery) is the reference category and is therefore left out. Finally, the log of the unemployment rate measured at the level of federal states is included as the crucial exogenous variable in which we are interested. The observation period is from 1993–2010.

As was analysed above, there are some problems with the attributes of employees. Some variables are defined slightly different in East and West. This distinction is especially true for the qualification variables. However, because the differences are small and because they affect primarily older workers, we are confident that the included variables sufficiently control for the heterogeneity of workers.

⁷ An updated version of the classification is available from the BBSR home page.

Table 4: Regression analysis of log of wages (1993 to 2010), N: 7,269,277

Variable	Model 1		Model 2		Model 3	
	Coefficient	t-Stat.	Coefficient	t-Stat.	Coefficient	t-Stat.
Log of unemployment.	-0.225***	-629.75	-0.067***	116.64	-	-
Dummy East	-	-	-0.188***	-368.92	-0.235***	-724.6
Female employee	-0.273***	-909.05	-0.2658***	-892.95	-0.265***	-890.8
Age	0.036***	429.30	0.0036***	434.72	0.036***	431.5
Age squared	-.0004***	-365.42	-0.0004***	-369.36	-0.0004***	-366.5
Region Type 1 Core cities in regions with large agglomerations	0.151***	230.20	0.109***	164.70	0.101***	153.4
Region Type 2 Highly urbanised areas in regions with large agglomerations	.0144***	211.25	0.090***	129.24	0.082***	119.2
Region Type 3 Populated areas in regions with large agglomerations	0.091***	117.01	0.048***	61.81	0.042***	53.6
Region Type 4 Rural areas in regions with large agglomerations	0.039***	42.44	0.042***	45.49	0.039***	42.3
Region Type 5 Core cities in regions with conurbational features	0.068***	92.45	0.044***	59.77	0.041***	55.4
Region Type 6 Populated areas in regions with conurbational features	0.061***	89.69	0.031***	46.59	0.041***	45.7
Region Type 7 Rural areas in regions with conurbational features	0.030***	40.55	0.014***	18.89	0.031***	19.2
Region Type 8 Densely populated areas in rural regions	0.014***	20.18	0.009***	12.38	0.014***	18.6
R^2	0.53		0.54		0.54	

Notes: ***, **, *: statistically significant at the 0.001, 0.01 and 0.05-level, respectively;

Data source: SIAB (see Data Appendix)

Additional control variables not shown in the table: education level (6 dummies), occupational status (3), occupation (11), industry (31), establishment size (8), and year (17).

The results show that unemployment affects wages. Although 16 regional units are included in the analysis, the East/ West divide dominates the results as shown by the large coefficient of the unemployment rate in Model 1, which does not include a fixed effect for eastern Germany. In this case, a doubling of the unemployment rate would reduce wages by approximately 23 %. This corresponds to the long-time proportion of unemployment rates between East and West and to the wage gap of the two parts of the country.

However, this first result cannot be directly interpreted as the effect of unemployment on wages, which is shown by the results for Model 2. Here, the fixed effect for eastern Germany is included, which is intended to capture all unobserved variables differing between East and West. This fixed effect receives a relatively large value of 19 %. The coefficient of the log of the unemployment rate is reduced to approximately 7 % because there is a correlation between the unemployment rate and the fixed effect for eastern Germany. This figure remains higher than those received separately for East and West (Baltagi et al. 2000, 2012). The relative size of this effect could be at least partly attributed to the inertia of the unemployment

rate, which fell only at the end of the observation period. This inertia makes it difficult to identify the exact size of the unemployment effect.

As the consequence of this identification problem, we propose that the “true” effect is in the range of the two estimates. It is difficult to imagine reasons other than unemployment that might have the ability to keep wages down in the East. Conversely, the recent decline of unemployment rates relative to those of the West has not resulted in a reduction of the East/West wage gap as far as it has been observed. Because we have micro-data only until 2010, the main effect of the unemployment reduction does not show.

Technically, the problem may be partly due to the flatness of the nonlinear wage curve at its lower end. However, the argument can also be based on considerations about the structure of the labour market. It can be expected that the wage reaction is small if wages approach the culturally defined minimum. If there are urgent needs, the reservation wage might be relatively high and show no responsiveness to labour market conditions. This might be the reason why, up to now, we observe no change in the wages in eastern Germany.

5. Conclusion and Outlook

We have argued in this article that the form of transformation of the East German economy influenced the form of its control; i.e., it is managed from western firms to a high degree. This condition has consequences for the innovation behaviour of plants. Innovations are further related to productivity and in a next step to the labour market. The variables characterising the labour market are influenced by this situation and transmit these impulses further. Therefore, the effects of the transformation process propagate through the economy, consequently affecting the labour market.

The regions of eastern Germany have problems developing an endogenous growth process because they are lagging behind with respect to the frequency of innovations. The form of privatisation of the eastern German economy, which was chosen almost 25 years ago, had a double effect; it created high growth rates in the initial phase and relatively low ones in later years. In the beginning, it was important for companies to build up western German solutions for production. This strategy was entirely effective at that time. Today, however, it would be important for these companies to generate new solutions themselves.⁸ Although there are some major examples of highly innovative plants in the East, there are not enough of them when the whole economy is regarded. Many firms lack autonomy and capacities in research and development. Because the owners of the East German firms remain located in the West, profits from these businesses are at least partly transferred to the West, and it is open whether they are reinvested in eastern regions.

The literature on the labour market of eastern Germany shows that the greater part of the wage differential with the West cannot be attributed to worker characteristics. Instead, the

⁸ Acemoglu et al. (2006) analyse generally two different growth processes for a country. One is based on innovation whereas the other one on adoption of existing technologies. The latter process can lead to a non-convergence trap.

conditions of the location matter. And these conditions are influenced by the long-term effects of the form of unification and of privatisation.

Are there any starting points for policy measures in the analysis presented so far? More than very brief remarks could not be added at this point. The lack of headquarters and of departments for research and development in the East could not be easily repaired by state measures. It is hoped that small enterprises located in the East will grow to considerable sizes over time. Because innovation behaviour of firms is crucial for their productivity development, technology policies could be a possibility for further improving the situation in eastern Germany. For reasons we have already mentioned, innovations in particular should be promoted in fields promising an elastic demand for goods, as employment gains are only to be expected here. This promotion could occur as part of integrated regional policies that would promote regional capacities by linking different areas of public responsibility. One example could be to organise degree courses at local universities as complements to the regional industry structure.

Another strategy focuses on the international integration of eastern Germany. The faster-growing economies in Eastern Europe offer prospects for development which have thus far not been sufficiently exploited (Burda 2012: 89). To guarantee contact advantages, a general orientation towards international openness is required, which involves special measures such as improving knowledge of languages and actions to tap markets.

Berlin could be the preferred place for trading with Eastern Europe, taking on a function similar to that once taken by Singapore for Southeast Asia. Recently, Berlin has found grounds to play a more significant role in the future; the city has developed a very active entrepreneurial scene, particularly in the high-technology area (see Röhl 2014: 10). If this scene continues to grow and develop transmission effects, Berlin could play the role of locomotive for eastern Germany that has so far been lacking.

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Data Appendix

1. For the analyses shown in Tables 1 and 3, data are generated by combining two datasets of the IAB – namely the IAB Employment Statistics (ES) and the IAB Establishment Panel (EP) – via a unique common establishment identifier (see Brunow and Blien, 2015 for a detailed description of the data basis and the construction of variables used). Therefore, a linked employer-employee database is constructed. The ES is generated from official German Employment Statistics and rests on administrative data which is collected by means of the German Social Security system. It covers the whole universe of all people working subject to social security (see appendix section 2 below for further details).

The IAB Establishment Panel is an annual survey of approximately 16,000 German plants collected in personal interviews. The sample for the Establishment Panel is drawn from the population of all German establishments with at least one employee subject to social security and is stratified across both plant size and industries. The unit of observation is the individual establishment, as opposed to the concept of a firm that could comprise several establishments. The IAB Establishment Panel provides a wide range of self-reported establishment-specific variables including innovative activities, turnover and the proportion of intermediate inputs in production, information on the legal form and other characteristics.

2. The dataset used in sections 3 and 4 is a two percent random sample of the Integrated Employment Biographies of the IAB (SIAB) constructed from Employment Statistics which includes the total population of people gainfully employed and covered by the social insurance system in western Germany. This is over 80 % of all employment. The observation period is 1993 to 2010. Excluded from this data are the self-employed, civil servants, and workers with a very small income (in 1995, less than 256 Euros a month). The database yields continuous information on employment spells, earnings, job and personal characteristics. It is based on microdata delivered by firms about their individual employees. For every employee, a new record is generated every year. The same occurs if he or she changes employment. The duration of a spell is computed not in days worked but in calendar days. The wage variable is measured for calendar days. It is deflated by the consumer price index calculated for western Germany by the German General Statistical Office.

One advantage of using the employment statistics is having the identification of the region in which a specific employee is located. For our study, administrative districts (*Landkreise*/

kreisfreie Städte) are used because they are regional units. Originally, the data of the employment statistics were taken over for administrative purposes of the social security system and were collected by the Federal Employment Agency (*Bundesagentur für Arbeit*). Because the data are used to calculate the pensions of retired people, the income and duration information is very reliable. No wage classifications are needed because the exact individual wage is reported.

Appendix on the IV Analysis of Table 3

In Table 3, models 3 and 4, wages are treated as exogenous. Although Brunow and Blien (2015) provide evidence that the endogeneity of wages in a productivity analysis with the IAB Establishment Panel is weak, we follow their approach and address the potential endogeneity problem. Wages are instrumented with a lagged value of the previous year and additionally with the average wage paid in the region in the year before. This approach reduces the number of cases slightly.

Model 3 benefits from inclusion of industry fixed effects. Because some test statistics show problems with so high a number of dummies, we also calculate Model 4 without industry fixed effects. With Model 3, the Hansen's J-test cannot be calculated. For the same model, the Sargan test is available. It indicates that the instruments are not valid, i.e., correlated with the error term. By excluding industry fixed effects in Model 4, the variance-covariance matrix can be estimated and the Sargan test and Hansen's J-test provide valid test statistics. The instruments are valid in Brunow and Blien (2015); therefore, the over-identification restriction is satisfied. To exclude the possibility of weak instruments, we also test for under-identification. This is rejected by the Kleibergen-Paap test. Finally, we compare the OLS and IV results by means of the Hausman test. It favours the IV estimation.

Considering the parameters of interest, the models with fixed effects provide very similar results compared with those without fixed effects. In addition, the instrumentation leads only to minor changes.

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