

Discussion Paper No. 08-022

**Wage Convergence and  
Inequality after Unification:  
(East) Germany in Transition**

Johannes Gernandt and Friedhelm Pfeiffer

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Zentrum für Europäische  
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Centre for European  
Economic Research

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## **Nontechnical Summary**

German reunification might become a paradigm of convergence and integration of neighbouring regions with unequal starting conditions. One of the most ambitious political goals has been the equalisation of living conditions and wages in both parts of Germany. What has happened to wages and wage convergence after 15 years of transition? Do labor markets in two neighbouring regions such as East and West Germany function in such a way that wage convergence takes place?

In this study, we empirically compare the evolution of wages and wage inequality after reunification in both parts of Germany. In particular, we compare three groups of workers who lived in East Germany in 1989, defined as stayers, migrants and commuters to West Germany, and groups of West German statistical twin workers, all taken from the Socio-Economic Panel (SOEP) 1992-2005.

Regression analysis, non-parametric matching methods and graphical presentations are employed to study wage convergence and inequality. Our findings indicate that for the largest group of workers, those workers who still work in East Germany, the hypothesis of wage convergence has to be rejected. After 15 years of transition wages for East and West German workers with similar characteristics did not converge. In terms of wage flexibility, labor markets seem to be a long way of from functioning as auction markets and even among two regions as close as East and West Germany wage disparity persists.

However, full wage convergence between East and West German workers has taken place in the group of migrants from East to West Germany. And, nearly full wage convergence occurred in the group of commuters from East Germany to West Germany. Furthermore, wage inequality converged. For prime age dependent employees living and working in East Germany the ratio of wages for high wage workers, as measured by the ninetieth percentile of the wage distribution, and low wage workers, as measured by the tenth percentile of the wage distribution, increased from 2.00 to 2.93 and is now similar to wage inequality in the group of West German statistical twin workers.

We conclude that labor markets in East and West Germany still exhibit large differences in wages, but that the degree of inequality in the two regions converged. Still, significant forces are shaping Germany's wage distribution through commuting and migration. The way to convergence and equalization takes time.

## Das Wichtigste in Kürze

Die Wiedervereinigung gilt als Musterbeispiel der wirtschaftlichen und sozialen Integration von zwei Ländern mit unterschiedlichen Startbedingungen. Bereits zu Beginn der Einigung von Ost- und Westdeutschland war es das Ziel, die Lebensbedingungen und auch die Löhne anzugleichen. Wurde dieses Ziel erreicht? Wie haben sich die Löhne und die Verteilung der Löhne nach dem Übergang Ostdeutschlands von der Plan- zur Marktwirtschaft entwickelt? Funktioniert der Wettbewerb auf den beiden Arbeitsmärkten in Ost- und Westdeutschland in dem Sinne, dass sich die Löhne und das Ausmaß der Ungleichheit der Löhne angeglichen haben?

In der vorliegenden Studie untersuchen wir diese Fragen empirisch mit Stichproben aus den Daten des Sozio-ökonomischen Panels (SOEP) von 1992 bis 2005. Für die Jahre seit 1992 werden für jedes Jahr drei Gruppen von Arbeitnehmern, die im Jahre 1989 (vor der Einigung) in Ostdeutschland lebten, unterschieden: Erstens die Gruppe der Arbeitnehmer, die in Ostdeutschland arbeiten („Bleiber“), zweitens, die Arbeitnehmer, die in Ostdeutschland leben und in Westdeutschland arbeiten („Pendler“), und drittens die Arbeitnehmer, die in Westdeutschland leben und dort arbeiten („Migranten“). Zu jeder dieser Gruppen wird mit statistischen Methoden eine Zwillinggruppe von westdeutschen Arbeitnehmern bestimmt, die sich in den im SOEP beobachteten Merkmalen (u.a. Geschlecht, Bildung, Alter, Unternehmensgröße) nicht von der jeweiligen Gruppe der Bleiber, Pendler oder Migranten unterscheidet.

Regressionsmethoden und grafische Veranschaulichungen lassen vermuten, dass für die Gruppe der Bleiber nicht von einer Lohnkonvergenz ausgegangen werden kann. Die Löhne von statistisch vergleichbaren Arbeitnehmern in Ost- und Westdeutschland unterscheiden sich weiterhin in einem signifikanten Ausmaß. Das durchschnittliche Lohnniveau im Osten beträgt ca. 75 Prozent desjenigen der Kollegen im Westen. Die Arbeitsmärkte in den beiden Regionen Deutschlands scheinen demnach für den Großteil der Arbeitnehmer nicht so zu funktionieren, dass es bereits zu einer Lohnangleichung gekommen ist. Die übrigen Ergebnisse deuten daraufhin, dass die Löhne von Migranten vollständig und die Löhne der Pendler annähernd vollständig konvergiert sind. Weiterhin legen die Schätzungen die Vermutung nahe, dass sich das Ausmaß der Lohnungleichheit in den vergleichbaren Gruppen von Arbeitnehmern in beiden Ländern angeglichen hat.

Zusammenfassend deutet unsere Analyse darauf hin, dass sich die Löhne nach der Vereinigung bis zum Jahre 2005 für die zahlenmäßig bedeutsame Gruppe der Arbeitnehmer, die im Jahre 1989 in Ostdeutschland lebten und die weiterhin in Ostdeutschland arbeiten, nicht angeglichen haben, dass sich jedoch die Löhne von Migranten und Pendler angeglichen haben. Auch das Ausmaß der Lohnungleichheit unterscheidet sich kaum mehr.

# Wage Convergence and Inequality after Unification: (East) Germany in Transition

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## **Abstract:**

This paper investigates the wage convergence between East German workers and their West German counterparts after reunification. Our research is based on a comparison of three groups of workers defined as stayers, migrants and commuters to West Germany, who lived in East Germany in 1989, with groups of West German statistical twin workers, all taken from the Socio-Economic Panel (SOEP). According to our findings, wage convergence for stayers is roughly 75 percent and for commuters 85 percent. Wages of migrants to West Germany equal the ones of their West German statistical twins. We conclude that labor markets in East and West Germany are still characterized by wage differences but that the degree of inequality in both regions converged.

## **Keywords:**

Wage convergence, wage inequality, German unification, migration, commuting

## **JEL-classification:**

J31, J30, J61

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# 1 Introduction

German reunification might become a paradigm of convergence and integration of neighbouring regions with unequal starting conditions. One of the most ambitious political goals has been the equalisation of living conditions and wages in both parts of Germany. There are various channels through which wages and living conditions may converge. With unification, barriers to labor market competition and migration were removed. Competition for jobs and wages increased and changed the allocation of labor and skills through migration, unemployment and wage adjustments in both German regions. However, wage adjustment takes time, because wage determination deviates from the determination of prices in auction markets (Bewley 1999, Pfeiffer, 2003, among others). While some wages, especially in larger industrial firms, are the result of central wage bargaining, the adaption of other wages, of qualifications and skills follows different pathways, influenced by expectations, migration and unemployment dynamics (Akerlof et al. 1991, Krueger and Pischke 1995, Lechner et al. 1993, among others).

This paper investigates the evolution of the wage distribution after reunification in both parts of Germany as well as the wages and the wage distribution of East German migrants and commuters to West Germany. Whether wages and the wage distribution have already converged is a topic of considerable debate among researchers and is discussed in our paper. Our approach is to compare the wage distribution of East German workers, commuters from East to West Germany and migrants from East to West Germany with their statistical twins from the West German workforce. Migration to West Germany, especially among the younger highly skilled workers still continues, indicating ongoing transition processes (compare also Burda et al. 1998, Franz and Steiner, 2000, Hunt 2006, Uhlig 2006). Our empirical part builds on samples for these groups of workers extracted from the German Socioeconomic Panel (SOEP) 1992-2005. Using regression and non-parametric matching methods, we identify a group of West German workers comparable to the East German workers. Based on this comparison in observables, wages and the convergence (or divergence) of wage distributions in the transition period from 1992 to 2005 are investigated.

Our contribution is related to the issue of rising wage inequality (compare Autor et al., 2006, among others). For a long time, rising wage inequality in Great Britain and the United States has been contrasted with a stable wage distribution in Europe and especially in Germany (e.g. Prasad 2004). The issue has been highlighted by Krugman (1994), who argues that rising inequality as well as low unemployment rates in the United States and rising unemployment and a stable wage distribution in Europe are two sides of the same coin. In this view, high European unemployment rates are the consequence of rigid labor market regulations that inhibit a downward adjust-

ment of wages. However, findings by Fitzenberger et al. (2001), Kohn (2006), Möller (2005), among others, suggest that wages in Germany have always been flexible to some degree and that wage inequality is rising in East and West Germany already since 1993/94 (Gernandt and Pfeiffer, 2007).

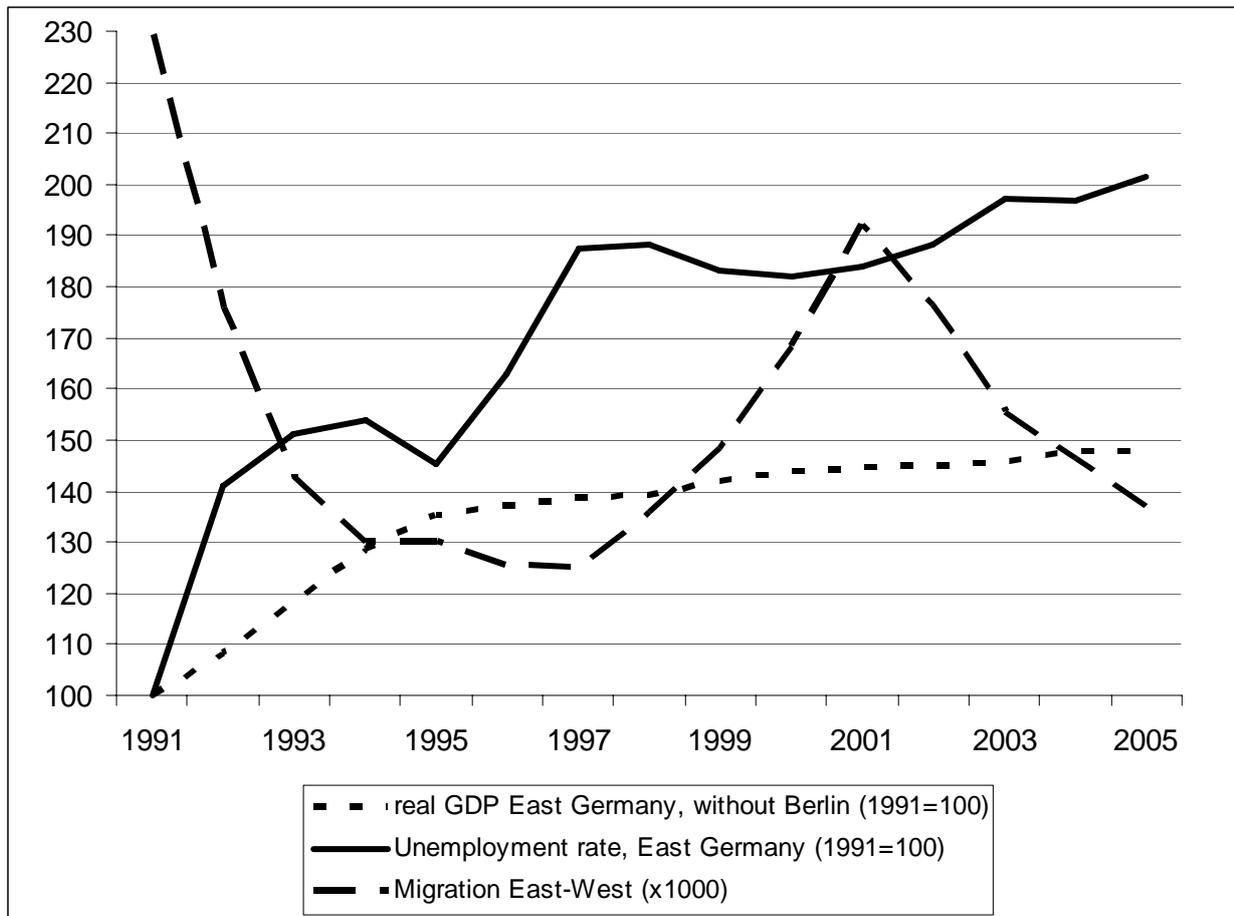
Based on samples taken from the SOEP, our findings indicate that between 1992 and 2005 the average gross hourly wage of prime age dependent workers living and working in East Germany increased by 52 percent, whereas it increased only by 9 percent for workers in West Germany. While the group of stayers receives on average between 70 and 75 percent, migrants receive 95 to 100 percent and commuters 85 percent of the wages of their West German statistical twins. Interestingly, wage inequality among East German workers today is higher when compared to their West German colleagues. For prime age dependent workers, living and working in East Germany, the ratio of wages for high wage workers, as measured by the ninetieth percentile of the wage distribution, and low wage workers, as measured by the tenth percentile of the wage distribution, increased from 2.00 to 2.93 between 1992 and 2005, and from 2.40 to 2.85 in West Germany. In terms of price flexibility, labor markets seem to be a long way of from functioning as auction markets and even among two regions as close as East and West Germany wage disparity persists. Significant forces are shaping Germany's wage distribution through commuting and migration and equalization takes time.

The paper is organized as follows: Section 2 gives an overview on migration, unemployment, wages and productivity after unification in East Germany. Section 3 introduces the data and the samples drawn from SOEP. Section 4 is concerned with the regression and matching methods employed. In Section 5 we discuss the empirical results. Section 6 concludes.

## **2 Migration and Aggregate Dynamics after Unification**

In East Germany privatisation and restructuring of state enterprises and wage bargaining took place since the formation of a monetary union on July 1<sup>st</sup> 1990. Because eastern unions were strongly connected with the old system of the former German Democratic Republic, western unions installed a bargaining system similar to the one in West Germany. Since firms were in a process of privatization their bargaining power was rather weak. After reunification, western unions feared wage competition in West Germany through labor migration while western employers were afraid of competition from newly founded firms in East Germany. The result was a rapid rise of wages after reunification and a high rate of unemployment (Akerlof et al. 1991, Sinn and Sinn 1992).

**Figure 1: GDP and Unemployment in East Germany and Migration to the West, 1991-2005**



Source: Statistisches Bundesamt, 2006, Statistische Ämter der Länder, 2005; own calculation.

Figure 1 shows the development of GDP, the unemployment rate for East Germany and the gross migration flows to West Germany between 1991 and 2005. Nominal GDP in East Germany (without Berlin) was 107 billion Euros in 1991. At that time 7 percent of the German GDP was generated in the East (2007: 278 billion Euro, 11.5 percent of GDP). GDP in East Germany first increased rapidly and then stabilized in the mid 1990s. Until 1995 the wage level in East Germany increased to 70 percent of the western level and remained at that level in the following years. Similarly, labor productivity rose to 70 percent of the western level, while GDP per capita increased to only 65 percent. Unemployment rates increased from 10.2 percent in 1991 to 20.6 percent in 2005 (and since then decreased to 15.1 percent in 2007).

Migration to the West (without Berlin) was highest in 1991 with 229,200 persons (compared to 63,800 who migrated from West to East Germany in the same year), decreased to 124,900 persons in 1997, increased again to 192,000 in 2001 and finally decreased to 137,200 in 2005. Between 1989 and 2001, 7.5 percent of the population in East Germany migrated to West Germany (Brücker and Trübswetter

2007). In 1989, migration reached levels (around 3 percent of the East German population, Pischke et al. 1994), nearly as high as before the closing the border in Berlin in 1963. Favourite destinations in West Germany are neighbouring regions like Hesse for workers from Thuringia or economical stronger regions like Bavaria, Baden-Wuerttemberg or North Rhine-Westphalia (Heiland 2004). Between 1990 and 1995, wage mobility was higher in the eastern than in the western part of Germany (Gernandt and Pfeiffer 2007, Hauser and Fabig 1999, Hunt 2001).

Migrants are often better educated compared to commuters, and commuting sometimes is a first step to migration. Economic incentives for migration from East to West Germany result from job better opportunities and higher wages in West Germany, despite the fact that migrants are likely to lose some of their more specific human capital (Burda et al. 1998, Brücker and Trübswetter 2007, among others). In general, Young and highly skilled workers in East Germany have gained from reunification (Bird et al. 1994, Franz and Steiner 2000), while for workers born between 1935 and 1945 the labour market situation has often changed to the worse (Hauser and Wagner 1996).

### 3 Data and Descriptive Analysis

For the purpose of the analysis, we make use of a sample from the German Socio-Economic Panel (SOEP)<sup>1</sup> for the period from 1992 to 2005.<sup>2</sup> We restrict the sample to dependent workers (not self-employed), aged between 25 and 55, who are wage-workers (in a cross-section) and hold German citizenship. All observations with missing information on household residence in 1989, workplace residence between 1992 and 2005, wages, and controls have been excluded.<sup>3</sup> The variable real gross hourly wage is obtained by the division of last month's salary by last month's work hours, including reported overtime.<sup>4</sup> Wages are trimmed by the two percent highest and lowest observations on hourly wages.

For our investigation of wage convergence and inequality, we further extract four samples for each year (see *Table 1*). Sample 1 (referred to as West Germans) contains workers who live in West Germany, who already lived there before unification (1989) and who do not commute for working to East Germany in a cross-section. This is the largest sample. Sample 2 (referred to as East Germans) contains cross-

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<sup>1</sup> See Haisken-DeNew and Frick (2005).

<sup>2</sup> SOEP-Samples 4 and 7 have been omitted. Sample 4 focuses on immigrants to West Germany between 1984 and 1993 (mainly foreigners). There are no immigrants to East Germany. Sample 7, which is available only for 2002, 2003 and 2004, is an expansion of the SOEP and contains mostly high wage earners. Several tests to check the sensitivity of the selected sample have been performed. Inclusion of sample 4 does not alter our findings. Sample 6 is included to exploit the total number of observations available in the SOEP.

<sup>3</sup> Since 1999 there are more observations with missing information about household residence in 1989.

<sup>4</sup> All wages are deflated with the Consumer Price Index for Germany, base year 2000, Statistisches Bundesamt (2006).

section observations of workers living in East Germany, who lived there before unification and who are working in East Germany. Sample 3 (referred to as Migrants) encompasses former East Germans who migrated to West Germany and also work in West Germany. The last sample (referred to as commuters) contains East Germans who lived in East Germany before the unification and still live there in the observation period but commute to work to West Germany. Samples 3 and 4 contain the lowest number of observations.

**Table 1: Mean real gross hourly wages in Euro in the four samples**

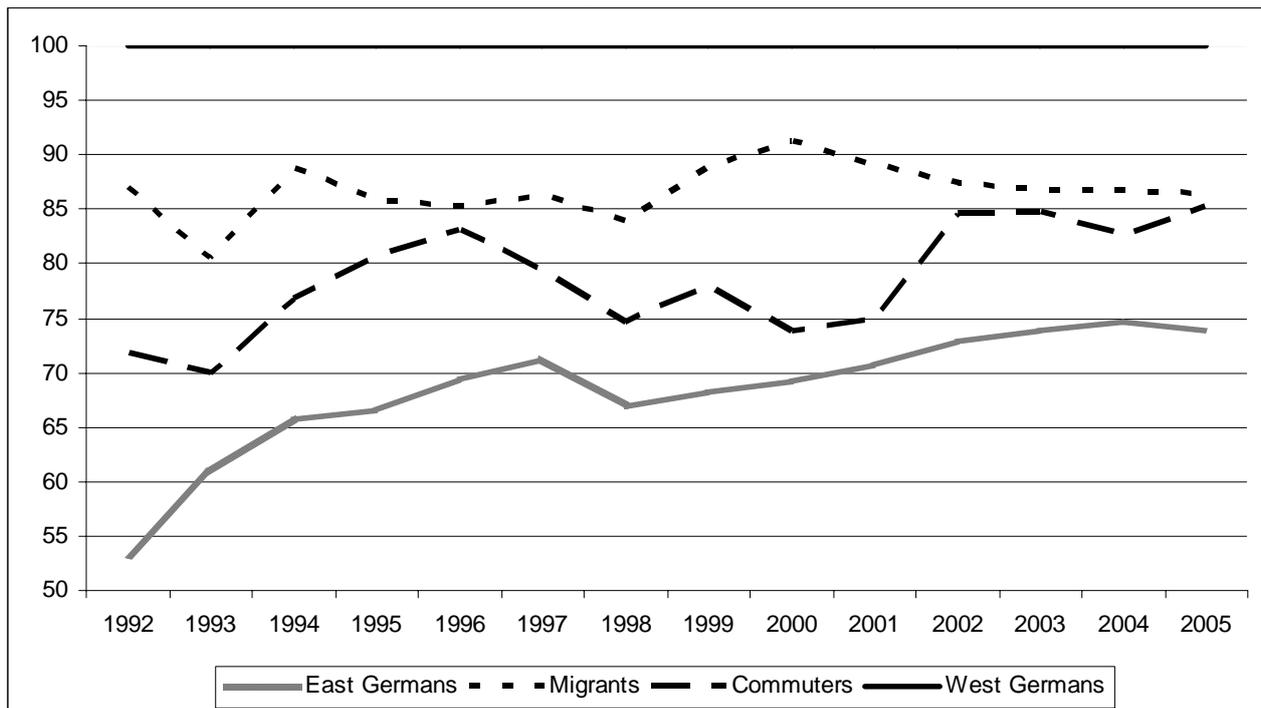
	<b>West Germans (Sample 1)</b>		<b>East Germans (Sample 2)</b>		<b>Migrants (Sample 3)</b>		<b>Commuters (Sample 4)</b>	
	<b>N</b>	<b>Euro, 95% confidence interval</b>	<b>N</b>	<b>Euro (ratio to West Germans), 95% confi- dence in- terval</b>	<b>N</b>	<b>Euro (ratio to West Germans), 95% confi- dence inter- val</b>	<b>N</b>	<b>Euro (ratio to West Germans), 95% confi- dence inter- val</b>
<b>1992</b>	1,585	12.96 12.75 – 13.18	1,582	6.88 (53%) 6.77 – 6.98	34	11.29 (87%) 9.95 – 12.63	82	9.31 (72%) 8.74 – 9.89
<b>1993</b>	1,628	13.24 13.02 – 13.45	1,415	8.04 (61%) 7.90 – 8.19	53	10.67 (81%) 9.96 – 11.78	87	9.25 (70%) 8.63 – 9.86
<b>1994</b>	1,677	13.24 13.03 – 13.45	1,341	8.72 (66%) 8.57 – 8.87	63	11.74 (89%) 10.76 – 12.72	85	10.15 (77%) 9.52 – 10.78
<b>1995</b>	1,695	13.52 13.30 – 13.74	1,309	9.01 (67%) 8.84 – 9.18	79	11.62 (86%) 10.76 – 12.47	84	10.90 (81%) 10.15 – 11.65
<b>1996</b>	1,721	13.55 13.33 – 13.77	1,245	9.41 (69%) 9.22 – 9.59	87	11.54 (85%) 10.71 – 12.37	79	11.25 (83%) 10.55 – 11.94
<b>1997</b>	1,747	13.35 13.14 – 13.56	1,173	9.51 (71%) 9.31 – 9.70	91	11.51 (86%) 10.62 – 12.40	90	10.61 (79%) 9.89 – 11.33
<b>1998</b>	1,821	13.58 13.37 – 13.79	1,092	9.76 (72%) 9.54 – 9.97	89	12.22 (90%) 11.28 – 13.16	91	10.87 (80%) 10.07 – 11.67
<b>1999</b>	1,177	14.01 13.75 – 14.28	550	9.57 (68%) 9.26 – 9.87	58	12.45 (89%) 11.20 – 13.69	69	10.91 (78%) 10.16 – 11.65
<b>2000</b>	2,150	14.21 14.01 – 14.41	709	9.85 (69%) 9.58 – 10.11	86	12.95 (91%) 11.91 – 13.98	82	10.47 (74%) 9.73 – 11.22
<b>2001</b>	2,031	14.22 14.01 – 14.44	676	10.06 (71%) 9.77 – 10.36	90	12.65 (89%) 11.66 – 13.65	104	10.65 (75%) 9.84 – 11.46
<b>2002</b>	3,745	14.07 13.90 – 14.24	1,375	10.27 (73%) 10.06 – 10.49	184	12.29 (87%) 11.61 – 12.96	123	11.90 (85%) 11.15 – 12.66
<b>2003</b>	3,681	14.45 14.27 – 14.62	1,275	10.67 (74%) 10.43 – 10.90	202	12.53 (87%) 11.82 – 13.24	145	12.25 (85%) 11.50 – 12.99
<b>2004</b>	3,585	14.28 14.10 – 14.46	1,252	10.68 (75%) 10.44 – 10.93	210	12.39 (87%) 11.73 – 13.06	144	11.78 (82%) 11.07 – 12.49
<b>2005</b>	3,325	14.14 13.96 – 14.32	1,167	10.46 (74%) 10.20 – 10.72	209	12.21 (86%) 11.54 – 12.88	145	12.04 (85%) 11.32 – 12.75

Source: Samples taken from the SOEP 1992-2005, see text; own calculations.

Wages are highest for workers living and working in West Germany (West Germans and Migrants from East Germany), followed by workers who commute to West

Germany (see *Table 1* and *Figure 2*). Workers living and working in East Germany earn between 53 percent (in 1992) and 75 percent (later on) of West Germans. Former East Germans, who migrated to the West, as well as commuters, earn higher wages. The differences between real wages for West German workers and the three other groups of workers are statistically significant as indicated by the 95 percent confidence intervals shown in *Table 1*.

**Figure 2:** Wage convergence between 1992 and 2005: East Germans, Migrants and Commuters compared to West Germans



Source: Samples from SOEP 1992-2005, see text; own calculations.

In 2005, workers who work and live in West Germany, and also lived there before reunification, earned on average 14.14 € per hour, workers who live and work in East Germany, and also lived there before reunification, earned 10.46 € (74 percent of West German wages). Workers who migrated from East to West Germany earned on average 12.21 € (86 percent of West German wages) and workers who commute to work from East to West Germany earned 12.04 € (85 percent of West German wages). The hourly wage of commuters is higher when compared to stayers but lower when compared to migrants. *Figure 2* shows the evolution of the wage gap relative to West Germans. Migrants earn about 86 percent of western wages, commuters approached this wage in the last years and East Germans in all years earned the lowest wages. Interestingly, the gap between East Germans, migrants and commuters narrowed. In the econometric part, in section 5, we will compare East Germans, migrants and commuters to their statistical West German twins.

*Figure 3* shows the wage distribution for the four samples of workers (West Germans, East Germans, Migrants and Commuters) for selected years (1992, 1994 and 2005) to illustrate the evolution of wages and their distribution over time. The figures indicate the usual shape of wage distributions and a stronger compression of East German wages. The evolution over time suggests some degree of wage convergence, although a closer look (especially on the right side of the distributions) reveals that considerable differences remain. Wages for East Germans were less dispersed in 1992 compared to 2005. After more than ten years of convergence the inequality of wages increased again in East Germany and is today even higher than in the West German wage distribution. The wages of the migrants show a much higher degree of similarity to the wages of the West Germans already in 1992.

The vector of observables for the wage regression and matching procedures contains formal educational qualification, firm size, potential experience, tenure, indicators of economic sectors, an indicator variable which equals one if the worker is born in 1975 or later and zero otherwise and a variable which indicates whether the worker still works in the job of his first educational qualification. The year 1975 has been chosen because people born after 1975 have started working only after the fall of the Berlin wall. *Table 2* contains descriptive statistics for some selected variables for the years 1992 and 2005.

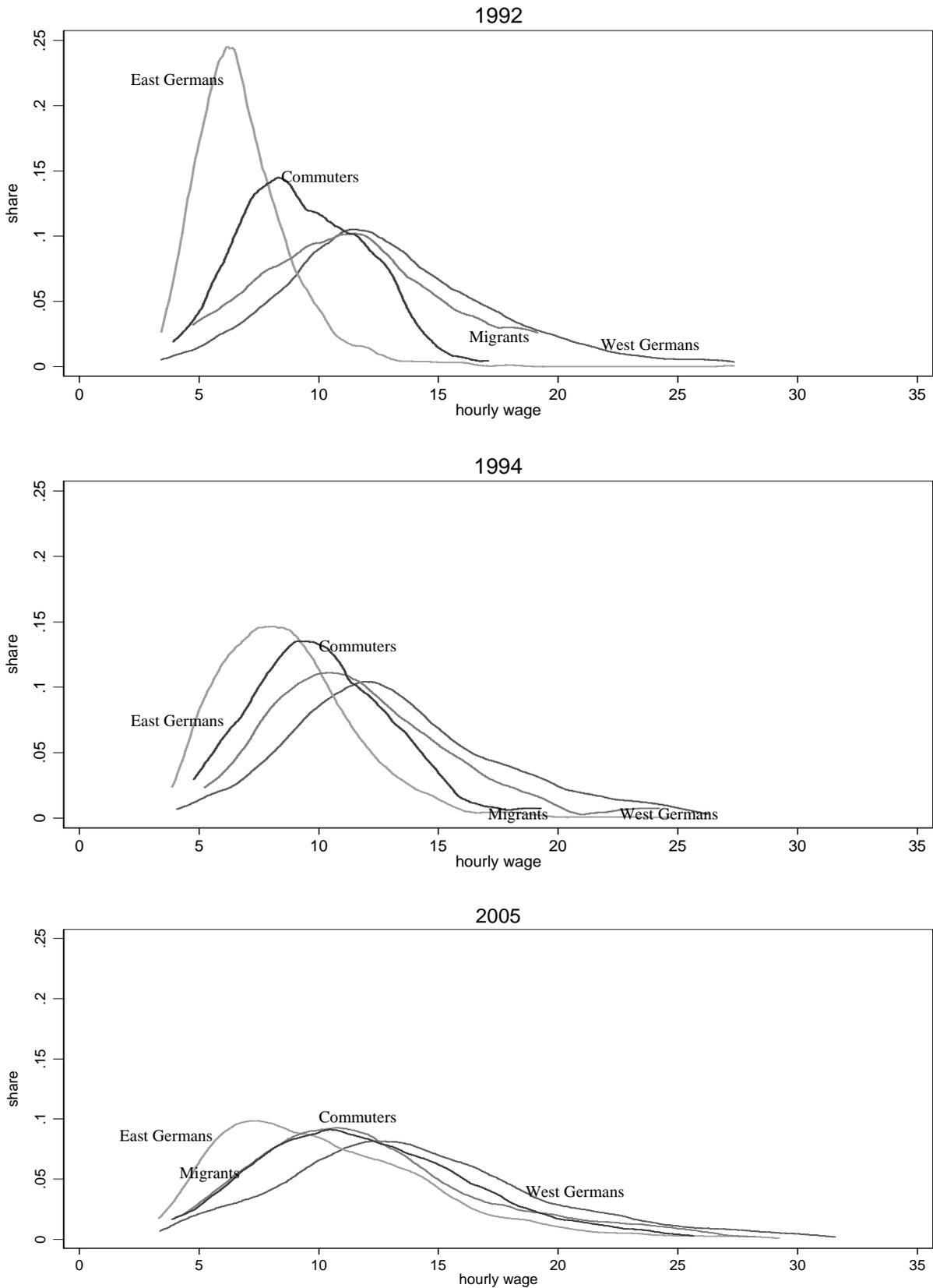
On average, workers migrating to the West are youngest (in 2005 31.10 percent are born after 1974), commuters are younger compared to East Germans who work in East Germany but significantly older than workers who migrate to West Germany. The share of working females is higher in the East (48 percent in 1992, 53 percent in 2005) compared to West Germany (43 percent in 1992, 48 percent in 2005). In 1992, only 35 percent of migrants and 18 percent of commuters were females, so females are under-represented in these groups. In 2005, females were over-represented in the migration sample, while the share of commuting females doubled since 1992 but remains below 50 percent.

Formal education has been divided into six categories<sup>5</sup>. According to this definition, East German workers are better educated than West German workers. In 2005, 29.8 percent (19.8 percent) of the workforce in our sample who lived in East (West) Germany before unification were high skilled, that means they had a degree from technical university or university. On the contrary, only 4.4 percent (9.6 percent) were low educated, meaning they had no vocational training or school degree.

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<sup>5</sup> These are: without a school qualification and without vocational training; with a school qualification but without vocational training; with a medium school qualification and with vocational training; with highest school qualification and with vocational training; with a technical university degree; with a university degree.

**Figure 3: Wage distributions for four groups of workers and selected years**



Source: Samples taken from the SOEP 1992-2005, see text; own calculations.

**Table 2:** Descriptive statistics of socio-economic characteristics, 1992 and 2005

	West Germans	East Germans	Migrants	Commuters
<b>1992</b>				
<b>Age (in years)</b>	38.89	39.79	35.65	37.43
<b>Born after 1974</b>	0%	0%	0%	0%
<b>Females</b>	42.71%	48.36%	35.29%	18.29%
<b>Low skilled</b>	13.82%	1.96%	5.88%	2.44%
<b>Skilled</b>	73.44%	65.55%	58.82%	75.61%
<b>High skilled</b>	12.74%	32.49%	35.29%	21.95%
<b>Tenure (in years)</b>	10.44	9.32	1.99	1.72
<b>Still in job of first education</b>	61.58%	60.62%	50.00%	45.12%
<b>2005</b>				
<b>Age (in years)</b>	41.21	41.99	37.22	39.74
<b>Born after 1974</b>	9.68%	11.57%	31.10%	16.55%
<b>Females</b>	47.76%	53.38%	54.55%	35.86%
<b>Low skilled</b>	9.62%	4.28%	5.26%	4.14%
<b>Skilled</b>	70.56%	64.01%	74.16%	68.28%
<b>High skilled</b>	19.82%	31.71%	20.57%	27.59%
<b>Tenure (in years)</b>	11.55	10.80	6.02	8.05
<b>Still in job of first education</b>	62.32%	61.27%	56.94%	57.93%

Low skilled: education categories 1 and 2 - workers without vocational training; Skilled: education categories 3 and 4 – workers with vocational training; High skilled: education categories 5 and 6 – workers with a degree from (technical) university. Source: Samples from SOEP 2000-2005, see text; own calculations.

Potential experience is defined as age minus years of education minus 6. It is the time a worker is potentially active in the labor market to gain human capital. We define 17 categories: less than or equal to 3 years of potential experience, 4-6 years, 7-9 years and so on till more than 48 years. Tenure is often regarded as a proxy for specific human capital and is divided into 13 categories: less than or equal to 3 years, 4-6 years, 7-9 years and so on. The highest category is more than 36 years of tenure. Potential experience is comparable between East (21.33 years in 1992, 23.05 years in 2005) and West Germans (21.24 years in 1992, 22.86 years in 2005) while tenure is higher for West Germans (10.44 years in 1992; 11.55 years in 2005) compared to East Germans (9.32 years in 1992, 10.80 years in 2005). Migrants and commuters have the lowest tenure, a result of job changes going hand in hand with migrating or commuting. In 2005, tenure increased, so there seems to be job stability and especially commuters seem to commute to the same employer for a longer time. Migrants to the West change their job more often compared to West and East Germans.

When compared to East Germany, more West German workers are still working in the job of their first educational qualification. In 1992, 50 percent of migrants and 45 percent of all commuters were still working in the job of their first occupation training. These shares increased until 2005 as a result of the increasing share of workers who were educated after reunification. Workers who were born before 1975 have potentially been employed in East Germany before unification. They may thus have a higher attachment to the East German labor market and region.

Firm size is measured by 4 categories<sup>6</sup>. There is a tendency towards smaller enterprises in both German regions. However, in East Germany more workers are employed in firms with less than 200 employees (59.3 percent in 2005), while in West Germany more workers are employed in firms with more than 2000 employees (48 percent in 2005). In addition, we control for 11 economic sectors. More East German workers are engaged in agriculture/ mining and construction while more West German workers are engaged in industry sectors and in finance/ business services.

Are these variables enough to identify similar workers in East and West Germany? From our point of view the variables are sensible indicators of human capital. Although their content may differ to some degree, taken together and given the amount and richness of our vector of observables, we think that our matching approach contributes to the understanding of wage convergence. On the one hand, there are possible differences in the meaning of the employment history before reunification and the educational degrees in East Germany. On the other hand, East and West Germans once were unified and despite the separation after World War Two they share the same language, similar working attitudes and history.

## **4 An Econometric Framework**

To analyze the evolution of wage convergence and wage inequality in the four groups of workers we employ a non-parametric matching procedure. The basic idea is to generate samples of West German workers, living and working in West Germany since before reunification, who are similar with respect to the observable characteristics of East German workers. First, we employ a matching procedure to generate a sample of West German workers that is similar to the group of East German workers, living and working in East Germany for each year starting in 1992 and ending in 2005. In these new samples of East and West German statistical twin workers we study wage convergence and the evolution of inequality. Second, we employ a matching procedure to generate a sample of West German workers that is similar to the group of East German workers, who migrated to West Germany.

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<sup>6</sup> These are: Small firms with less or equal than 19 employees; medium-sized firms with 20-199 employees; large firms with 200-2000 employees; Very large firms with more than 2000 employees.

Third, we employ a matching procedure to generate a sample of West German workers that is similar to the group of East German workers, who live in East Germany and commute to work to West Germany. The second and third part of the analysis is restricted to the cross-sections from 2000 to 2005. In earlier cross-sections there are too few observations.

The matching procedure for part one, concerning sample 1 (West Germans) and sample 2 (East Germans) shall be briefly described (for an introduction to the evaluation literature see Blundell et al. 2005 or Lechner and Pfeiffer 2001). Living in East Germany (currently and before unification) and working in East Germany is our “treatment” group of workers ( $D=1$ ). The matched group of workers ( $D=0$ ) is chosen from the sample of workers who live in West Germany, lived there before unification and currently work in West Germany.

For the purpose of our investigation we interpret the difference in wages from East German workers and West German statistical twin workers as evidence on wage convergence with respect to the observed characteristics (and not as an average treatment effect). If there no longer remains any difference between the groups compared, then this is interpreted as evidence on wage convergence. Our analysis is not restricted to means or variances, since we compare the evolution of the entire wage distribution over time.

The following matching procedure is used<sup>7</sup>:

1. An observation is drawn from the pool of workers living in East Germany since before reunification.
2. For these workers the nearest neighbour is determined (identified by the propensity score) from the pool of workers living in West Germany since before reunification.
3. The worker from the West German sample, drawn in step two, is deleted (matching without replacement).
4. Steps 1-3 are repeated for all East German workers.
5. Finally, matches of bad quality are excluded<sup>8</sup>.

This procedure functions well in identifying West German workers who are similar in observable characteristics to the three groups of workers from East Germany. After matching, the two groups of workers are statistically identical with respect to the means of all observed characteristics (the detailed results are available from the authors upon request).

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<sup>7</sup> Estimation was performed with STATA (psmatch2, see Leuven and Sianesi 2003).

<sup>8</sup> Observations are deleted if the difference of the propensity scores exceeds 0.05.

## 5 Empirical Findings on Convergence and Inequality

*Table 3* contains the results for four selected cross-sections, 1992, 1994, 2000 and 2005 of West German workers (sample 1 in the first line), East German workers (sample 2, second line) and their West German statistical twin workers (third line). Our measure of wage inequality is the ninetieth to tenth percentile of real gross hourly wage, as well as its two sub-groups, the ninetieth to fiftieth, and fiftieth to tenth percentile of the wage distribution.

Mean wages of East German workers are significantly lower in each cross-section when compared to West German workers in general and their West German statistical twin workers in particular. The differences remain significant, which can be seen by comparing the 95 percent confidence intervals in *Table 3* (in brackets). In 2005, East German workers earn about 74 percent of the wage of their West German statistical twins, starting from 51 percent in the year 1992. Interestingly there is no measurable difference between the mean wages of West German workers and West German statistical twin workers. Therefore, our findings indicate that the observed wage differentials between East and West German workers are not attributable to differences in the structure of the socio-economic characteristics. For the large group of East German workers, who continue working in East Germany, wage convergence has not taken place after the first 15 years of transition. The labor market returns to similar observed characteristics still differ to a significant degree between East and West Germany.

Our results for commuters and migrants have to be interpreted with caution, since they are based on fewer observations, *Table 4*. Having said this, a clear picture emerges from the matching approach. First, migrants from East to West Germany earn the same wages as their West German statistical twins. A similar set of characteristics results in similar wages. The hypothesis that wages between migrants and West German statistical twins significantly differ, can be rejected in all years as seen by comparing the 95 percent confidence intervals in *Table 4* which do overlap. Lower average wages in the group of migrants are therefore caused by differences in individual characteristics, such as lower tenure or working in smaller companies. Second, commuters earn about 85 percent of their West German statistical twin workers and the difference in wages is significant (with the exception of the years 2002 and 2005, which can be seen by comparison of the 95 percent confidence intervals given in *Table 4* in brackets).

**Table 3:** Wage convergence and wage inequality: East German workers, West German workers, and West German statistical twins

	Mean wage in €	90/10 percentile	90/50 percentile	50/10 percentile	N
<b>1992</b>					
West Germans	12.96 (12.75 – 13.18)	2.40 (2.25 – 2.54)	1.52 (1.48 – 1.56)	1.57 (1.49 – 1.66)	1,585
East Germans <sup>a</sup>	6.75 (6.61 – 6.89) (51%)	2.01 (1.90 – 2.12)	1.46 (1.39 – 1.52)	1.38 (1.33 – 1.43)	904
West Germans statistical twins	13.11 (12.82 – 13.40)	2.32 (2.17 – 2.47)	1.52 (1.46 – 1.58)	1.53 (1.45 – 1.61)	904
<b>1994</b>					
West Germans	13.24 (13.03 – 13.45)	2.34 (2.24 – 2.44)	1.51 (1.46 – 1.56)	1.55 (1.51 – 1.60)	1,677
East Germans <sup>a</sup>	8.56 (8.37 – 8.76) (64%)	2.26 (2.13 – 2.39)	1.45 (1.39 – 1.51)	1.56 (1.50 – 1.62)	805
West Germans statistical twins	13.35 (13.04 – 13.66)	2.49 (2.36 – 2.63)	1.58 (1.50 – 1.65)	1.58 (1.53 – 1.64)	805
<b>2000</b>					
West Germans	14.21 (14.01 – 14.41)	2.43 (2.34 – 2.52)	1.54 (1.50 – 1.58)	1.58 (1.53 – 1.63)	2,150
East Germans <sup>a</sup>	9.91 (9.61 – 10.20) (72%)	2.63 (2.45 – 2.82)	1.62 (1.54 – 1.70)	1.63 (1.52 – 1.73)	606
West Germans statistical twins	13.80 (13.42 – 14.19)	2.60 (2.38 – 2.82)	1.60 (1.52 – 1.67)	1.63 (1.52 – 1.75)	606
<b>2005</b>					
West Germans	14.14 (13.96 – 14.32)	2.85 (2.75 – 2.96)	1.60 (1.56 – 1.63)	1.79 (1.73 – 1.84)	3,325
East Germans <sup>a</sup>	10.52 (10.25 – 10.80) (74%)	2.90 (2.71 – 3.08)	1.70 (1.60 – 1.79)	1.70 (1.64 – 1.77)	1,022
West Germans statistical twins	14.16 (13.83 – 14.50)	2.80 (2.58 – 3.02)	1.61 (1.55 – 1.67)	1.74 (1.62 – 1.85)	1,022

Source: Samples from SOEP 1992-2005, see text; own calculations; 95 percent confidence interval and percentage to West German statistical twins in brackets; confidence intervals for percentile ratios are calculated by bootstrapping (1,000 replications); <sup>a</sup> Only East German workers with a matched West German statistical twin.

We summarize our findings so far in *Figure 4*. Full wage convergence between East and West German workers has taken place in the group of migrants from East to West Germany. Nearly full wage convergence occurred in the group of commuters from East Germany to West Germany. For the largest group of workers, those workers who still work in East Germany, we have to reject the hypothesis of wage convergence.

**Table 4:** Wage convergence in the groups of migrants and commuters

	Migrants		West Germans statistical twins	Commuters		West Ger- mans statisti- cal twins
	N	Euro, 95% con- fidence interval (ratio to West Germans)	Euro, 95% Confidence Interval	N	Euro, 95% con- fidence interval, (ratio to West Germans)	Euro, 95% confidence interval
<b>2000</b>	85	12.97 (11.92 – 14.01) (103%)	12.64 (11.69 – 13.60)	80	10.46 (9.71 – 11.22) (83%)	12.63 (11.52 – 13.74)
<b>2001</b>	89	12.71 (11.71 – 13.71) (94%)	13.55 (12.50 – 14.60)	97	10.70 (9.86 – 11.54) (86%)	12.45 (11.61 – 13.29)
<b>2002</b>	178	12.36 (11.67 – 13.05) (95%)	13.02 (12.20 – 13.85)	120	11.93 (11.17 – 12.69) (88%)	13.54 (12.56 – 14.51)
<b>2003</b>	189	12.42 (11.71 – 13.14) (93%)	13.39 (12.67 – 14.11)	131	12.20 (11.43 – 12.97) (84%)	14.55 (13.59 – 15.51)
<b>2004</b>	205	12.46 (11.79 – 13.13) (100%)	12.41 (11.71 – 13.11)	142	11.80 (11.09 – 12.52) (87%)	13.56 (12.66 – 14.45)
<b>2005</b>	199	12.28 (11.58 – 12.97) (97%)	12.68 (11.96 – 13.40)	141	12.03 (11.30 – 12.76) (89%)	13.45 (12.52 – 14.37)

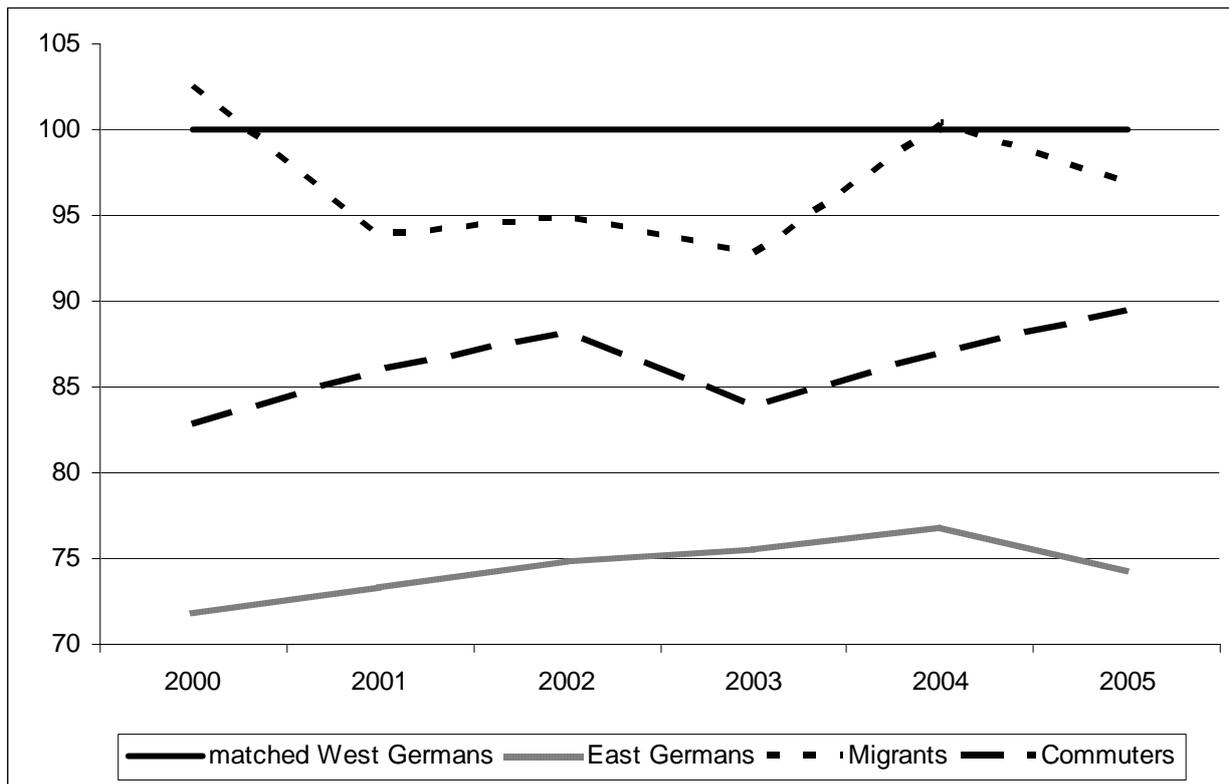
Source: Samples from SOEP 1992-2005, see text; own calculations.

Our additional analysis deals with the evolution of wage inequality. Among West German workers the ratio of the ninetieth to tenth percentile first decreased from 1984 to 1992, indicating moderate wage compression (Gernandt and Pfeiffer 2007). Since around 1993/94, the year of a severe recession after the unification boom, wage inequality has increased in both parts of Germany. In our samples, (see *Table 3*) over the period from 1992 to 2005 wage inequality, measured by the ninetieth to tenth wage percentile ratio, has increased by 19 percent (from 2.40 to 2.85) in West Germany and by 44 percent in East Germany (from 2.01 to 2.90). In West Germany inequality increased stronger below, in East Germany above the median.

Compared to West German workers, wage inequality was lower in the sample of East German workers in 1992. Today, our measures of wage inequality show no longer any significant differences between East and West German workers and between East German workers and their West German statistical twins. In both parts of Germany, the degree of wage inequality seems to have converged. We summarize some of these findings in *Figure 5*. The figure shows the wage distribution for East and West German workers and for the West German statistical twin workers of the

East German workers. *Figure 5* nicely illustrates that there is no difference in the wage distribution between West German workers and the West German statistical twins of East German workers. In addition, it shows that the shape of the wage distribution of East German workers converges to the shape of West German workers.

**Figure 4:** Wage convergence of East German workers with their West German statistical twins between 2000 and 2005

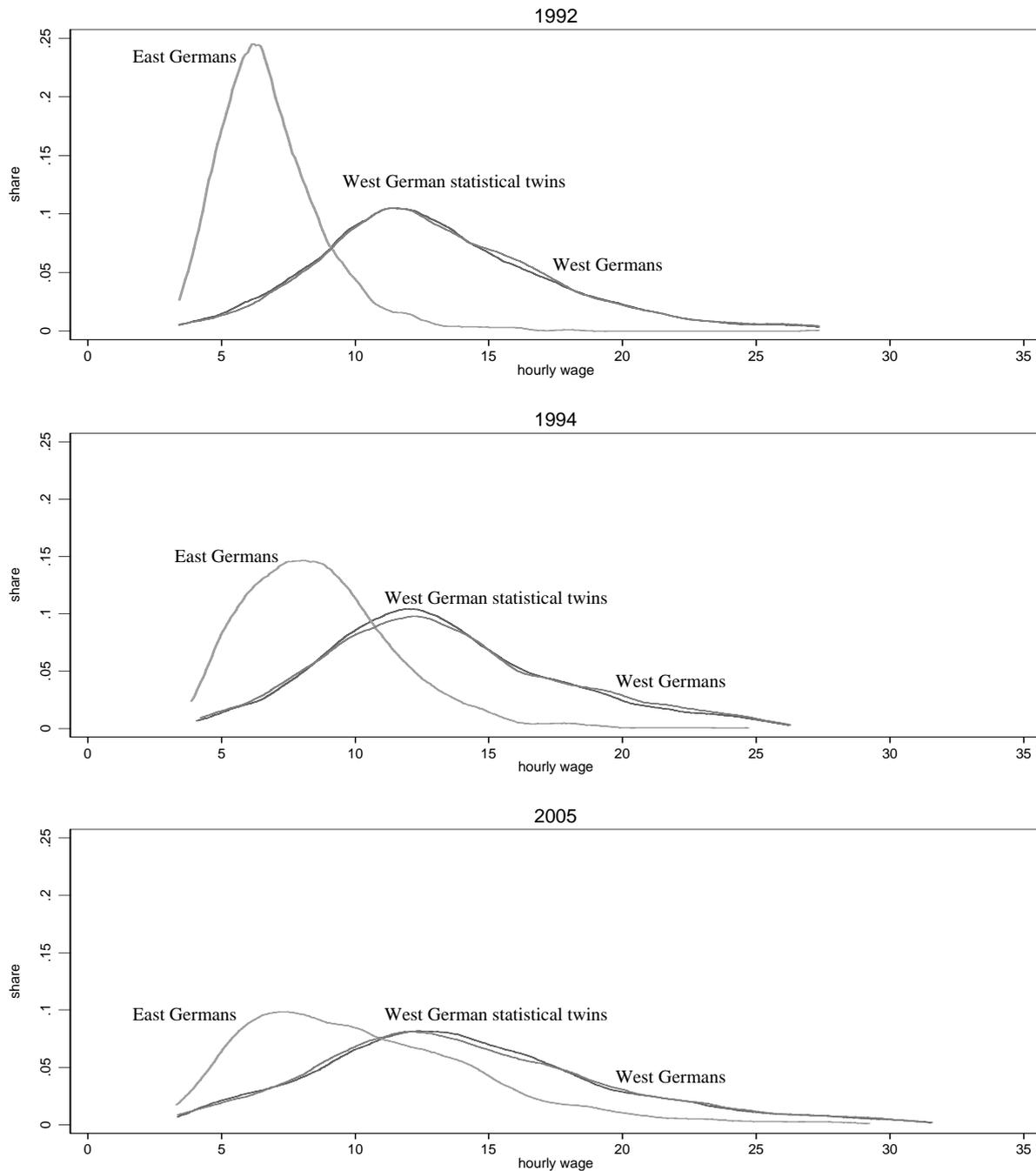


Source: Samples from SOEP 2000-2005, see text; own calculations.

To further investigate price, composition and residual factors behind the evolution of wage inequality we employ the Juhn et al. (1993) decomposition method. *Table 5* contains the results for these three factors from 1994 to 2005, with the base year 1994. In East Germany, wage inequality measured by the ninetieth-tenth wage percentile ratio increased by 0.248 log points. A larger part of the increase, 0.159 log points, took place above the median. In West Germany, wage inequality increased by 0.197 log points. A larger part of the increase, 0.141 log points, took place below the median. In West Germany, rising wage inequality is mainly driven by residual (0.101 log points) and price effects (0.028 log points), in East Germany price effects (0.159 log points) are the most important reason for rising wage inequality followed by residual effects (0.087 log points). The evolution of wage inequality in the group

of West German statistical twin workers shows more similarities to the development of West German workers as compared to East German workers.

**Figure 5:** The evolution of wage distributions for East and West German workers



Source: Samples from SOEP 1992-2005, see text; own calculations.

**Table 5:** Composition, price and residual effects, 1994-2005

<b>Differential</b>	<b>Total</b>	<b>Quantities</b>	<b>Prices</b>	<b>Unobserved</b>
<b>West Germans</b>				
<b>90-10</b>	0.197	0.028	0.068	0.101
<b>90-50</b>	0.056	-0.007	0.021	0.041
<b>50-10</b>	0.141	0.035	0.047	0.060
<b>East Germans</b>				
<b>90-10</b>	0.248	0.002	0.159	0.087
<b>90-50</b>	0.159	0.024	0.095	0.040
<b>50-10</b>	0.089	-0.022	0.064	0.047
<b>West German statistical twins</b>				
<b>90-10</b>	0.116	-0.028	0.054	0.091
<b>90-50</b>	0.024	-0.035	0.027	0.031
<b>50-10</b>	0.093	0.007	0.026	0.060

Source: SOEP 1994-2005, see text; own calculations.

## 6 Concluding Remarks

German reunification might become a paradigm of convergence and integration of neighbouring regions with unequal starting conditions. One of the most ambitious political goals has been the equalisation of living conditions and wages in both parts of Germany. What has happened to wages and wage convergence after 15 years of transition? Do labor markets in two neighbouring regions such as East and West Germany function in such a way that wage convergence takes place?

In this study, we empirically compare the evolution of wages and wage inequality after reunification in both parts of Germany. In particular, we compare three groups of workers who lived in East Germany in 1989, defined as stayers, migrants and commuters to West Germany, and groups of West German statistical twin workers, all taken from the Socio-Economic Panel (SOEP) 1992-2005. Regression analysis, non-parametric matching methods and graphical presentations are employed to study wage convergence and inequality. Our findings indicate that for the largest group of workers, those workers who still work in East Germany, the hypothesis of wage convergence has to be rejected. After 15 years of transition wages for East and West German workers with similar characteristics did not converge. However, full wage convergence between East and West German workers has taken place in the group of migrants from East to West Germany. And, nearly full wage convergence occurred in the group of commuters from East Germany to West Germany.

Furthermore, wage inequality converged. For prime age dependent employees living and working in East Germany the ratio of wages for high wage workers, as measured by the ninetieth percentile of the wage distribution, and low wage workers, as

measured by the tenth percentile of the wage distribution, increased from 2.00 to 2.93 and is now similar to wage inequality in the group of West German statistical twin workers. We conclude that labor markets in East and West Germany still exhibit large differences in wages, but that the degree of inequality in the two regions converged.

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