

The East German Wage Structure after Transition

Robert Orlowski

and

Regina T. Riphahn

April 15, 2009

We extend the literature on transition economies' wage structures by investigating the returns to tenure and experience. This study applies recent panel data and estimation approaches that control for hitherto neglected biases. We compare the life cycle structure of East and West German wages for fulltime employed men in the private sector. The patterns in the returns to seniority are similar for the two regional labor markets. The returns to experience lag behind in the East German labor market, even almost 20 years after unification with significant differences particularly for high skill workers. The results are robust when only individuals are considered who started their labor market career in the market economy. We expect that the different returns are related to the heterogeneity of work experience gathered in East versus West Germany.

JEL Codes: J31, J24

Key words: wage structure, life cycle earnings, returns to tenure, returns to experience.

Correspondence to:

Regina T. Riphahn

Economics Department

Univ. of Erlangen-Nuremberg

Lange Gasse 20

D - 90403 Nuremberg

Germany

Email: Regina.Riphahn@wiso.uni-erlangen.de

We thank two anonymous referees, the editor, Jennifer Hunt, Katja Sonderhof as well as participants of the economics seminar at the University of Regensburg, the DFG-SPP summer school 2008, and the DFG-SPP Oct. 2008 workshop at RWI Essen for helpful comments.

1. Introduction

Much interest focuses on the adjustment of transition economies' wage structures on the path to market oriented economies. Numerous contributions investigate the development of returns to human capital in transition economies and test whether the abolition of wage grids and socialist wage compression has led to more dispersed wages and to increases in the returns to human capital (see e.g. Andrén et al. 2005, Gorodnichenko and Sabirianova Peter 2005, Flanagan 1998, Boeri and Flinn 1999, or Liu 2006). In their meta-analysis of this literature Fleisher et al. (2005) present a record of rising returns to education throughout.

However, the focus on rising returns to education might be misleading if at the same time wages remained irresponsive to other dimensions of human capital. Interestingly, only a handful of studies in this literature investigate the development of returns to tenure and experience. Among them are Jones and Ilayperuma Simon (2005) who take advantage of Bulgarian employer-employee data. They find that returns to education about doubled after transition while returns to experience stayed constant at low levels. Münich et al. (2005) look at the development of the Czech wage structure and confirm a dramatic increase in the returns to education, yet no shift in the returns to experience at the end of the communist regime. Noorikoiv et al. (1997) study the case of Estonia where returns to schooling increased sharply between 1989 and 1995 whereas the age-earnings profile flattened.

For the case of East Germany Bird et al. (1994) show that prior to unification returns to experience and tenure were half those earned in West Germany. Life cycle wage heterogeneity was much below West German levels (Krueger and Pischke 1995). Burda and Schmidt (1997, p.195) studied East German wages through 1993 and concluded that "returns to age were depressed under socialism and continue to be so (...)." Jurajda and Harmgart (2007) find that in 1995 the experience profile was considerably flatter in East than in West Germany, which is confirmed by Franz and Steiner (2000) based on data through 1997. Gathmann (2005) extended the analysis through 2000 and found that the relative East-West

wage difference was largest for experienced workers. Thus even ten years after unification the flat wage experience profile of the socialist economy had not disappeared.

A possible explanation for the different developments in the returns to human capital inherent in schooling and in labor market experience might be related to the specific adjustment coinciding with economic transition: if schooling were a valid signal for innate individual productivity it could be remunerated immediately. In contrast, socialist labor market experience may have been only of limited value and it took time for labor market experience in the market economy to accumulate value. This might explain why the adjustment in returns to experience lags behind the adjustment in returns to education.

In this study we compare the East and West German wage structures almost two decades after unification. We investigate whether systematic differences in the returns to experience and tenure in the two regional labor markets, which derive from differences in past wage setting mechanisms, have disappeared over time. This complements the literature on the transition process in East Germany, where optimistic studies from the early 1990s have been replaced by more somber assessments.¹

Our study contributes to the literature in various ways: first, in contrast to most analyses which study labor market adjustments of former socialist countries on their way to market oriented economies, in the case of Germany we can take advantage of a benchmark economy. East and West Germany since 1990 share labor market institutions in addition to history and language. Therefore East Germany is adjusting to an institutional setting which at the same time and identically determines West German labor market outcomes. This allows us to identify the consequences of a socialist heritage in a comparative perspective, which is not available for other countries. Second, we improve on the least squares approach which predominates in studies of wage structures in transition economies and account for the

¹ For recent contributions see Snower and Merkl (2006) or Uhlig (2006, 2008). For accounts of German unification and its labor market aspects see e.g. Steiner and Bellman (1995), Burda and Schmidt (1997), Franz and Steiner (2000), Burda and Hunt (2001), Hunt (2001), Spitz-Oener (2007), or Burda (2006, 2008).

endogeneity of tenure and experience. We apply the more advanced estimators of Altonji and Shakotko (1987) and Topel (1991). The former uses an instrumental variables technique while the latter identifies returns to tenure and experience in a two step procedure assuming exogenous job changes. Estimates based on these procedures at times differ vastly from biased least squares results and in our case the biases may well differ for East and West Germany. Third, we take advantage of recent and representative panel data on life-cycle wage structures. Finally, since Görzig et al. (2008) point to shifts in the sectoral and occupational employment structure as the main determinant of differences in wage levels in East and West Germany, we control for such composition effects.

Our results are of immediate policy relevance: German active labor market policies spend large amounts to create public employment opportunities for the East German labor force (for a survey see Fertig et al. 2006). If there are no or only low returns to experience then the payoff of expensive public employment is much lower than expected. In addition, prior analyses of transition economies' labor market adjustments may have been too optimistic when they built their conclusions on the increasing returns to schooling only. Taking returns to experience and tenure into account the transition processes in labor markets may be much slower than has been assumed so far.

After first confirming the results of prior studies on wage structures since unification with our data, we focus on the most recent surveys of the German Socioeconomic Panel (SOEP Group, 2001) to analyze East and West German wage structures. We provide evidence on returns to tenure and experience and investigate whether socialist labor market institutions continue to characterize East German wages. Numerous commentators interpreted the previously observed lack of returns to experience in East Germany as a consequence of the obsolescence of general human capital following reunification. We test whether these findings are due to a cohort effect that disappears when only those cohorts are considered who entered the labor market after 1990. Also, we compare wage structures of East German

workers in both regions of the country. As wage structures are generally heterogeneous across skill groups we also study East and West German life cycle wages by skill group.

Our key results are that the returns to tenure are small but similar in East and West Germany, while the experience profiles still differ substantially even after controlling for potential biases and composition effects. Particularly for medium and high skill workers returns to experience are significantly higher in West than in East Germany. Additional analyses suggest that the difference between returns to general human capital may result from differences in the average quality of this human capital rather than from differences in its regional prices. We discuss possible interpretations of this evidence, which suggests that it takes at least one generation to leave the socialist heritage behind.

2. Estimation Approach

The key challenge in identifying the causal returns to tenure and experience in a wage model is to account for the potential endogeneity of the measures of human capital. This problem has been neglected in the transition economics literature on the development of wage structures so far. Let for person i in employment j and period t

$$W_{ijt} = b_1 T_{ijt} + b_2 E_{ijt} + e_{ijt} , \quad (1)$$

where W represents the log real hourly wage, T and E represent (polynomials of) tenure and experience. Other control variables may enter (1) but are ignored here for ease of exposition. b_k are coefficients to be estimated. e_{ijt} is the error term, which is assumed to combine fixed individual effects (e_i), fixed job match effects (e_{ij}), and a random term η_{ijt}

$$e_{ijt} = e_i + e_{ij} + \eta_{ijt} . \quad (2)$$

There are several reasons why T or E may be correlated with components of the error term, which unless accounted for causes biased and inconsistent least squares estimates of the return parameters b_k : tenure may be correlated with e_i if person-specific characteristics affect the stability of employment relationships as well as wages. Also, job match-specific

unobservables e_{ij} are likely to affect the probability of quits and thereby of observed tenure. In addition, we observe only those selected new employment relationships which improve individual outcomes. An overall positive correlation between tenure and the unobservables would lead to an overestimation of the least squares coefficient.

Experience may be correlated with e_{ij} as matching and job search processes increase the probability of a good match the longer an individual is active in the labor market. This may generate a positive correlation between experience and the match specific error component e_{ij} . If individuals with specific unobserved characteristics such as motivation spend more time in the labor market, this correlation between experience and e_i may yield an overestimate of the returns to experience.

Two classic approaches to deal with these potential endogeneities are suggested by Altonji and Shakotko (AS, 1987) and Topel (1991). AS address the endogeneity of tenure using an instrumental variables approach. They instrument all tenure indicators based on the difference between the period-specific and the average value \bar{T}_{ij} for a given job match j of person i :²

$$\tilde{T}_{ijt} = T_{ijt} - \bar{T}_{ij} . \quad (3)$$

This instrument is correlated with T and uncorrelated with person- and match-specific unobservables thus solving the endogeneity problem.³ The endogeneity of experience both with respect to e_i and e_{ij} is not accounted for in this approach, which is why b_2 may be biased upward. Since tenure and experience are generally positively correlated overestimated returns to experience generate underestimated returns to tenure.

As a second estimator, we apply Topel's (1991) two-step procedure. Step one estimates average within-job annual wage growth for individuals who did not change jobs:

² There may be more than one tenure indicator due to higher order polynomial and interaction terms.

³ Dustmann and Pereira (2008) discuss an alternative approach introduced by Finnie (1999), which corrects only for the correlation between tenure and person-specific error terms. Their estimates for West German data show that the returns to tenure based on this approach (which uses the difference between T_{ijt} and the average of T_i) are between those generated by OLS and AS.

$$W_{ijt} - W_{ijt-1} = (b_1 + b_2) + e_{ijt} - e_{ijt-1} \quad (4)$$

If we estimate a model for annual wage growth the constant term reflects the sum of the returns to seniority (b_1) and to experience (b_2), because over the period of one year

$$\Delta T = \Delta E = 1^4. \quad (5)$$

The procedure generalizes to non-linear specifications of tenure and experience, where we applied second and third order polynomials. Step two then investigates the earnings of workers who started new jobs. As they have not yet accumulated seniority a cross-sectional estimation of the returns to experience of individuals with zero tenure identifies their returns to general labor market experience:

$$W_{ijt} = b_2 E_{ij0} + e_{ijt} \quad (6)$$

Here E_{ij0} reflects the initial experience of workers starting a new job. The returns to seniority are then approximated as the difference in the returns found in steps one and two of the analysis.

To obtain these estimates we follow the literature in rewriting total experience as the sum of initial experience on the new job and current tenure,

$$E_{ijt} = E_{ij0} + T_{ijt}, \quad (7)$$

which then generates the following wage equation

$$W_{ijt} = (b_1 + b_2)T_{ijt} + b_2 E_{ij0} + e_{ijt}. \quad (8)$$

The second step regression thus uses

$$W_{ijt} - T_{ijt} b^* = b_2 E_{ij0} + e_{ijt} \quad (9)$$

where b^* is the estimated value of $(b_1 + b_2)$ from step 1 (see equation 4). We additionally consider changes in a large set of control variables when estimating b^* .

⁴ Equation (5) describes changes in tenure and experience for individuals who are employed full year and who are re-interviewed exactly after one year. In the GSOEP data interview dates vary. Therefore ΔT and ΔE also take on values other than exactly one year (e.g. with a first interview in August of 2002 and a second interview in February of 2003 we obtain 6 months). Since we are able to take advantage of precise information on tenure, experience and the interview date we can consider the actually observed changes in tenure and experience when estimating $(b_1 + b_2)$. Thus our results are not affected.

Unbiased estimators result only if the groups of individuals who did not change jobs and those who started a new job are randomly selected and if their characteristics are not correlated with the unobservables. Since this is unlikely to be the case, Topel (1991) interprets his estimate of b_2 (returns to experience) as an upper bound such that the resulting estimate of b_1 (returns to tenure) is a lower bound of the returns to seniority. While both, the AS and the Topel estimators rely on restrictive assumptions, both improve on the least squares approach to estimate the returns to tenure and experience and are frequently applied in this literature (see e.g. Parent 2000, Luchsinger et al. 2003, or Dustmann and Pereira 2008).

3. Data and Descriptive Analysis

3.1 Data, Sample, and Definition of Variables

We use data taken from the German Socio-Economic Panel (SOEP Group 2001), a representative dataset on German households. The focus of our analysis is on the years 2002-2006, yet we also discuss the evidence for earlier years, starting with German unification. We consider full-time employed males, aged 25-60, who are not self-employed, not in vocational training, not in marginal jobs and who work in the private sector.⁵

Since there were some missing values in the observed gross wage, hours, and education measures we generated ten complete multiply imputed datasets which we use for all analyses. The imputation procedure fills missing values of certain variables in several steps. First, a value is drawn randomly out of the distribution of observed values. Then the random draw is replaced by predicted values which are obtained successively in twenty iteration steps (following a recommendation of van Buuren et al. 1999). The process is repeated ten times with different random draws of the starting values and generates ten

⁵ In future work we will investigate the determinants of the wage structure of female workers. Females, who make up the smaller part of the private sector work force are omitted here in order to generate a homogeneous sample and to avoid sample selection issues.

complete datasets without missing values. All ten are used in the analysis and inference procedures are adjusted following Rubin's rule (Rubin 1987 and Little and Rubin 1987).

The dependent variable measures log hourly wages in 2002 Euros. Wages are calculated based on current gross monthly incomes, which we divided by hours worked in the month of the interview. We apply current working hours because monthly income includes overtime pay and thus likely varies with the actual number of hours worked.⁶ This allows for more precise measurement compared to studies based e.g. on the Panel Study of Income Dynamics (PSID) which only provides annual incomes or studies based on German unemployment insurance data, which have no information on hours worked at the individual level beyond full-time or part-time status.⁷

Figure 1 characterizes the age-earnings profiles observed for workers in East and West Germany. It immediately suggests that the regional difference is not only one of levels but also of life-cycle patterns. Figure 2a presents the life cycle wage structures for medium skill, i.e. with completed vocational education, and high skill groups with completed tertiary education. It confirms the difference in wage levels across age groups for the two regions. To focus on the difference in the slopes of wage profiles Figure 2b depicts life cycle wages relative to the wage level obtained by the youngest age group, again separately for both regions and skill groups. The difference in relative wage increases between the two regions appears to begin with the age group of the 35-39 year olds. This may suggest that there is a cohort effect at work, which causes different valuations for labor force participation experience under the communist and the market oriented regimes. This hypothesis is tested below.

⁶ Only if the respondent did not provide the number of current hours worked the contractual working hours were applied.

⁷ Additional disadvantages of the data available from the German unemployment insurance (UI) are first that earnings are censored at about the 80th percentile of the wage distribution, second that the data is much less informative than the GSOEP in measures such as overtime hours or education, and third that work experience may be underestimated as periods in self-employment or as civil servant are not reflected in the UI data (for a discussion see e.g. Gerhardt and Pfeiffer 2007).

Our key explanatory variables are tenure and experience. Tenure measures the time spent with the current employer over all possible jobs at the monthly level. Experience measures the sum of total full-time and part-time work experience.⁸ Both, tenure and experience are measured at the same time as wages, i.e. at the annual interview. When someone participates in the GSOEP for the first time the individual is asked about tenure at the current job and retrospectively about work experience. This information provides the initial information which is updated with every subsequent interview on an annual basis. Therefore the tenure of individuals who change jobs is calculated based on observed behavior. To obtain the level of experience at the start of an ongoing job we calculate the difference between current experience and tenure: cases where the difference was smaller than minus two years were dropped.⁹ Since the data does not inform on the exact date of job terminations, the exact initial work experience when taking on a new job cannot be determined.¹⁰ Since only those individuals can be considered in the Topel estimator which are observed in at least two subsequent periods, we censor observations in the first year of missing data (e.g. due to panel attrition).

Figure 3 illustrates the distribution of tenure and experience outcomes in East and West Germany for the period 2002 to 2006: the share of East German employees with tenure

⁸ Recent studies (e.g. Parent 2000) consider industry-specific experience. In our case it could be interesting to separately control for East or West German experience. Unfortunately, our data do not provide information at this level of detail for the full sample. When respondents join the survey they are asked about their total prior work experience, but not about the region where the experience was acquired, nor about industry or occupation. Information on experience and tenure by region, occupation or industry could be coded for the time individuals participate in the panel survey, but is not available for the period prior to joining the survey. Less than one third of our East German observations joined the GSOEP at the time of unification. For these it would be possible to check whether they moved between East and West Germany and gathered different types of experience. For the majority of our East German observations we do not know where they worked in the past.

⁹ This affected about 4.5 percent of our observations. In addition, in cases where the measured experience was slightly smaller than tenure, initial experience was replaced by the value of tenure and then updated based on subsequent observations.

¹⁰ We added half of the uncertain period as additional experience and considered the other half as unemployment. If e.g. a person started a new job in October and was observed to be employed on the old job in March the termination date of the old job could be at any point between March and October. We added half of this uncertain period (three of the six months from April to September) to the prior experience value, on average 2 months. This uncertainty affected about 5 percent of all person-year observations.

above 15 years is visibly smaller than in the West. This is exactly the pattern we would expect as a consequence of German unification and of the economic shifts starting in 1989. We find a somewhat lower share of workers with many years of work experience in the East, which is likely to be a consequence of intensive early retirement programs initiated at unification.

Our specification of the wage model considers cubic terms in tenure and experience, a set of 6 indicators of highest educational attainment, immigrant status, federal state of residence (9 for West and 6 for East Germany), 12 industry indicators as well as calendar year fixed effects. The variables are described in Table 1 by subsample.

3.2 Descriptive Analysis

Before we investigate the German wage structure in most recent times we estimate the returns to tenure and experience in East and West Germany in earlier periods to replicate the results from studies cited in the introduction. Using the specification described above we estimated wage regressions for East and West German samples, separately for moving five year windows (e.g. 1992-1996, 1993-1997 etc.). We used these results to predict the wage effects of tenure and experience. They are presented in Table 2 for two non-overlapping periods and in Figure 4 for six moving and overlapping five year windows. Based on Figure 4 we confirm prior evidence in that the returns to experience in East Germany (depicted for predictions of zero vs. five and zero vs. ten years) have always been below those in the West. The returns to tenure (see Table 2) have been stable in West Germany, while in East Germany they increased from the early to the late 1990s.

Next, we extend the analysis to more recent periods and present in Table 3 the least squares results of our wage model for the time period from 2002 to 2006. For both regions the third order polynomials in tenure and experience are jointly significant mostly at the one

percent level. We applied these estimates to predict the wage effects of ten years tenure and experience. They are presented in Table 4, in columns 1 and 4 for West and East Germany. A comparison of the predicted effects yields very similar associations between seniority and wages in East and West Germany: staying with the same employer for ten years is associated with 14 percent higher wages in both regions. This indicates a stable pattern for West Germany and a drop in returns to tenure for East Germany (see Table 2 column 4). The predicted returns to experience are somewhat larger in West than in East Germany. We tested the hypothesis that the OLS parameter estimates of tenure and experience differ significantly between East and West Germany. These tests yield similar returns to tenure but significantly different returns to experience in a fully interacted model. Figure 5 plots the wage-experience profiles in East and West Germany. Figure 5a shows the levels of predicted wages. In Figure 5b predicted wages are indexed to one at five years of experience: the patterns predicted based on least squares results differ substantially between the two regions with much steeper profiles in West Germany. In addition, we tested whether predicted tenure and experience effects (in Table 4) are identical in East and West Germany. The hypothesis is rejected at the 10 percent significance level for the highest experience values.

4. Results

4.1 Main Results

Least squares results can be biased due to the correlation between covariates and error terms. Based on the discussion in section 2 it is plausible that these biases can affect East and West German estimates in different ways. East and West German labor markets differ in terms of job stability (Boockmann and Steffes 2008), the dynamics of industrial adjustment (Görzig 2008) and overall unemployment. This may affect the correlation between individual unobservables and job stability, the relevance of job-match characteristics, search behavior, and the patterns of search outcomes. Since these mechanisms determine the potential biases

of the least squares estimator the biases for East and West Germany may well differ such that the least squares results may not hold up to more advanced estimation approaches.

We apply the approaches by Altonji and Shakotko (1987) and Topel (1991) to the model specification of Table 3. The predicted impact of the first 5 and 10 years of tenure and experience are presented in Table 4 separately for the two regions. Overall, the results confirm expectations. As in much of this literature we obtain for both regions vastly reduced returns to tenure when the AS estimator is applied, they even turn negative for East Germany. The predictions are not significantly different from zero.¹¹ The returns to experience obtained with the AS estimator are very similar to the least squares results in both cases, confirming higher returns to experience in West Germany. The wage-experience profile in Figure 5 yields a somewhat dampened curvature with the AS estimator compared to OLS, while the key conclusion of flatter returns in the East than in the West remains. However, the difference between East and West German returns to experience and tenure are not statistically significant based on the AS estimator.

Next, we apply the Topel estimator which identifies the causal returns to tenure and experience if job changes are exogenous (columns 3 and 6 in Table 4).¹² The resulting returns to tenure lie between the OLS and AS results but are hardly statistically significant: we obtain a return of 7 percent to ten years of tenure for West and 13.8 percent for East Germany. The returns to experience for the West German sample are significantly different from zero throughout and much above the levels obtained for East Germany: while ten years of work experience in West Germany yield a return of 44 percent, they increase East German wages only by 22 percent. Thus, the results of the AS and Topel estimators confirm that even 20 years after reunification the life cycle earnings patterns are still substantially flatter in East

¹¹ In their analysis for Switzerland Luchsinger et al. (2003) similarly observed a drop from significant 7.5 percent wage increase with ten years of tenure based on OLS to an insignificant 1.7 percent when they applied the AS estimator. Dustmann and Pereira (2008) find a drop from a significant 12.8 percent to a small negative value for West German data from 1984-1999, as well.

¹² The regression results of the first and second step Topel estimation for the West German case are provided in Appendix Table 1.

than West Germany. Mostly likely due to the lack of precision in the estimates for East Germany we do not obtain statistically significant differences in the predicted returns to experience (or tenure) between the two German labor market regions for either of the two estimators.

According to the literature wage structures may differ substantially across skill groups. Dustmann and Meghir (2005) found that skilled workers benefit much more from general labor market experience than unskilled workers. So, if the average worker in East Germany was less skilled than his West German colleague this might have caused the observation of different returns to experience.

We repeated our analyses separately for three skill-subsamples, defining skill groups following the literature.¹³ workers without a vocational education are considered as low skill workers. We observe 5 and 13 percent of our East and West German samples in that group. Medium skill workers are those who completed a vocational degree (more than 72 and 64 percent of the East and West German samples, respectively) and high skill workers are those who hold a tertiary education degree, which is observed for about 22 percent in both regions. The mere skill distribution in the two regional subsamples does not seem to support the skill based explanation of differences in life-cycle wage structures.

The predicted returns to experience and tenure for medium and high skill groups are presented in Table 5. While Dustmann and Pereira (2008) added skill interaction terms to their specification we estimate separate equations for the different skill groups to flexibly account for potential differences in composition effects across skill groups. We do not present the results for low skill workers because they are based on very small samples which do not yield informative results. For the other skill groups the returns to tenure are somewhat mixed:

¹³ See e.g. Dustmann and Meghir (2005), Dustmann and Pereira (2008), or Fitzenberger (1999).

returns to tenure in the East exceed those in the West, in the West they are higher for medium skill workers, in the East they are higher for high skill workers.

Now, we find significantly lower returns to experience in the East than in the West for all subgroups.¹⁴ The returns to experience are higher for those with high than with medium skills. Generally, the higher returns to experience in West Germany appear to be driven by high skill workers, whose relative wage gains due to experience are about twice as high as those observed for medium skill workers.

4.2 Robustness Tests

We complement the above analyses by two immediate tests. First, we repeated all analyses after adding six categorical firm size indicators to the specification. Even though the firm size effects were jointly significant in almost all estimations they did not affect the predicted returns to tenure and experience. Second, we evaluated whether the results for East Germany in Table 4 are sensitive to controlling for third order polynomials. Since the sample size is small this might have caused some overfitting. We redid the analysis for East Germany using only second order polynomials and obtained returns to experience that were even smaller than those presented in Table 4.

As an additional test of whether the results presented above are indicative of a different wage structure in the two German regions we repeated the analysis considering only the birth cohorts born 1970 or later. These individuals' labor market history should not be affected by personal employment experience under the East German socialist regime. If we find subdued returns to experience even for them it suggests ongoing differences in the earnings structures rather than cohort effects.¹⁵ We applied the same estimation and

¹⁴ At first it seems surprising that the experience differences by skill group are more significant than in the overall sample. This appears to go back to the much smaller conditional variance of the dependent variable when skill-group specific effects are considered.

¹⁵ In addition to grouping subsamples based on the regime under which they gathered work experience it would be interesting to distinguish between those who received their education under the

prediction procedure as above, only now omitting cubic tenure and experience terms from the specification to avoid overfitting.¹⁶ The results are presented in Table 6. Our main conclusions hold up when the younger sample is considered: under least squares the returns to tenure are similar across regions, and the returns to experience are significantly higher in the West compared to the East. Under the AS estimator the returns to tenure diminish. The predictions based on the Topel procedure yield larger returns to tenure in the East and substantially larger returns to experience in the West. This suggests that the different returns to experience are not due to cohort effects but instead to systematic regional differences in the wage-structure.

4.3 Aggregate Wage Trends

One might argue that with respect to the development of individual earnings low returns to work experience can be complemented and balanced by high overall real wage increases over time. Thus if general wage trends have steeper slopes in East Germany than in the West the impact of lower returns to experience were ameliorated.

As our estimations control for the overall development in real wages we can inspect the evidence on this point. The year indicators in the least squares estimates in Table 3 illustrate *ceteris paribus* real average wage increases between 2002 and 2006 of 6.4 percent in West and 7.8 percent in East Germany, which implies annual increases of about 1.6 and 1.9 percent. While eastern wages generally grow somewhat faster this cannot balance the lower returns to experience of about 20 percentage points in ten years (cf. Tables 4 and 6).

When we compare the aggregate wage trends across skill groups, we find larger wage increases in the regressions for high skilled than for medium or low skilled workers. While

communist system versus those who were educated in the market economy. The latter group includes the birth cohorts since the mid 1980s. It seems to be too early to evaluate these individuals' returns to experience.

¹⁶ For this sample we observed mean values of tenure of 4.2 years in the East and 4.7 years in the West. Mean experience amounted to 7.6 years in the East and 8.3 years in the West.

this differs from Dustmann and Pereira's (2008) finding for the 1990s it agrees well with the overall widening of the income distribution in recent years (Dustmann et al. 2007 or Gernandt and Pfeiffer 2007). Thus, overall secular wage growth is somewhat larger in East than in West Germany. Yet in the individual life cycle this effect is too small to make up for subdued returns to experience in East Germany.

4.4 Returns to East vs. West German Experience

After we established that the difference in East-West German wage structures still exists many years after unification it is an open question why this might be the case. One possible explanation could be selective East-West migration of individuals with particularly high expected wage growth.¹⁷ A rigorous test of the hypothesis of selective East-West migration requires counterfactual evidence on potential wages for migrants in the East or for stayers in West Germany, which is beyond the focus of our analyses.

We concentrate instead on the potential mechanisms behind the return to experience differentials. Higher returns to experience in West compared to East Germany may result from two mechanisms: first, they may go back to different evaluations of the homogenous good "experience" in the two regions, i.e. identical labor market experience may receive a higher price in the West than in the East. Second, the type of experience which is generally available in the East German labor market may differ from the type of experience predominantly available in West Germany. In that case homogeneous experience could well receive the same price in both regions. However, we observe different returns to experience because the average quality of experience is heterogeneous between East and West Germany.

¹⁷ Brücker and Trübswetter (2007) use data through 1997 and confirm that East-West migrants are positively selected based on unobserved abilities. For a more general analysis of East-West migration patterns see Hunt (2006).

We can test whether one or both of these mechanisms are at work if we accept two assumptions. First, we assume that within a given regional labor market East and West German experience earn an identical price if their quality is identical. In that case we can compare the returns to East and West German experience in a given regional labor market and test whether they differ significantly. If they do we conclude that there must be differences in quality. If we accept as a second assumption that the experience of West (or East) Germans is of identical quality independent of where it is applied we can compare East and West German returns to an identical good and thus learn about regional price differences.

We re-estimated our wage models to test the hypothesis of quality differences in experience of East versus West German origin. Unfortunately, our data do not allow us to clearly measure for every individual year of experience in which region of the country it was gathered. Therefore, we proxy East vs. West German experience using an indicator of whether an individual originally, i.e. in the year prior to unification (1989), resided in East or West Germany.

Table 7 presents the predicted returns to tenure and experience in Panel (a) for East Germans working in the West and in Panel (b) for East Germans working in the East. A comparison of the returns to experience for East Germans in West Germany (Table 7a) to those of the overall West German workforce (see Table 4, columns 1-3) shows that East Germans in West Germany receive lower returns to experience than the average worker in West Germany.¹⁸ In addition, the coefficients on the experience interaction terms for individuals with East German origin in the West German sample are jointly significantly different from zero at the one percent level.¹⁹

An investigation of West Germans in East Germany yields similar results. Table 7(b) presents the predicted returns to experience for East Germans in East Germany. These can be

¹⁸ This differs from the finding in Gernandt and Pfeiffer (2008), who conclude that for East German migrants in the West wages have fully converged.

¹⁹ Generally, we do not present the estimated coefficients and tests of joint statistical significance referred to in this subsection in order to avoid clutter. The results are available from the authors.

compared to the returns in Table 4 (columns 4-6) for the entire East German workforce to learn about the wage structure of West Germans in East Germany. Since East Germans receive lower returns in East Germany than the entire East German workforce, West German experience must earn higher returns in East Germany than East German experience. This is confirmed by the joint statistical significance of experience interaction terms for West Germans in the wage regressions for all of East Germany. Both panels of Table 7 as well as the tests for statistical significance therefore support the conclusion that in both regional labor markets experience from the two regions earns different returns. Under assumption one we interpret this as indicative of quality differences between East and West German experience.

Under assumption two we can investigate whether there is evidence for price differences. If East (or West) German experience is a homogenous good we can compare its price in both regions of the country. A comparison of returns to East German experience in Panels (a) and (b) of Table 7 yields no clear answer: based on the OLS and AS estimators returns to East German experience are higher in the West, based on the Topel estimator they are higher in the East. In a wage regression for all East Germans the experience interaction terms for those who now work in West Germany are jointly significant at the 5 percent level if quadratic experience terms are used and jointly insignificant with a cubic specification. Thus we find no clear evidence in favor of true price differences with respect to East German experience.²⁰ In addition, one may well question the underlying assumption that the experience of East German workers now working in the West is on average still of the same quality as that of East German workers working in the East. - Finally, in a wage regression for all West Germans a joint significance test does not reject the null hypothesis that the returns to West German experience are identical in East or West Germany.

In sum, our initial analyses yielded that the returns to experience earned in East Germany are lower than those earned in West Germany. Further tests provided in this

²⁰ This result would be expected in a scenario of convergence between the two German regional labor markets (see Gernandt and Pfeiffer 2008).

subsection show that this is unlikely to be due to true differences in the price for homogenous experience. Instead the evidence is stronger for the alternative explanation that the type of experience earned in the East German labor market differs in character or quality from that earned in the West German labor market. Since we found above that returns to experience differ already for young workers in East versus West Germany this implies that even the type of experience gathered in East Germany since unification earns lower returns than work experience gathered in the West. It is left for future research to determine the mechanisms behind this intriguing phenomenon.

5. Conclusions

The literature on the adjustment of wage structures in transition economies suffers from two major shortcomings: first, it concentrates almost exclusively on the returns to schooling and disregards the life-cycle perspective of wage structures. Second, it generally relies on least squares estimation which does not account for important biases in the estimation of wage determinants.

This paper contributes to that literature by studying the returns to tenure and experience based on more appropriate estimators. We analyze the wage structure of a transition economy and compare East German life-cycle wage patterns to those in West Germany, a region with the same institutional framework but no heritage of a centrally planned economy. Previous studies found flat age-earnings profiles in East Germany immediately after unification in the early 1990s. We first corroborate that these differences existed in the 1990s and then investigate the wage patterns between 2002 and 2006, almost two decades after the fall of the iron curtain.

Our results confirm that not much has changed since the early 1990s, the wage-experience profile in East Germany is still substantially flatter than in the West. The East-West differences in returns to experience are statistically significant for the high and medium

skilled in most specifications. The low East German returns to experience might be due to a cohort effect and could be determined by workers whose experience became obsolete at the economic transition. These individuals may be more likely to be employed in positions that do not match their - at times outdated - qualifications. To test whether this drives our results we estimate our models separately only for those birth cohorts who gathered their entire labor market experience after unification. However, even for these individuals we find significantly lower returns to experience in East than in West Germany. This confirms that up until today returns to experience are lower in East than West Germany. In a separate analysis we compared the returns to experience for subsamples of different regions of origin. These results indicate that former East Germans earn lower returns to experience in the West German labor market than West Germans and vice versa that West Germans earn higher returns in the East than East Germans. Since the returns to West German experience do not differ significantly across the two labor markets we conclude that it may be the character of East German experience rather than general price differences which are behind the observed patterns.

This opens the intriguing research question of why the returns to human capital and the character of experience differ systematically and significantly between the two regions, even after controlling for composition effects related to education, industry, firm size, and region. In a recent contribution Fuchs-Schündeln and Izem (2008) emphasize that productivity differentials between East and West Germany are not due to worker characteristics but instead must be explained by differences in firm characteristics, regional public policy, or the cooperation between firms (see also Uhlig 2006 and 2008). This corroborates our conclusion that there are indeed systematic regional - rather than individual - differences between East and West Germany affecting the wage structure. In future research we plan to consider the following potential explanations: (i) possibly, the value of experience depends on the type and quality of formal education and workers with formal East German

training are systematically disadvantaged. This can be tested, when younger East German cohorts grow into the labor market, who received their complete education under the market economy system. (ii) Possibly, continued education activities are predominantly used in West Germany. In that case different life-cycle wage developments reflect systematically different additions to productivity over time, which might be complemented by different deferred compensation patterns in the two regions. (iii) Employees in the two regions might be differently affected by collective bargaining. We know that East German employers are less likely to be a member in employer associations (Kohaut and Schnabel 2003). This could explain the observed results if union-contracts tend to prescribe age-based wage structures. (iv) Independent of institutional differences in the collective bargaining frameworks, life-cycle wage structures might be affected by differences in the negotiating power of older workers in East and West Germany. One way to learn about any such differences could be to compare wage curves in East and West Germany by age group. Buscher (2003) finds unusually high wage elasticities in East Germany overall. It would be interesting to compare this evidence for different age groups and to test the hypothesis of monopsonistic labor markets for older employees in East Germany. (v) Finally, München et al. (2005) find heterogeneous wage structures across industries in the Czech Republic. If such heterogeneities in returns to experience and tenure exist in Germany as well, we might be observing simple differences in the composition of the work force in the two regions.

This research yields three conclusions. First, even today East German workers could on average gain substantially over the life-cycle by moving West and accumulating Western type work experience. Second, there appears to be little benefit to using public funds to keep otherwise unemployed East German workers in subsidized employment, as the East German labor market does not seem to reward work experience. This is particularly relevant as e.g. Lechner and Wunsch (2009) point to this mechanism as the main justification for otherwise ineffective and at times even counterproductive active labor market policies in East

Germany.²¹ Third, studies which celebrate the arrival of market economies based on an analysis of returns to schooling alone might be jumping too short. Based on a comparison with the West German benchmark we find evidence for substantially subdued life-cycle wage structures in the transition economy of East Germany, even close to twenty years after unification and even for those workers who entered the labor force after unification. Therefore the transition process might be much more protracted than had been assumed so far and - to the extent that returns to tenure and experience reflect real productivity differentials - the productivity gap between economic systems may have been larger than assumed so far.

An intriguing question for future research is to investigate the mechanisms behind the differential developments of returns to experience across transition economies over time, with rising returns to experience in Estonia (Noorkoiv et al. 1997), constant levels in the Czech republic (Münich et al. 2005) and rising though subdued returns in East Germany.

²¹ For similar results see also e.g. Caliendo et al. (2006), or Fitzenberger and Völter (2007).

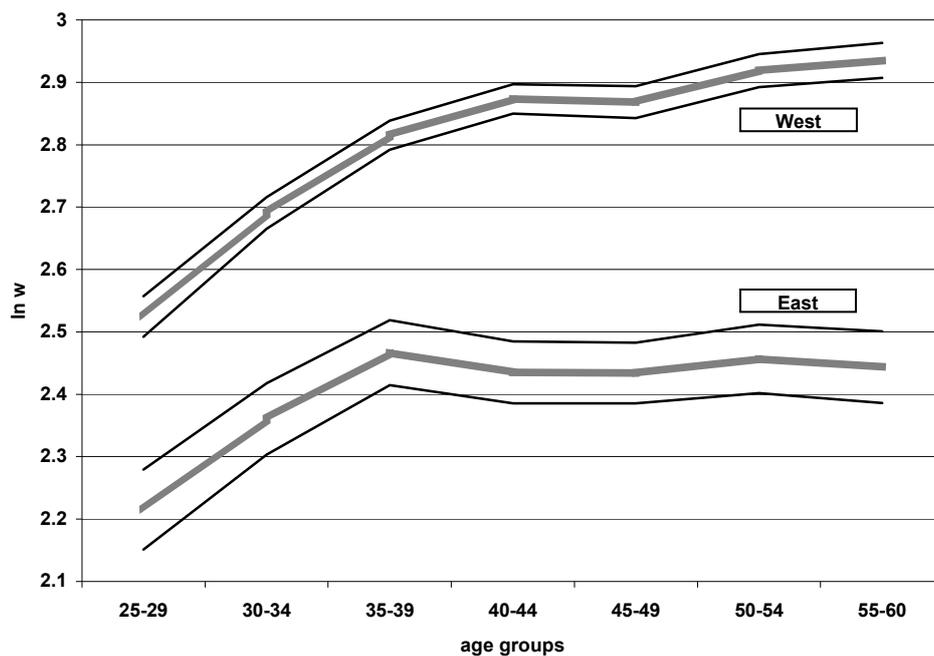
References

- Altonji, Joseph G. and Robert A. Shakotko, 1987, Do Wages Rise with Job Seniority?, *Review of Economic Studies* 54, 437-459.
- Andrén, Daniela, John S. Earle, and Dana Sapatoru, 2005, The wage effects of schooling under socialism and in transition: Evidence from Romania, 1950-2000, *Journal of Comparative Economics* 33(2), 300-323.
- Bird, Edward J., Johannes Schwarze and Gert G. Wagner, 1994, Wage effects of the move toward free markets in East Germany, *Industrial and Labor Relations Review* 47(3), 390-400.
- Boeri, Tito and Christopher J. Flinn, 1999, Returns to Mobility in the Transition to a Market Economy, *Journal of Comparative Economics* 27(1), 4-32.
- Boockmann, Bernhard and Susanne Steffes, 2008, Workers, Firms, or Institutions: What Determines Job Duration for Male Employees in Germany?, *ZEW DP* 2008-116, Mannheim.
- Brücker, Herbert and Parvati Trübswetter, 2007, Do the best go west? An analysis of the self-selection of East-West migrants in Germany, *Empirica* 34, 371-395.
- Burda, Michael C., 2006, Factor Reallocation in Eastern Germany after Reunification, *American Economic Review: Papers and Proceedings*, 96(2), 368-374.
- Burda, Michael C., 2008, What kind of shock was it? Regional integration and structural change in Germany after unification, forthcoming: *Journal of Comparative Economics*.
- Burda, Michael C. and Jennifer Hunt, 2001, From Reunification to Economic Integration: Productivity and the Labor Market in Eastern Germany, *Brookings Papers on Economic Activity* 2, 1-92.
- Burda, Michael C. and Christoph M. Schmidt, 1997, Getting behind the East-West Differential: Theory and Evidence, in: Pohl, Rüdiger and Hilmar Schneider (eds.), *Wandeln oder Weichen – Herausforderungen der wirtschaftlichen Integration für Deutschland*, IWH Halle, 170-201.
- Buscher, Herbert S., 2003, Gibt es eine Lohnkurve in den neuen Bundesländern? *Mitteilungen aus der Arbeitsmarkt- und Berufsforschung* 36(4), 461-475.
- Caliendo, Marco, Reinhard Hujer, and Stephan Thomson, 2006, Sectoral Heterogeneity in the Employment Effects of Job Creation Schemes in Germany, *Journal of Economics and Statistics (Jahrbücher für Nationalökonomie und Statistik)* 226(2), 139-179.
- Dustmann, Christian and Costas Meghir, 2005, Wages, Experience and Seniority, *Review of Economic Studies* 72(1), 77-108.
- Dustmann, Christian, Johannes Ludsteck, and Uta Schönberg, 2007, Revisiting the German Wage Structure, *IZA Discussion Paper* No. 2685, Bonn.
- Dustmann, Christian and Sonia C. Pereira, 2008, Wage Growth and Job Mobility in the United Kingdom and Germany, *Industrial and Labor Relations Review* 61(3), 374-393.
- Fertig, Michael, Christoph M. Schmidt, and Hilmar Schneider, 2006, Active labor market policy in Germany – Is there a successful policy strategy?, *Regional Science and Urban Economics* 36(3), 399-433.
- Finnie, Ross, 1993, Tenure, Experience, and Men's and Women's Wages: Panel Estimates from the National Longitudinal Survey of Youth, Cahier de recherche 9305, Quebec, Université de Laval.
- Fitzenberger, Bernd, 1999, *Wages and Employment Across Skill Groups. An Analysis for West Germany*, ZEW Economic Studies, Physica Verlag, Heidelberg.
- Fitzenberger, Bernd and Robert Völter, 2007, Long-Run Effects of Training Programs for the Unemployed in East Germany, *Labour Economics* 14(4), 730-755.

- Flanagan, Robert J., 1998, Were communists good human capitalists? The case of the Czech Republic, *Labour Economics* 5, 295-312.
- Fleisher, Belton, Klara Sabirianova, and Xiaojun Wang, 2005, Returns to skills and the speed of reforms: Evidence from Central and Eastern Europe, China, and Russia, *Journal of Comparative Economics* 33(2), 351-370.
- Franz, Wolfgang und Viktor Steiner, 2000, Wages in the East German Transition Process: Facts and Explanations, *German Economic Review* 1(3), 241-269.
- Fuchs-Schündeln, Nicola und Rima Izem, 2008, Explaining the Low Labor Productivity in East Germany – A Spatial Analysis, *mimeo*, Harvard University.
- Gathmann, Christina, 2005, The Skill Loss of Older East Germans after Unification, *Schmollers Jahrbuch* 125(1), 7-16.
- Gernandt, Johannes and Friedhelm Pfeiffer, 2007, Rising Wage Inequality in Germany, *Journal of Economics and Statistics (Jahrbücher für Nationalökonomie und Statistik)* 227(4), 358-380.
- Gernandt, Johannes and Friedhelm Pfeiffer, 2008, Wage Convergence and Inequality after Unification: (East) Germany in Transition, *ZEW Discussion Paper* 2008-022, Mannheim.
- Görzig, Bernd, Martin Gornig, and Axel Werwatz, 2008, Firm Wage Differentiation in Eastern Germany: A Non-parametric Analysis of the Wage Spread, *Economics of Transition* 16(2), 273-292.
- Gorodnichenko, Yuriy and Klara Sabirianova Peter, 2005, Returns to Schooling in Russia and Ukraine: A Semiparametric approach to cross-country comparative analysis, *Journal of Comparative Economics* 33(2), 324-350.
- Hunt, Jennifer, 2001, Post-Unification Wage Growth in East Germany, *Review of Economics and Statistics* 83(1), 190-195.
- Hunt, Jennifer, 2006, Staunching Emigration from East Germany: Age and the Determinants of Migration, *Journal of the European Economic Association* 4(5), 1014-1037.
- Jones, Derek C. and Kosali Ilayperuma Simon, 2005, Wage determination under plan and early transition: Bulgarian evidence using matched employer-employee data, *Journal of Comparative Economics* 33(2), 227-243.
- Jurajda, Stepan, and Heike Harngart, 2007, When do female occupations pay more?, *Journal of Comparative Economics* 35(1), 170-187.
- Kohaut, Susanne and Claus Schnabel, 2003, Tarifverträge-nein danke!? Einflussfaktoren der Tarifbindung west- und ostdeutscher Betriebe, *Journal of Economics and Statistics (Jahrbücher für Nationalökonomie und Statistik)* 223(3), 312-331.
- Krueger, Alan B. and Jorn-Steffen Pischke, 1995, A Comparative Analysis of East and West German Labor Markets: Before and after Unification, in: Richard B. Freeman and Lawrence F. Katz (eds.), *Differences and Changes in Wage Structures*, Chicago: University of Chicago Press, 405-445.
- Lechner, Michael H. and Conny Wunsch, 2009, Active Labour Market Policy in East Germany: Waiting for the Economy to take off, *Economics of Transition* forthcoming (this issue).
- Little, R.J.A. and Donald B. Rubin, 1987, *Statistical Analysis with Missing Data*, Wiley and Sons, New York.
- Liu, Amy Y.C., 2006, Changing wage structure and education in Vietnam, 1992-1998. The roles of demand, *Economics of Transition* 14(4), 681-706.
- Luchsinger, Cornelia, Rafael Lalive, and Jörg Wild, 2003, Do Wages Rise with Seniority? The Swiss Case, *Swiss Journal of Economics and Statistics* 139(2), 207-229.

- Münich, Daniel, Jan Svejnar, and Katherine Terrell, 2005, Returns to Human Capital under the Communist Wage Grid and during the Transition to a Market Economy, *Review of Economics and Statistics* 87(1), 100-123.
- Noorkoiv, Rivo, Peter F. Orazem, Allan Puur, and Milan Vodopivec, 1997, How Estonia's Economic Transition Affected Employment and Wages (1989-1995), *Policy Research Working Paper* 1837, World Bank, Washington D.C.
- Parent, Daniel, 2000, Industry-Specific Capital and the Wage Profile: Evidence from the National Longitudinal Survey of Youth and the Panel Study of Income Dynamics, *Journal of Labor Economics* 18(2), 306-323.
- Rubin, Donald B., 1987, *Multiple Imputation for Nonresponse in Surveys*, Wiley and Sons, New York.
- Snower, Dennis J. and Christian Merkl, 2006, The Caring Hand that Cripples: The East German Labor Market after Reunification, *American Economic Review* 96(2), 375-382.
- SOEP Group, 2001, The German Socio-Economic Panel (GSOEP) after more than 15 years - Overview. In: Elke Holst, Dean R. Lillard, and Thomas A. DiPrete (eds.): Proceedings of the 2000 Fourth International Conference of German Socio-Economic Panel Study Users (GSOEP2000), *Vierteljahrshefte zur Wirtschaftsforschung* 70(1), 7-14.
- Spitz-Oener, Alexandra, 2007, Human Capital, Job Tasks and Technology in East Germany after Reunification, *National Institute Economic Review* 201, 97-106.
- Steiner, Viktor and Lutz Bellmann, 1995, The East German Wage Structure in the Transition to a Market Economy, *Labour: Review of Labour Economics and Industrial Relations* 9(3), 539-560.
- Topel, Robert, 1991, Specific Capital, Mobility, and Wages: Wages Rise with Seniority, *Journal of Political Economy* 99(1), 145-176.
- Uhlig, Harald, 2006, Regional Labor Markets, Network Externalities and Migration: The Case of German Reunification, *American Economic Review* 96(2), 383-387.
- Uhlig, Harald, 2008, The slow decline of East Germany, forthcoming: *Journal of Comparative Economics*.
- van Buuren, S., H. C. Boshuizen, and D. L. Knook, 1999, Multiple imputation of missing blood pressure covariates in survival analysis, *Statistics in Medicine* 18, 681-694.

Figure 1 Life Cycle Wage Structure in East and West Germany

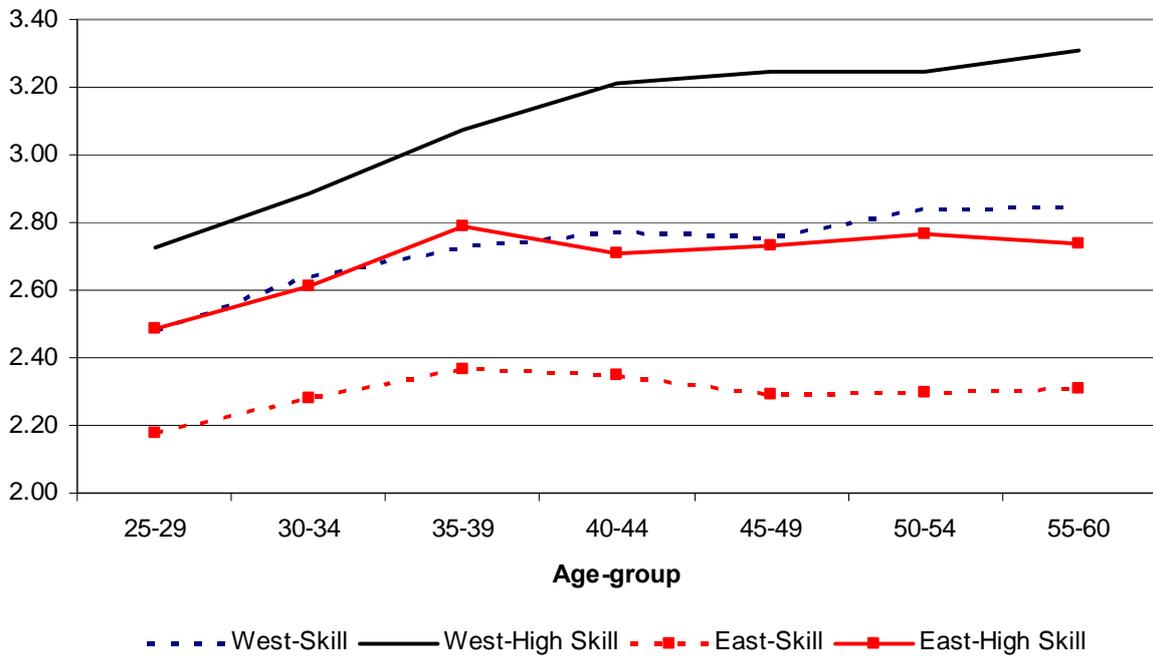


Note: Real hourly wages are deflated to 2002 prices. Estimates were obtained by regressing real log hourly wages on a set of indicator variables for age group and year. The thin lines are pointwise 95 percent confidence intervals obtained from least squares standard errors adjusted for multiple imputation.

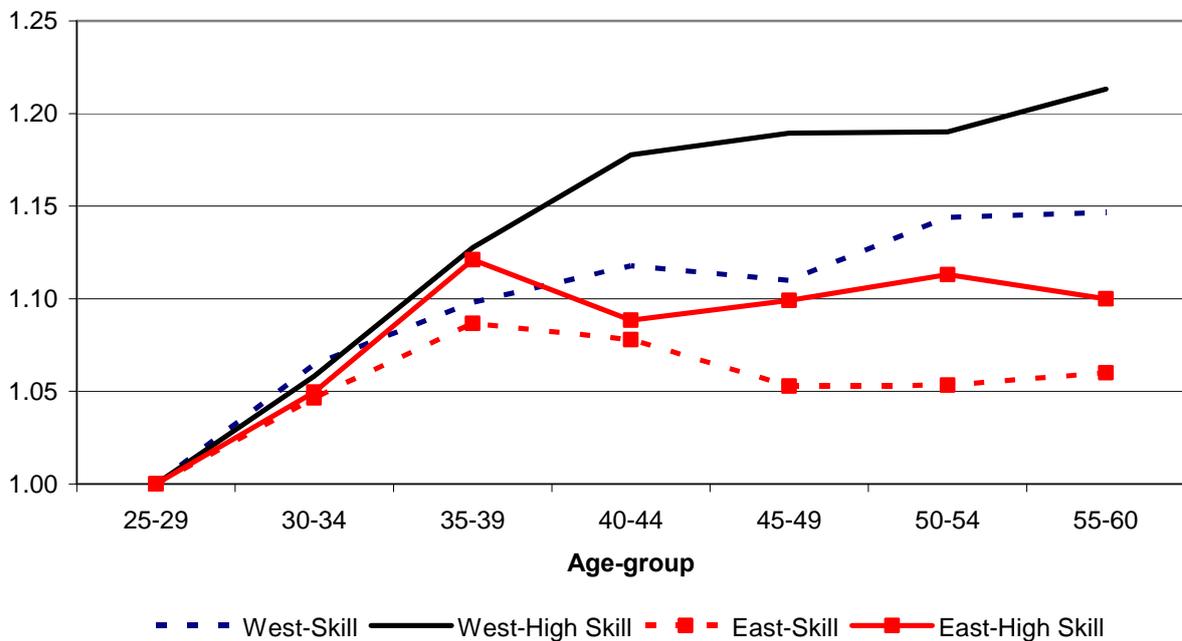
Source: Germany Socio-Economic Panel (2002-2006), own calculations.

Figure 2 Life Cycle Wage Structure by Region and Skill Group: Log-Level and Groupwise Indexed to wages of age group 25-29

(a) Log Real Hourly Wages by Region and Skill Group



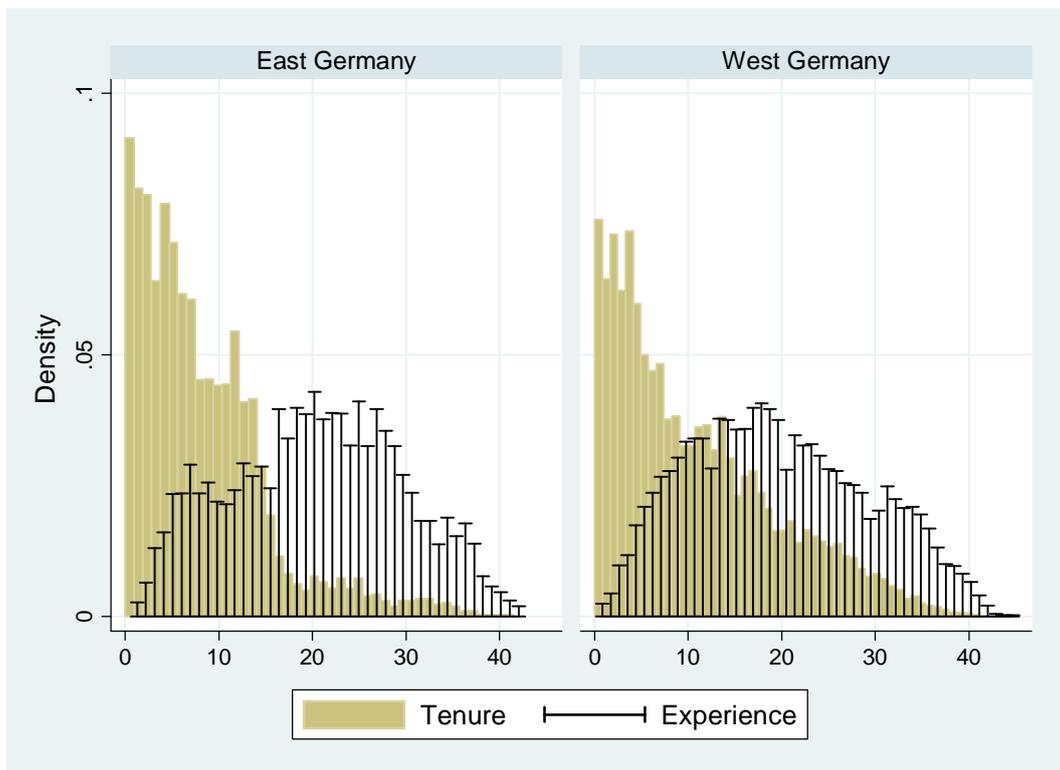
(b) Log Real Hourly Wages Indexed to Age-group 25-29



Note: Skill stands for workers with completed vocational training, high skill represents those with completed tertiary degree. The wage development of workers without vocational training is not presented because of small sample sizes.

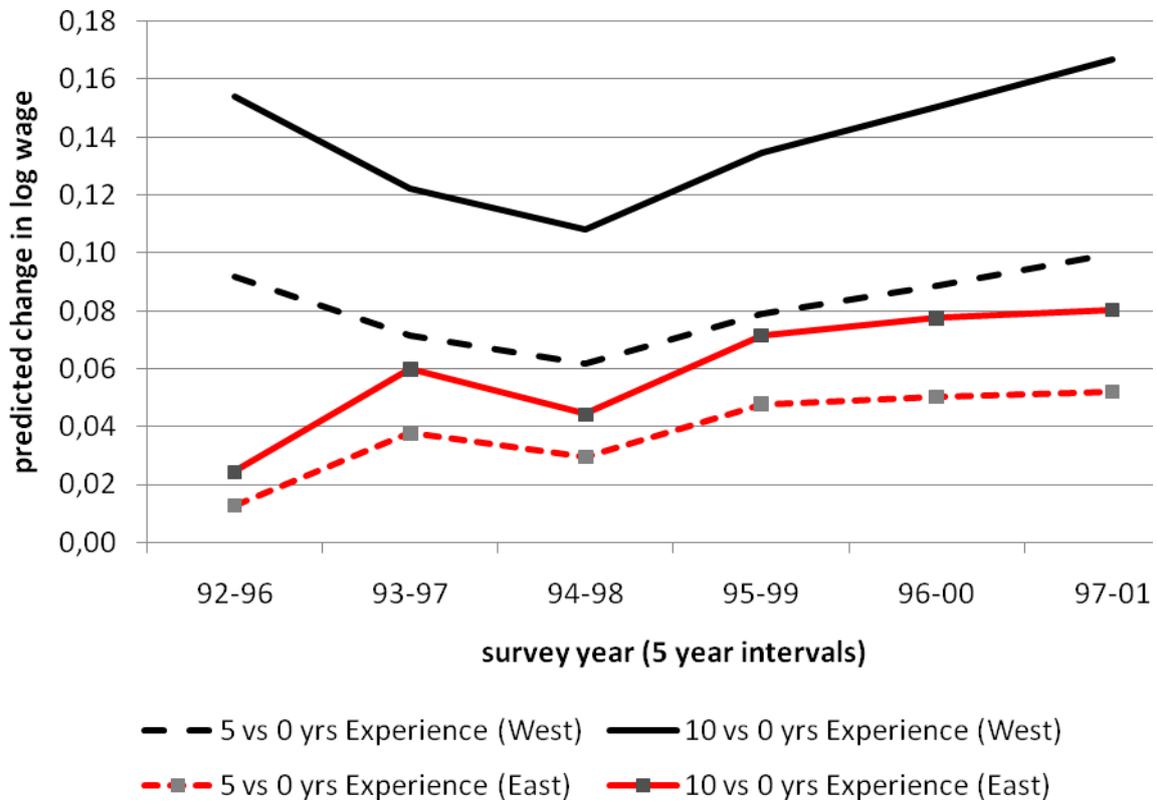
Source: Germany Socio-Economic Panel (2002-2006), own calculations.

Figure 3 Tenure and Experience in East and West Germany



Source: Germany Socio-Economic Panel (2002-2006), own calculations.

Figure 4 Returns to Experience in East and West Germany over Time



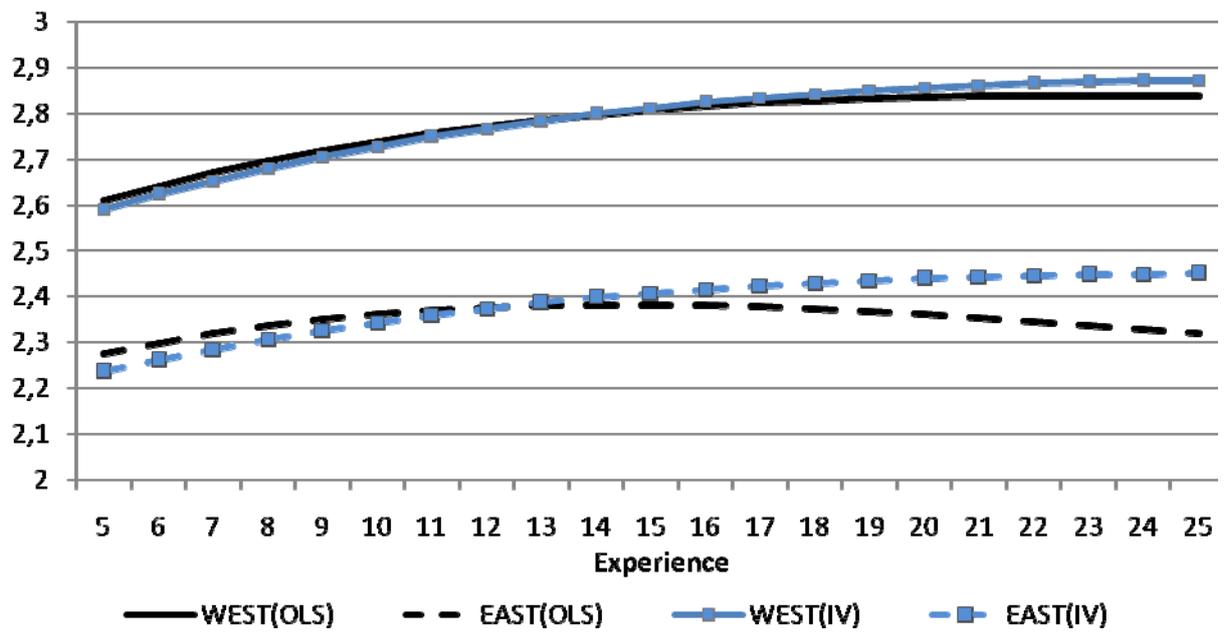
Notes:

The lines represent the returns to experience in East and West Germany, both for five vs. zero (dashed lines) and for ten vs. zero years (full lines) of experience. The returns were estimated in linear regression models, which controlled for cubic terms in tenure and experience, a set of six indicators of highest educational attainment, immigrant status, federal state of residence, 12 industry indicators, and calendar year fixed effects. The samples were gathered from moving observation windows of five subsequent calendar years.

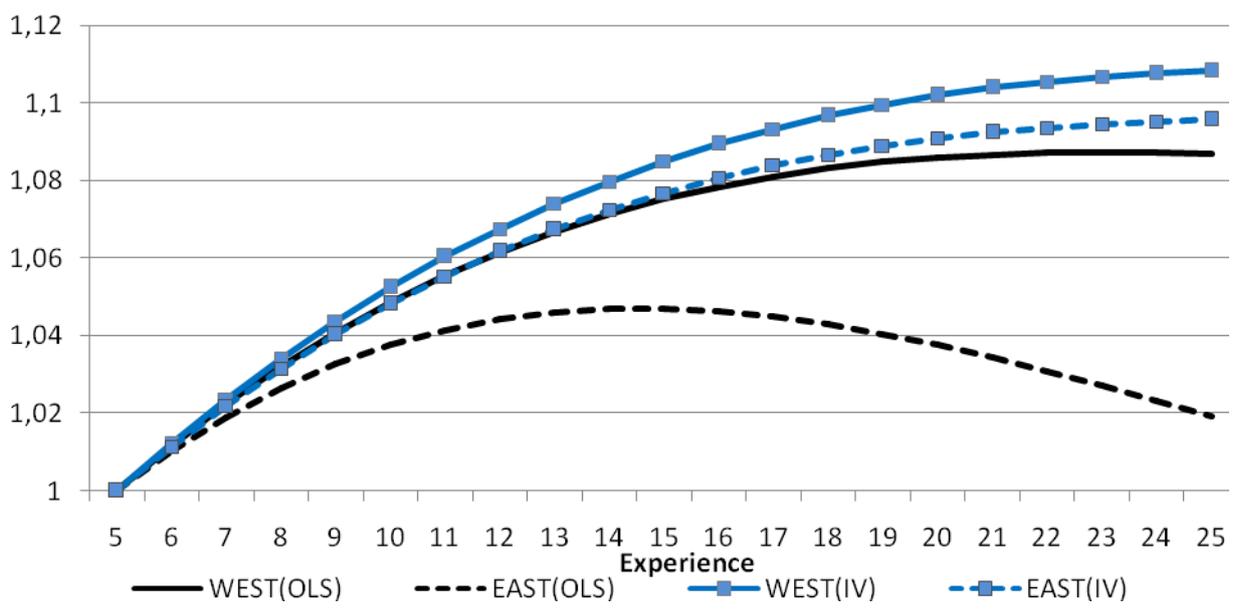
Source: Germany Socio-Economic Panel (1992-2001), own calculations.

Figure 5 Estimated Polynomials in Experience in East and West based on Least Squares and Instrumental Variables Estimation (AS)

(a) Predicted log wages



(b) Predicted log wages indexed at the level of five years of experience



Note: The wages were predicted for individuals with five years tenure, born in Germany, observed in 2006, employed in the energy sector with intermediate education, and residing either in Saxony or NRW. The predictions are based on the OLS and AS estimates. Figure (b) was generated as the ratio of predicted wage at every value of experience over the predicted wage at five years of experience.

Source: Germany Socio-Economic Panel (2002-2006), own calculations.

Table 1 Descriptive Statistics

	West Germany Mean (Std. Dev.)	East Germany Mean (Std. Dev.)
Dependent Variable		
log real hourly wage	2.82 (.0013)	2.41 (.0026)
Explanatory Variables		
Tenure	10.79 (.0275)	8.26 (.0423)
Experience	19.73 (.0301)	20.36 (.0561)
Education: Lower Secondary School	.3934 (.0015)	.1400 (.0021)
Education: Intermediate Sec. School	.2034 (.0013)	.5609 (.0030)
Education: Upper Secondary	.0850 (.0009)	.0470 (.0013)
Education: University, Technical College	.2224 (.0013)	.2345 (.0026)
Education: Other / Missing	.0958 (.0009)	.0175 (.0008)
Born in Germany	.8268 (.0012)	.9800 (.0008)
Industry: Not Applicable	.0102 (.0003)	.0288 (.0010)
Industry: Agriculture	.0438 (.0006)	.0438 (.0012)
Industry: Energy	.2945 (.0014)	.2068 (.0024)
Industry: Mining	.1524 (.0011)	.1156 (.0019)
Industry: Manufacturing	.1019 (.0010)	.1662 (.0022)
Industry: Construction	.1120 (.0010)	.1344 (.0021)
Industry: Trade	.0988 (.0009)	.0758 (.0016)
Industry: Transport	.0872 (.0009)	.0971 (.0018)
Industry: Bank, Insurance	.0207 (.0004)	.0387 (.0012)
Industry: Services	.0455 (.0007)	.0488 (.0013)
Industry: Other	.0025 (.0002)	.0022 (.0003)
Industry: Missing	.0306 (.0005)	.0418 (.0012)
Number of person-year observations	10,087	2,746

Note: Region indicators not presented to save space.

Source: Germany Socio-Economic Panel (2002-2006), own calculations.

Table 2 Development of Predicted Least Squares Returns to Tenure and Experience in West and East Germany

	West Germany		East Germany	
	(92-96)	(97-01)	(92-96)	(97-01)
5 vs 0 yrs Tenure	.0899 *** (.0143)	.0819 *** (.0120)	.0417 * (.0240)	.1332 *** (.0235)
10 vs 0 yrs Tenure	.1468 *** (.0191)	.1454 *** (.0166)	.0627 ** (.0298)	.2035 *** (.0322)
5 vs 0 yrs Experien.	.0917 *** (.0186)	.0996 *** (.0186)	.0128 (.0444)	.0519 (.0452)
10 vs 0 yrs Exper.	.1538 *** (.0283)	.1668 *** (.0281)	.0245 (.0653)	.0803 (.0664)
20 vs 0 yrs Exper.	.2038 *** (.0316)	.2228 *** (.0313)	.0411 (.0659)	.0779 (.0684)

Notes:

- (a) ***, ** and * indicate statistical significance at the 1, 5 and 10 percent level.
- (b) Standard errors are generated by block-bootstrap of the observations in the unbalanced panel using 100 replications based on ten multiply imputed data sets (e.g. Rubin 1987, Little and Rubin 1987).
- (c) The underlying regression models control for cubic terms in tenure and experience, a set of 6 indicators of highest educational attainment, immigrant status, federal state of residence, 12 industry indicators and calendar year fixed effects.
- (d) The returns were predicted based on regressions with 7561 and 9272 person-year observations for West Germany and 2697 and 3007 person-year observations for East Germany in two considered periods, respectively.

Source: Germany Socio-Economic Panel (1992-2001), own calculations.

Table 3

OLS Regression Results – Dependent Variable: log wages

	West Germany	East Germany
Tenure/10	.1651*** [.0447]	.1349 [.0930]
Tenure ² /100	-.0229 [.0319]	.0140 [.0718]
Tenure ³ /1000	-.0008 [.0062]	-.0099 [.0142]
Exp/10	.4842*** [.0669]	.4446*** [.1453]
Experience ² /100	-.1781*** [.0361]	-.2162*** [.0767]
Experience ³ /1000	.0211*** [.0057]	.0292** [.0120]
Educ: Intermediate	.1272*** [.0162]	.0143 [.0391]
Educ: Upper secondary	.2837*** [.0236]	.2008*** [.0750]
Educ: Univ., techn. College	.5017*** [.0168]	.3952*** [.0462]
Educ: Other / Missing	.0156 [.0211]	-.0787 [.1278]
Born in Germany	.0926*** [.0175]	.2630** [.1226]
2003	.0420*** [.0068]	.0213* [.0121]
2004	.0469*** [.0076]	.0552*** [.0145]
2005	.0501*** [.0087]	.0631*** [.0160]
2006	.0642*** [.0089]	.0776*** [.0184]
Constant	2.0718*** [.0394]	1.6786*** [.1470]
State of Residence	yes	yes
Industry	yes	yes
Observations	10,087	2,746
R-squared	0.38	0.33

Notes:

(a) ***, ** and * indicate statistical significance at the 1, 5 and 10 percent level.

(b) The coefficients of the indicators for state of residence, industry, and calendar year are not presented to save space. Standard errors are calculated based on Rubin's Rule for multiply imputed data using Stata's *micombine* command.

Source: Germany Socio-Economic Panel (2002-2006), own calculations.

Table 4 Predicted Returns to Tenure and Experience in East and West Germany with Alternative Estimators – Full Sample

	West Germany			East Germany		
	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	AS	Topel	OLS	AS	Topel
5 vs 0 yrs Tenure	.0767 *** (.0150)	-.0079 (.0178)	.0452 * (.0243)	.0697 ** (.0312)	-.0298 (.0282)	.0497 (.0493)
10 vs 0 yrs Tenure	.1413 *** (.0204)	.0055 (.0307)	.0704 (.0493)	.1390 *** (.0419)	-.0639 (.0513)	.1378 (.0933)
5 vs 0 yrs Experience	.2002 *** (.0237)	.1993 *** (.0281)	.2249 *** (.0433)	.1719 *** (.0551)	.1631 ** (.0725)	.1424 * (.0830)
10 vs 0 yrs Experience	.3273 *** (.0353)	.3353 *** (.0450)	.4372 *** (.0868)	.2576 *** (.0822)	.2709 (.3003)	.2175 (.1669)
20 vs 0 yrs Experience	.4223 *** (.0381)	.4639 *** (.0615)	.8301 *** (.1804)	.2576 *** (.0868)	.3666 (.2338)	.2871 (.3478)

Notes:

(a) ***, ** and * indicate statistical significance at the 1, 5 and 10 percent level.

(b) Shaded cells indicate a significant difference in the predicted wage effects between East and West Germany at least at the 10 percent level. Assuming no correlation between the predicted wage effects, the z-test statistic divides the difference in predicted wage values (DW) by the square root of the sum of their variances:

$$Z = (DW_{West} - DW_{East}) / [\text{var}(DW_{West}) + \text{var}(DW_{East})]^{0.5}$$

(c) Standard errors are generated by block-bootstrap of the observations in the unbalanced panel using 100 replications based on ten multiply imputed data sets (e.g. Rubin 1987, Little and Rubin 1987).

(d) The underlying regression models are specified as in Table 3.

(e) The OLS and AS returns were predicted based on regressions with 10,087 person-year observations for West and 2,746 person-year observations for the East German sample. The first step of the Topel-estimator used 9,300 and 2,479 person-year observations, the second step is based on 10,087 and 2,746 person-year observations in West and East Germany, respectively.

Source: Germany Socio-Economic Panel (2002-2006), own calculations.

Table 5 Returns to Tenure and Experience in East and West Germany according to Alternative Estimators – By Skill Group

(a) Medium Skilled (Person-Year Observations West: 6508, East: 1953)

	West Germany			East Germany		
	(1) OLS	(2) AS	(3) Topel	(4) OLS	(5) AS	(6) Topel
5 vs 0 yrs Tenure	.0829 *** (.0105)	-.0125 (.0236)	.0424 * (.0243)	.0873 *** (.0252)	-.0213 (.0341)	.1125 *** (.0393)
10 vs 0 yrs Tenure	.1501 *** (.0180)	-.0143 (.0452)	.0936 ** (.0422)	.1585 *** (.0433)	-.0526 (.0640)	.1959 *** (.0652)
5 vs 0 yrs Experience	.0917 *** (.0148)	.1399 ** (.0707)	.1514 *** (.0305)	.0360 (.0262)	.1533 (.1321)	.0440 (.0473)
10 vs 0 yrs Experience	.1673 *** (.0260)	.2650 * (.1402)	.2926 *** (.0611)	.0608 (.0459)	.2814 (.2628)	.0983 (.0946)
20 vs 0 yrs Experience	.2698 *** (.0391)	.4710 (.2779)	.5443 *** (.1270)	.0768 (.0666)	.4620 (.5224)	.2371 (.1952)

(b) Highly Skilled (Person-Year Observations West: 2244, East: 643)

5 vs 0 yrs Tenure	.0258 (.0253)	-.0255 (.0351)	.0130 (.0353)	.1097 ** (.0472)	-.0865 * (.0486)	.1472 (.0937)
10 vs 0 yrs Tenure	.0623 (.0416)	-.0166 (.0639)	.0334 (.0626)	.1919 *** (.0737)	-.1875 ** (.0934)	.2795 ** (.1363)
5 vs 0 yrs Experience	.2298 *** (.0322)	.2321 *** (.0607)	.2974 *** (.0484)	.0978 * (.0522)	.0743 (.2748)	.1784 ** (.0890)
10 vs 0 yrs Experience	.4013 *** (.0553)	.4058 *** (.1140)	.5648 *** (.0962)	.1627 * (.0899)	.1414 (.5486)	.3331 * (.1744)
20 vs 0 yrs Experience	.5696 *** (.0755)	.5779 *** (.2038)	1.0091 *** (.2021)	.1939 (.1239)	.2544 (1.0973)	.5710 (.3579)

Notes:

(a) See notes below Table 4.

(b) The underlying regression models follow the specification in Table 3, where we use second instead of third order polynomials in tenure and experience in order to avoid overfitting.

Source: Germany Socio-Economic Panel (2002-2006), own calculations.

Table 6 Predicted Returns to Tenure and Experience in East and West Germany with Alternative Estimators – Sample of Individuals born after 1969

	West Germany			East Germany		
	(1) OLS	(2) AS	(3) Topel	(4) OLS	(5) AS	(6) Topel
5 vs 0 yrs Tenure	.0963 *** (.0284)	.0279 (.0401)	.0827 * (.0430)	.1034 * (.0560)	-.1116 (.0763)	.0598 (.0670)
10 vs 0 yrs Tenure	.1561 ** (.0348)	.0611 (.0753)	.1216 (.0840)	.1344 ** (.0667)	-.1589 (.1378)	.1520 (.1702)
5 vs 0 yrs Experience	.2142 *** (.0408)	.2251 *** (.0549)	.1891 *** (.0672)	-.0381 (.1039)	.1474 * (.0843)	.0212 (.1390)
10 vs 0 yrs Experience	.3366 *** (.0559)	.3665 *** (.0955)	.3229 ** (.1376)	.0315 (.1422)	.2800 ** (.1307)	.1220 (.2888)

Notes:

(a) See notes below Table 4.

(b) The underlying regression models follow the specification in Table 3, where we use second instead of third order polynomials in tenure and experience in order to avoid overfitting.

(c) The predicted returns to 20 years of experience are not presented because they are out of sample predictions for this subsample.

(d) The OLS and AS returns were predicted based on regressions with 2069 person-year observations for West and 534 person-year observations for the East German sample. The first step of the Topel estimator used 1752 and 448 person-year observations, the second step is based on 2069 and 534 person-year observations in East and West Germany, respectively.

Source: Germany Socio-Economic Panel (2002-2006), own calculations.

Table 7 Returns to East vs. West German Experience

(a) East Germans in West German Employment

	(1) OLS	(2) AS	(3) TO
5 vs 0 yrs Tenure	.0756 *** (.0155)	-.0124 (.0172)	.1865 ** (.0746)
10 vs 0 yrs Tenure	.1344 *** (.0212)	-.0068 (.0282)	.3425 *** (.0962)
5 vs 0 yrs Experience	.1548 (.1012)	.1885 *** (.0764)	.0816 (.1189)
10 vs 0 yrs Experience	.2208 (.1424)	.3003 *** (.1130)	.1652 (.1189)

(b) East Germans in East German Employment

	(1) OLS	(2) AS	(3) TO
5 vs 0 yrs Tenure	.0732 ** (.0307)	-.0421 (.0307)	.0567 (.0547)
10 vs 0 yrs Tenure	.1378 *** (.0408)	-.0932 (.0577)	.1470 (.0990)
5 vs 0 yrs Experience	.1393 ** (.0549)	.1201 (.0873)	.1353 (.0826)
10 vs 0 yrs Experience	.2028 ** (.0824)	.2061 (.1631)	.2084 (.1658)
20 vs 0 yrs Experience	.1858 ** (.0888)	.3027 (.3031)	.2861 (.3454)

Notes:

(a) ***, ** and * indicate statistical significance at the 1, 5 and 10 percent level.

(b) We do not present the predicted returns to 20 years of East German experience in West Germany because this involves out of sample predictions.

(c) The standard errors were obtained via block-bootstrap using 100 replications based on ten multiply imputed data sets.

(d) The underlying regression models are specified as in Table 3. In addition, we considered interaction terms on the experience polynomials for East Germans in West Germany in Panel (a) and for West Germans in East Germany in Panel (b). For the Topel estimator the interaction terms were considered at the second stage only, which implies that experience gathered in the ongoing employment yields the same returns for all employees. Heterogeneity in returns to experience is thus limited to experience accumulated on prior employments. The coefficients of the interaction terms in combination with the main effects were always jointly

significant at the one percent level, except for the AS estimator in Panel (a) where they were insignificant.

(e) The OLS and AS returns were predicted based on regressions with 9,870 person-year observations for the West and 2,694 person-year observations for the East German sample. The first step of the Topel estimator used 7,225 and 1,910 person-year observations, the second step is based on 9,870 and 2,694 person-year observations in Panels (a) and (b), respectively.

Source: Germany Socio-Economic Panel (2002-2006), own calculations.

Appendix

Table A1: Regression Results of the Topel estimator for West Germany

Topel estimation (1st step)		Topel estimation (2nd step)	
Δ tenure/10	.5775 *** .1080	initial exper./10	.4634 *** .0486
Δ tenure ² /100	.0088 .0479	initial exper. ² /100	-.0283 .0404
Δ tenure ³ /1000	.0020 .0101	initial exper. ³ /1000	.0021 .0089
Δ exper. ² /100	-.0877 .0587	educ_intermediate	.1843 *** .0183
Δ exper. ³ /1000	.0071 .0091	educ_upper sec.	.3848 *** .0263
Δ educ_Sec.School	-.0911 .1049	educ_university	.5879 *** .0197
Δ educ_intermed.	-.1958 * .1068	educ_other/missings	-.0011 .0279
Δ educ_upper sec.	-.1854 .4702	state_Schleswig-Hols.	-.0848 ** .0386
Δ educ_university	-.0755 .1064	state_Hamburg	-.0618 .0598
Δ educ_other	-.0974 .0940	state_Lower Saxony	-.0249 .0265
Δ state_Schleswig-H.	.1251 .0803	state_Bremen	-.0366 .0794
Δ state_Hamburg	-.0294 .0523	state_N-Rhein-Westfa.	-.0303 .0206
Δ state_Lower Saxony	-.0816 .0889	state_Hessen	-.0110 .0267
Δ state_Bremen	.1827 *** .0049	state_R-Pfalz,Saarl.	-.0199 .0259
Δ state_N-Rhein-Westfa	.1720 .1982	state_Baden-Wuertt.	.0655 *** .0216
Δ state_Hessen	-.0175 .0534	Born in Germany	.0753 *** .0214
Δ state_R-Pfalz,Saarl.	-.1984 .2089	ind_Not Applicable	-.3294 *** .0869
Δ state_Baden-Wuertt.	-.0556 *** .0176	ind_Agriculture	-.1036 *** .0357
Δ state_Bavaria	-.0836 .0569	ind_Mining	.0167 .0199
Δ ind_Not Applicable	-.2604 * .1542	ind_Manufacturing	-.0674 *** .0211
Δ ind_Agriculture	-.0552 .0510	ind_Construction	-.1140 *** .0219
Δ ind_Energy	-.0327 .0343	ind_Trade	-.0313 .0256
Δ ind_Mining	.0162 .0264	ind_Transport	.0334 .0274
Δ ind_Manufacturing	-.0755 * .0453	ind_Bank,Insurance	.0013 .0427
Δ ind_Construction	.0065 .0402	ind_Services	-.0573 ** .0276
Δ ind_Trade	-.0773 * .0415	ind_Other	-.0629 .0938
Δ ind_Transport	.0287 .0443	ind_Missing	-.0504 * .0300
Δ ind_Bank,Ins.	-.0399 .0324	y2003	.0319 *** .0068
Δ ind_Services	-.0114 .0499	y2004	.0339 *** .0078
Δ ind_Other	.0712 .0930	y2005	.0325 *** .0092
Δ ind_Missing	-.0372 .0644	y2006	.0315 *** .0092
		Constant	1.8676 *** .0304

Note: The results are based on 10 multiply imputed datasets for West Germany. The first step estimation uses 9300 and the second step 10087 observations.

Source: Germany Socio-Economic Panel (2002-2006), own calculations.