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# Wage growth and inequality change during rapid economic transition

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# Wage Growth and Inequality Change During Rapid Economic Transition

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ABSTRACT

East Germany, a unique socialist command economy prior to the 1990s, underwent rapid transition to a market-oriented economic system. This transition has been of intense interest given the environment of Eastern Germany vis-a-vis Western Germany, a setting different from most other transition economies. However, changes in the Eastern wage structure during transition demonstrates considerable similarity to that occurring in other transition economies. During the course of this transition, East Germany experienced big increases in both its wage level and wage dispersion. From 1990 to 2000 real wages in East Germany for men aged 20-60 rose by 118%, while various inequality measures indicate an increase in wage inequality of 25 to 61%. This paper studies the causes of this growth in wages and the changes in wage inequality, the first two moments of the wage distribution. We find that changes in the wage structure due to the transition explains most of wage growth and inequality change in East Germany. Most of the increases occur at the beginning of the transition. We compare our 1990-2000 results for East Germany to West German wage earners during the same period in order to investigate whether convergences took place in terms of mean (level) and dispersion (inequality).

JEL codes: D30, J30
Keywords: decomposition analysis, wages and inequality, earnings equation, coefficients (price) effect, characteristics (quantity) effect, residuals effect, transition

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## 1. Introduction

East Germany (the former German Democratic Republic or GDR) underwent rapid transition from a socialist to a market-oriented economic system after the fall of the Berlin Wall. During the course of this transition East Germany experienced large increases in both its wage level and wage dispersion. From 1990 to 2000 real wages in East Germany for men aged 20 to 60 rose by 118%, while various inequality measures indicate an increase in wage inequality of 25 to 61%. In this paper we analyze these changes in the first two moments. The increases in the mean and inequality of East German wages are not surprising considering the transition East Germany underwent in moving to a market-oriented system. We focus on the sources of wage growth and inequality change, asking "How much of the changes in the level and dispersion of wages can be explained by the changes in the characteristics of workers?" and "How much of the changes in the level and dispersion of wages can be explained by the changes in returns to the characteristics of workers?". It is natural to also ask how much closer the transition brings East Germany to West Germany (the pre-unification Federal Republic of Germany or FRG). We compare our 1990-2000 results for East Germany to West German wage earners during the same period in order to investigate whether convergences took place in terms of mean wages (level) and wage dispersion (inequality).

## 2. East Germany: Background and Transition

The economic system of Eastern Germany has been of interest both during the command era and the 1990's transition era, in part due to the unique setting of the two Germanies. Prior to the division of Germany after World War II, the two regions had similar endowments of human capital, similar culture, institutions and background, and similar economic characteristics such as income levels, trade patterns and the like. However, there were differences. The area of the GDR suffered

greater loses during World War II, was ultimately a "smaller" economy facing post war development integrated with the Soviet Bloc rather than Western trade and aid.

A critical issue distinguishing the nature of transition in different settings has been the role of the set of initial conditions, or distortions of resource allocation left over from the command era. Unlike most of the command economies, economic growth in the GDR was "intensive" although familiar distortions (heavy industry emphasis, for example) could be observed. The performance of the GDR was generally held to be among the best of the former command economies, though arguably the standard of living in the GDR at the beginning of unification was well below that in the FRG.

The process of transition in the former GDR was quite different from that in other transition economies, a fact which helps to explain observed outcomes during the 1990s. In a sense, the institutions and policies of the West were implanted quickly and aggressively into the former GDR. West German laws, financial institutions, trading arrangements and labor institutions were transferred directly to the East. Moreover, unlike other transition economies in which sources of capital accumulation became a major problem during transition, capital flows from West to East were a major stimulant to the transition process in the new united Germany.

Since the beginning of the transition era, the performance of the unified German economy has been mixed, perhaps in part a result of placing Western institutions on outdated Soviet type structures. In this setting, it is not surprising that changes in resource allocation, for example labor allocation, might be different in the unified German economy than in other transition economies.

An important approach to understanding and assessing the results of transition is an examination of various measures of convergence. Since a major objective of transition is to achieve market outcomes through newly established market mechanisms, it would seem natural to observe

outcomes such as rates of economic growth, structural changes, and changing trade patterns, asking to what degree such indicators have, in a new setting, converged towards market expectations. In this paper, we examine one important outcome, namely wage growth and structure, asking to what degree observed outcomes in East Germany have converged towards West German (market) patterns during the process of transition.

**3. Wages in Transition Settings**

During the command era, state enterprises dominated, wages were set by the state (with significant wage "leveling" in a socialist setting), and full employment was generally assured through overstaffing. As transition emerged, private enterprises replaced state enterprises, market institutions appeared (including labor unions), and the allocation of labor and related wage structures changed. Although it is difficult to generalize about outcomes in the many transition economies, typically there has been a shift of employment from the public to the private sector, wage variation has increased, while returns to education have increased in some cases, decreased in others. In most cases, unemployment has increased and the labor force has shrunk.

There is a small but substantial literature that has looked at wage growth and inequality in transition economies, in particular the East German economy. Hunt (2001) examines the determinants of wage growth from 1990-1996, emphasizing the role of job changes. She finds that low paid workers gained during the onset of the transition, while higher educated workers gained later on, perhaps understandable in the German case where the Western model was put in place very quickly. Franz and Steiner (2000) and Burda and Hunt (2001) address changes in the distribution of hourly wages from 1990-1997, finding that inequality increases. Some papers (e.g., Abraham and Houseman ,1995, Hunt, 2002, and Krueger and Pischke, 1995) discuss the effects of the transition

in terms of wage inequality and the gender wage gap. Biewen (2000) extensively analyzes income inequality changes (based on net monthly household income), finding increased inequality in East Germany after unification. Gang and Yun (2003) analyze the changes in wage dispersion in East Germany. Generally, all of these papers find a widening dispersion of household income and wages.

The literature has, for the most part, either addressed wage growth (important in the transition setting given very different wage setting processes in the command systems) or wage inequality. However, to develop a comprehensive picture of changes in the East Germany labor market since the fall of the Berlin Wall, we study both of these moments of the wage distribution. We employ the standard Oaxaca (1973) wage decomposition method and a newly developed Oaxaca-type inequality decomposition method (Yun, 2006), respectively, for analyzing the changes in mean wages and the changes in wage inequality since the fall of Berlin Wall. The standard Oaxaca decomposition explains wage differentials in terms of differences in individual characteristics (characteristics effect) and differences in the coefficients of the earnings equations (coefficients effect). Yun (2006) develops an inequality decomposition, an equivalent to Oaxaca decomposition for wage differentials by synthesizing the methods of Fields (2003) and Juhn, Murphy and Pierce (1993) and overcoming each own limitations. This allows us to explain changes in wage inequality in terms of changes in characteristics and changes in returns to characteristics at various levels of aggregation, in addition to changes in the distribution of residuals, also based on earnings equation estimates.

There is no *a priori* relationship between wage growth and changes in wage inequality. However, the fact that we use the same earnings equations estimates in both our decomposition of changes in mean wages and changes in wage dispersion (inequality) is of some interest. We consider whether, and to what degree, the same variables in the earnings equation contribute to changes in the two moments.

We turn next to a description of the data and major trends in male wages in East Germany since unification. Section 5 discusses our methodology. Our decomposition results for changes in the mean and dispersions of wages in East Germany, and comparisons to West Germany, are reported in Section 6. Section 7 concludes.

## 4. The Data and the Gaps

We employ the 1990-2000 waves of the German Socioeconomic Panel (GSOEP), a comprehensive panel of household and individual data.[1] Collection in East Germany began in 1990. We restrict our sample to individuals between 20 and 60 years old who have completed their education (including formal occupational training), whose real before tax wages (in 1995 DM) are less than 100DM per hour, and who work less than 100 hours per week. We exclude the self-employed, those on maternity leave, those in agriculture, and those who were originally in the sample but moved from East to West Germany. For each wave, we perform our analysis on all people meeting these criteria (unbalanced sample).

Basic data on East German men are presented in Table 1, where we observe for each year from 1990 to 2000 the mean hourly wage rates, and various standard measures of inequality (the variance of log-wage, a version of the Theil index, the Gini coefficient, the coefficient of variation and log-wage differentials between the top 10% and bottom 10% of the population).[2] The growth in mean wages and the immediate surge in wage inequality in East Germany stand out. Mean wages

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[1] We use the international version of the GSOEP, which is a 95% sample of the German version. For a full description, see http://www.diw.de/soep/soepe.htm.

[2] Population weights provided in the GSOEP data are applied to calculation of measures and estimation of earnings equations.

doubled during the first five years (1990-1994), while wage inequality measured by the variance of log-wages increases from 1990 to 2000 by 58.1%. The changes in wage inequality are remarkable: wage inequality in East Germany increased substantially during the first two years (1990-1991). From 1991 to 2000 wage inequality fluctuates without much overall change. The rapid increases in the level and inequality of East German wages over the decade stand in stark contrast to the lack of growth and inequality change in West Germany. In Figure 1 we contrast wage growth and changes in wage inequality (measured as the variance of log-wages) in East and West Germany, setting both measures equal to one in 1990, to emphasize their divergent paths.[3]

The striking increase in wage inequality in East Germany is not an artifact of our use of the variance of log-wages in Figure 1. Table 1 and Figure 3 show that the distribution of wages became much less egalitarian in East Germany using various indices from 1990 to 2000. The different indices generally agree on the path of inequality change, with the log-wage differentials between the top 10% and bottom 10% of the population behaving somewhat differently from the other measures. However, though the paths are not smooth or linear, Figure 3 shows that wage inequality among males has risen 25-61% over the transition. Similarly, Figure 4 shows stable wage inequality in West Germany using various measures.

In the remainder of the paper we restrict our attention to the variance of log-wages as our measure of inequality. The variance of log-wages has been widely used in studying wage inequality and serves quite well for our decomposition analysis. The variance of log-wages fluctuates somewhat, but generally indicates an increase in inequality among East German male wage earners

[3] Though our main focus is on male wage growth and changes in inequality, we show the trends in female wage levels and inequality in East and West Germany in Figure 2. The main difference in comparison to male wage inequality is that East German female wage inequality did not quickly surge after the fall of the Berlin Wall.

during transition, with inequality in 2000 at 158.13% of the level it was at in 1990.

Table 2 presents the sample means for the variables we use in our analysis. We examine traditional basic variables for our wage analysis: experience, education, occupation, firm size and industry. Our main interest is what happened between 1990 and 2000 in East Germany. However, we also examine the sub-period 1990-1994, as it appears most of the wage change occurred during this time. Education and experience increase slightly from 1990 to 2000. There is a substantial change in occupation, with the number of blue collar workers falling by 9%, and scientist/managers and office/business/service sector workers increasing by about 4.5% each. There is a marked movement to employment in smaller sized firms. The distribution of employment by sector also shifts, the most notable changes being the decline in transportation/postal, and the13% increase in the construction sector from 1990 to 1994, though it declined 4% from the 1994 peak by 2000.

Under socialism we would expect its bias toward egalitarianism to have suppressed wage differences and wage inequality. Our simple calculations show that among men absolute wages as well as wage dispersion have increased during transition. These simple numbers tell an amazing story of economic change during transition, especially in comparison to the lack of distributional changes in West Germany during this same period. The remainder of this paper attempts to disentangle some of the elements of this story by studying the sources of the changes in wage levels and inequality. We turn to an analysis of whether these changes in East Germany have their origins in changes in workers' characteristics or in the returns to their characteristics.

## 5. Explaining Wage Growth and Changes in Inequality using the Earnings Equation

Wage growth may be studied by applying the well-known Oaxaca decomposition method, based on the earnings equation. For examining changes in wage inequality measured in terms of the

variance of log-wages, Yun (2006) develops a new decomposition method utilizing the information contained in the earnings equation. Note that both decomposition methods utilize the same earnings equation. Both decomposition methods explain changes in the mean (level) and dispersion (inequality) of wages in terms of differences in characteristics (characteristics effect), differences in coefficients (coefficients effect) and differences in distribution of the residuals (residuals effect). Here we lay out our approach.

Let wages ($Y_t$) be generated from the following regression equations (earnings equations)

$$y_A = \beta_{0A} + \sum_{k=1}^{k=K-1} \beta_{kA} x_{kA} + e_A \text{ and}$$

$$y_B = \beta_{0B} + \sum_{k=1}^{k=K-1} \beta_{kB} x_{kB} + e_B, \quad (1)$$

where $y_t = \log(Y_t)$, and $x_{kt}$, $e_t$ are the $k$ th exogenous variable and residuals, respectively, and $t = A, B$. Exogenous variables in the regression specification usually do not include reference groups in order to avoid the dummy variable trap. However, the specification in the earnings equation above includes reference groups. That is, we use normalized equation (Suits, 1984). It is well-known that the Oaxaca decomposition used to study sources of differences in mean wages suffers from the so-called invariance or identification problem when sets of dummy variables are included (Oaxaca and Ransom, 1999). Recently it has been shown that using normalized equations offers a resolution to the invariance problem (Gardeazabal and Ugidos, 2004 and Yun, 2005a). We obtain the estimates of the normalized equation by transforming the estimates of the usual regression equation in which the reference groups are omitted (see the Appendix for an overview of the normalized equation).

In order to calculate characteristics, coefficients, and residuals effects, we construct auxiliary

equations. Start with the earnings equation for time period $A$ ($y_A$). First, replace the coefficients of the earnings equation of time period $A$ ($\beta_{kA}$) with those of time period $B$ ($\beta_{kB}$), while keeping the individual characteristics and residuals unchanged. The auxiliary earnings equation after changing coefficients is

$$y_1 = \beta_{0B} + \sum_{k=1}^{k=K-1} \beta_{kB} x_{kA} + e_A. \quad (2)$$

Second, replace the individual characteristics of time period $A$ ($x_{kA}$) with those of time period $B$ ($x_{kB}$).[4] Compute another auxiliary earnings equation,

$$y_2 = \beta_{0B} + \sum_{k=1}^{k=K-1} \beta_{kB} x_{kB} + e_A. \quad (3)$$

Finally, replace the residuals from time period $A$ ($e_A$) with those from time period $B$ ($e_B$). This results in exactly the earnings of time period $B$ ($y_B$). Using the four earnings equations, $y_A$, $y_1$, $y_2$ and $y_B$, we may compute measures of interests, $M(y)$. The measures corresponding to each earnings equation are denoted as $M(y_A), M(y_1), M(y_2)$ and $M(y_B)$, respectively.

The differences in measures of interests between time periods $A$ and $B$ are decomposed as follows;

$$M(y_A) - M(y_B) = [M(y_A) - M(y_1)] + [M(y_1) - M(y_2)] + [M(y_2) - M(y_B)], \quad (4)$$

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[4] In practice, the auxiliary earnings equation ($y_2$) can be obtained by replacing the residuals of the earnings equation from time period $B$ ($y_B$) with those of the earnings equation from time period $A$ ($y_A$). Juhn, Murphy and Pierce (1993) use the cumulative density functions of the residuals from the earnings equations $A$ and $B$ in order to find corresponding residuals between the two earnings equations ($y_A, y_B$).

where the first, second and last components of right hand side represent, respectively, the effects of differences in coefficients (coefficients or price effect), the effects of differences in individual characteristics (characteristics or quantity effect), and the effects of differences in the distribution of unobservables (residuals effect).

The first measure of interest to us is mean wages.[5] The decomposition of changes in (mean) wages can be formalized using the Oaxaca decomposition equation,

$$\begin{aligned} &\bar{y}_A - \bar{y}_B \\ &= \Sigma_{k=1}^{k=K-1} (\bar{x}_{kA} - \bar{x}_{kB}) \beta_{kB} + [ (\beta_{0A} - \beta_{0B}) + \Sigma_{k=1}^{k=K-1} \bar{x}_{kA} (\beta_{kA} - \beta_{kB}) ] + \bar{e}_A - \bar{e}_B , \end{aligned} \tag{5}$$

where $\Sigma_{k=1}^{k=K-1} (\bar{x}_{kA} - \bar{x}_{kB}) \beta_{kB}$, $[ (\beta_{0A} - \beta_{0B}) + \Sigma_{k=1}^{k=K-1} \bar{x}_{kA} (\beta_{kA} - \beta_{kB}) ]$ and $\bar{e}_A - \bar{e}_B$ are, respectively, characteristics, coefficients, and residuals effects. The first and second components of the coefficients effect are related to the effect of differences in constants and differences in coefficients of characteristics other than constants on changes in wages. When OLS is used for the estimation of the earnings equation, the residuals effect is zero.

We also study changes in the dispersion of wages using an inequality decomposition method which unifies the methods of Fields (2003) and Juhn, Murphy and Pierce (1993). We have already introduced the decomposition method by Juhn, Murphy and Pierce (1993) in equation (4). Their method, however, cannot identify characteristics and coefficients effects at the individual variable level, i.e., a detailed decomposition. This shortcoming is overcome by incorporating an inequality decomposition method by Fields (2003).

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[5] It is obvious that we don't need to construct $y_2$ to isolate the residuals effect when we study changes in mean wages.

From equation (1), we can find following identity, $\sigma_y^2 = \sum_{k=1}^{K-1} \sigma_{\beta_k x_k, y} + \sigma_{e,y}$, where $\sigma_{e,y} = \sigma_e^2$ if OLS is used for estimating equation (1). Fields (2003) defines the relative factor inequality weight for a factor *k* using the OLS estimate of the coefficient of the earnings equation as $s_k = \sigma_{\beta_k x_k, y} / \sigma_y^2 = \beta_k \sigma_{x_k} \rho_{x_k, y} / \sigma_y$, where $\sigma_{x_k}$ is the standard deviation of $x_k$ and $\rho_{x_k, y} = \sigma_{x_k, y} / \sigma_{x_k} \sigma_y$.[6] Fields applies the relative factor inequality weight ($s_k$) to study the changes in wage inequality over time. Fields' method, however, does not decompose the changes in wage inequality in terms of characteristics, coefficients and residuals effects

By unifying the two methods the changes in the variance of log-wages may be decomposed as follows (Yun, 2006),

$$\begin{aligned} \sigma_{y_A}^2 - \sigma_{y_B}^2 = & \sum_{k=1}^{k=K-1} (s_{ky_1} \sigma_{y_1}^2 - s_{ky_B} \sigma_{y_B}^2) \\ & + \sum_{k=1}^{k=K-1} (s_{ky_A} \sigma_{y_A}^2 - s_{ky_1} \sigma_{y_1}^2) \\ & + (\sigma_{e_A}^2 - \sigma_{e_B}^2), \end{aligned} \tag{6}$$

where $y_1 = \beta_{0B} + \sum_{k=1}^{k=K-1} \beta_{kB} x_{kA} + e_A$ . The first, second and last terms of the equation (6), respectively, represent the characteristics, coefficients, and residuals effects.

As shown above, both decomposition equations (5) and (6) are based on the information contained in the earnings equation (1). Wage growth and changes in wage inequality may be explained in terms of changes in characteristics, changes in coefficients and residuals effect using

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[6] In the inequality literature the term "factor" is used, while in other literatures the term "variable" is used. We use the terms interchangeably.

the equation (5) and (6), respectively. We are thus able to closely examine whether similar driving forces are behind changes in mean wages and the dispersion (inequality) of wages.

## 6. Analysis - Empirical Results

In this section we present our decomposition results. We apply the standard Oaxaca decomposition for wage growth and the unified inequality decomposition to study the coefficients, characteristics, and residuals effects. Our primary emphasis is on what happened to the wage distribution of East German male workers from 1990 to 2000. Changes in wages during the first 5-year sub-period 1990-1994 are also examined since effects of the transition from a socialist to a market-oriented economic system on wages are quite visible in the first half of the decade. Later in this section, we compare our 1990-2000 results to West German male wage earners during the same period in order to investigate whether convergence took place in terms of mean (level) and dispersion (inequality) of wages between East and West Germany. In order to perform both our wage level and inequality decompositions, we estimate earnings equations for 1990, 1994 and 2000 using OLS.

### 6.1. Analyzing Changes in Wages in East Germany: Level and Dispersion

Table 3 reports the earnings equation estimates for East German males. In both 1990 and 2000 experience is significant and follows an inverse U-shape. Education adds to wages, with the return to an additional year of schooling increasing from 1990 to 2000. Occupation, firm size, and industry differentially affect wages, and the effects seem to vary from 1990 to 2000. The Oaxaca decomposition of wage changes is presented in Table 4, while the Yun (2006) decomposition of

inequality change is found in Tables 5-1 and 5-2.[7] Each decomposition is broken down into the effects of human capital, occupation, firm size, industry and either the intercept (wage growth) or the residuals (inequality change).

From 1990 to 2000, male real wages increased by 118.05% or 0.75 log points. Most of the increase occurred during the first half of the decade. From 1990 to 1994 the increase was by 101.40% or 0.68 log points. Table 4 reports the wage growth decomposition results. The characteristics effect tells us the effect on male wages from 1990 to 2000 of changes in the levels of the attributes possessed by male respondents, holding the coefficients' constant. The coefficients effect shows the effect on male wages of changes in the prices paid for characteristics, holding the level of the characteristics unchanged. Examining the top row in Table 4, it is clear that the characteristics effect does not explain wage growth; men's wages are increasing exclusively because of the coefficient effect, i.e., changes in wage structure due to the transition from a socialist to a market-oriented system in East Germany.

In Table 4 we also provide a more detailed decomposition - into the characteristics and the coefficients effects of groups of variables and individual variables. Here we see most of the real wage growth for East German males was due to a change in the intercept. In the 1990-94 (1990-2000) period it explains 96.2% (87.0%) of the total wage change. This may indicate that wages shift up and most of the wage increase may not be attributed to changes in individual characteristics.

The premium to education only accounts for 6.5% of the change in wages for 1990-1994. However, from 1990-2000, the education premium accounts for 21.3% of wage growth. Thus the role of education increases dramatically over the decade. Similar results are found in Munich,

[7] Tables using the usual (non-normalized) regression equation are available from authors upon request.

Svejnar and Terrell (2005) and Chase (1998) for the Czech Republic, Gang and Stuart (1997, 2000) on Soviet emigres to the U.S., and Bird, Schwarze and Wagner (1994) and Krueger and Pischke (1995) for the early transition in East Germany.

Tables 5-1 and 5-2 show our inequality decomposition results from 1990 to 2000 and 1990 to 1994, respectively, where the variance of log-earnings is used as our inequality measure. The left hand side columns of each table shows us how much each variable contributes to inequality in that year, while the right hand side columns show decomposed inequality change. From 1990 to 2000 wage inequality measured by the variance of log-wages increased by 58.1% (from 0.086 to 0.135). In total, the characteristics, coefficients and residuals effects are, respectively, 0.6%, 46.6% and 52.7%. This means that wage inequality in 2000 was higher than in 1990 due to differences in the coefficients of the earnings equation by 46.6% and due to differences in the distribution of residuals by 52.7%. However, the effect of differences in the characteristics of wage/salary earners on increasing wage inequality was negligible (0.6%).

As we did in the wage growth decomposition, from Tables 5-1 and 5-2 it is easy to see the sources of the changes in wage inequality. The variables used in the inequality decomposition may be grouped as human capital (education and experience), occupation, firm size and industry.[8] During the transition, the residuals played a major role in wage inequality change. Judging from the gross effects of the variables (that is, the sum of the coefficients and characteristics effects), factors related to education and firm size have played major roles in widening wage inequality while only a few variables contributed to narrowing wage inequality. When the gross effects are further decomposed into characteristics and coefficients effects, the fact that the characteristics effect is negligible for

[8] The effects of categorical variables (e.g., industry) or very closely related variables (e.g., experience and experience squared in hundreds) are computed by aggregating the effects of each variable.

virtually every factor stands out. Indeed, the coefficients effect is almost equal to the gross effect. As the East German economy increased its market-orientation, the returns to schooling increased. The increase in the returns to schooling and increasing wage inequality may point to the fact that the East German economy not only experienced transition to a market oriented economy, but also skill-biased technological changes (see Juhn, Murphy and Pierce (1993) for the effects of skill-biased technological changes on inequality).[9] Another interesting finding is that the large firm size premium became substantial. It is also noteworthy that though the industrial wage premium changes during the transition, it does not contribute much to the changes in wage inequality.

Although there is no systematic relationship between changes in the level and dispersion of wages in general, it may be interesting to examine whether the effect of the transition on both moments of the wage distribution can be explained in similar fashions. The fact that both decompositions are based on exactly the same earnings equation estimation makes it easy to compare which factors play a role in wage growth vis-a-vis those that play a role in inequality change. In terms of level and dispersion, the characteristics effect can not explain changes in the wage distribution, while the remaining coefficients effect and the residuals effect explain virtually everything. Blau and Kahn (1996, page 813) have written "...we consider the part of the differential that is not accounted for by measured characteristics as potentially due to wage structure,...." In our context we offer a similar explanation - we are observing a change in wage structure due to transition from a socialist to market-oriented economy.

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[9] Interestingly, the changes in returns to experience do not explain much of the change in wage inequality. The increases in the returns to observed skills (measured by experience and schooling), in addition to unobserved skills, are major components of a skill-biased technological change explanation of the widening wage inequality during last two or three decades in the United States. See Card and DiNardo (2002) for a critical review of explanations of increasing wage inequality based on skill-biased technological changes.

Another notable fact regards the roles of the intercept and residuals in the decomposition analysis of changes in the level and dispersion of wages. Above we argue that changes not explained by changes in the distribution of characteristics can be thought of as the effect of changes in the wage structure. It is clear from our decompositions that the driving force in explaining the changes in the wage structure cannot be attributed to the individual variables. Rather, system change may be directly captured by the intercept term coefficient effect and the residuals effect, in the wage growth and inequality decompositions, respectively.

The role played by specific variables, e.g., education, firm size, etc., vary in their importance in explaining wage growth and inequality change. From the analysis we see that the coefficients effect is far larger than the characteristics effect. Education is important in explaining both wage growth and increased inequality, particularly the coefficients effect of education, 21.3% and 17.3%, respectively. It appears that, overall, the same variables are important in explaining both wage growth and inequality change. The size of each variable's impacts, however, varies in our two decompositions.

**6.2. Closing Gap between East and West Germany**

Our analysis so far has dealt with what has happened to male wages in East Germany after the Berlin Wall fell. A natural question to ask is how do our results compare to what has been happening to the male wages in West Germany. Whether or not we consider the wage distribution of West Germany desirable, it is likely that a unified Germany will eventually have similar wage distributions in both the East and West. This outcome, given our earlier discussion of the unique nature of transition in the German setting, will set it apart from transition outcomes in other settings. Our expectations are that the largest changes should be in East Germany, and that East Germany's

economic characteristics should converge on West Germany's values, and should do so relatively quickly.

Figure 1 shows that male real wages in West Germany rose very little in the 1990s. This corresponds to Franz and Steiner (2000) finding that the West German wage structure has remained fairly stable in the 1990s, whereas in East Germany it has changed. East German wages over the course of the decade, but especially in the first few years of the transition, began to converge to those of the West. The wage gap between West and East German men was approximately 118% in 1990, falling to 40% by 2000. For the early years our results are similar to those of Burda and Schmidt (1997) who find a persistent wage gap of 20-30% between West and East Germany. An Oaxaca decomposition of the wage gap between West and East Germany (Figure 5) shows that the characteristics effect explains very little of the convergence in the wage gap. That is, the level of, and changes in, the wage gap are explained entirely by the coefficients effect. Furthermore, when we identify the effect of differences in intercept between East and West Germany separately, the intercept seems to play a trend-setting role. It seems reasonable to conclude that the unique nature of the German transition, that is the immediate shift of institutions and policies from West to East, has played a major role in the changes observed in the East, and the convergence of the East to Western values.

Figure 1 and Figure 4 show the changes in wage inequality in West Germany during 1990-2000. In Figure 4 we see that, again, different measures provide us with somewhat different pictures about what is happening to inequality in West Germany. On balance it looks like inequality within West Germany decreased slightly during the first part of the decade, but on net for the decade inequality stayed the same.

We apply the unified decomposition in order to explain the wage inequality gap between

West and East Germany. As shown in Figure 6, this difference in wage inequality is explained largely by the residuals effect with some contribution by the coefficients effect.

As Figure 7 shows, over the course of the decade, East German wages grew closer to West German wages, especially in the first 5 years. From Figure 8 we observe that male wage inequality increased in East Germany, but remained relatively stable in West Germany. The main driving force behind the convergence between East and West Germany seems to be the fact that the East German economy has adopted the market- oriented economy of West Germany, but did so in a setting and process quite different from other more isolated transition economies. The effect of differences in the intercept in the wage gap decomposition and the residuals effect in the wage inequality decomposition might be the most outstanding indication of the effect of transition on the wage distribution.

**7. Conclusion**

In this paper we examine the increases in the level and inequality of male wages in East Germany following the fall of the Berlin Wall. From 1990 to 2000 both wage levels and wage inequality increased substantially in East Germany, as expected for economies in transition from a socialist to a market oriented system. Real wages doubled, while inequality rose by 58.1 percent (using the variance of log-wages) over the decade. Are these wage changes due to the transition, and especially the unique nature of transition in the German case? Which variables have played the largest role in changing the wage distribution in terms of level and dispersion? In order to answer these questions, decomposition methods are employed for changes in wage levels and dispersion.

For studying increases in mean wages, a methodological fit is readily available. Using the Oaxaca decomposition we decompose wage changes for East German males over the decade using

the estimates of the earnings equation. We also examine changes in the wage gap between East and West Germany. In order to examine changes in wage inequality, another decomposition method developed in the spirit of the Oaxaca decomposition (Yun, 2006) is utilized.

One advantage of using these decompositions for changes in mean wages and inequality is that both decomposition methods are based on a regression equation, the earnings equation. We are able to decompose the changes into characteristics, coefficients and residuals effects at both overall and detailed levels. These two methods, taken together, allow us to easily compare which variables play a role in wage growth and which variables play a role in inequality change.

For East Germany, the characteristics effect does not explain changes in the wage distribution in terms of level or dispersion. This leaves the coefficients effect and the residuals effect exclusively to explain the changes in wages in level and dispersion. Both the coefficients effect and the residuals effect may be interpreted as representing the effect of transition, that is economic system-wide changes from a socialist to a market-oriented economy. In particular, the fact that the intercept and residuals, respectively, play the major role in explaining the changes in the level and dispersion of wages lends support to the story that the impact of transition on the wage distribution is enormous and cannot be easily attributed to individual variables. This does not necessarily mean that specific variables do not play a role in explaining wage growth and inequality change. The same variables tend to be important, though the size of their impact varies in the two decompositions. What is very clear is that the coefficients effect is far larger than the characteristics effect. The role played by specific variables, e.g., education, firm size, etc., are sometimes a little different but the fact that the coefficients effect is by far the larger than the characteristics effect is confirmed from the two decomposition results.

We come to similar conclusions when we compare the changes in East Germany to changes

experienced in West Germany over the same period of time. The wage distribution of West Germany has not changed substantially during last decade; the transition in East Germany is the driving force behind the observed convergence between East and West.

The results that we have observed in this paper are precisely those that would be expected in a case where market institutions and policies have in fact replaced command institutions and polices. The result that we observe is a convergence of outcomes towards expected market patterns confirming the strength and speed of the transition process in the German case.

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**Appendix. Overview of normalized regression equation and decomposition analysis**

Suppose that we have two sets of dummy variables in addition to continuous variables in the regression equation.[10] The usual regression equation – suppressing the individual subscripts – is as follows,

$$y = \alpha + \left[\sum_{g=2}^{G} D_g \cdot \kappa_g + \sum_{t=2}^{T} Q_t \cdot \zeta_t\right] + \sum_{l=1}^{L} V_l \cdot \delta_l + e, \quad (7)$$

where there are two sets of categorical variables ($D$'s and $Q$'s) and $L$ continuous variables ($V$'s); the first and second sets of dummy variables ($D$'s and $Q$'s) have $G$ and $T$ categories and $G$-1 and $T$-1 dummy variables in the equation, respectively; without loss of generality, the reference group is the first category for each set of dummy variables, i.e., $\kappa_1 = \zeta_1 = 0$.

The identification problem in the detailed Oaxaca decomposition is that the sum of the coefficients effects for dummy variables of the $D$'s, i.e., $\sum_{g=2}^{G} \overline{D}_{gA}(\kappa_{gA} - \kappa_{gB})$, is not invariant when the reference group is changed (Oaxaca and Ransom, 1999). The same is true of the coefficients effects for dummy variables of the $Q$'s. One solution is using a normalized equation which can separately identify the intercept and coefficients of all dummy variables including the reference category (Yun, 2005a and Gardeazabal and Ugidos, 2004).[11] As long as consistent estimates of equation (4) are obtained, we can manipulate these consistent estimates to obtain a normalized regression equation (Suits, 1984 and Yun, 2005a).[12] The normalized regression equation

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[10] The extension of the discussion to incorporate more sets of dummy variables is trivial.

[11] The sums of coefficients for sets of dummy variables (e.g., $D$'s or $Q$'s including the omitted category variable) in the normalized equation are restricted to be zero.

[12] Gardeazabal and Ugidos (2004) transform dummy variables and estimate coefficients in the normalized regression equation. Their method can be extended beyond OLS. However, if the model becomes more complicated, then their method may be less attractive since they have to revise the

is:[13]

$$y = (\alpha + \bar{\kappa} + \bar{\zeta}) + \left[\sum_{g=1}^{G} D_g(\kappa_g - \bar{\kappa}) + \sum_{t=1}^{T} Q_t(\zeta_t - \bar{\zeta})\right] + \sum_{l=1}^{L} V_l \delta_l + e, \qquad (7')$$

where $\bar{\kappa} = \sum_{g=1}^{G} \kappa_g / G$, $\bar{\zeta} = \sum_{t=1}^{T} \zeta_t / T$, and $\kappa_1 = \zeta_1 = 0$. The covariance of the estimates in the normalized equation can be easily obtained using the covariance matrix of the consistent estimates for equation (7). $X$ and $\beta$ in the equations of Section 5 consist of (1, $D$'s, $Q$'s and $V$'s), and ($\alpha + \bar{\kappa} + \bar{\zeta}$, $(\kappa_g - \bar{\kappa})$'s, $(\zeta_t - \bar{\zeta})$'s, and $\delta$'s), respectively.

We can apply the Oaxaca decomposition with the normalized equation (7'). It resolves the identification or invariance problem for the detailed decomposition. We can test hypotheses regarding characteristics and coefficients effects the same way as we do with usual estimates and their covariance matrix. It is obvious that the use of the normalized equation does not change our inference for the overall characteristics and coefficients effects (see Yun, 2005b, for details).

It is easy to show that using normalized regression does not change the contribution of the set of dummy variables to inequality, hence the decomposition results will not be affected. For illustration's purposes, let's examine sum of contribution of dummy variables, $D$'s to inequality. Define $\kappa_g^* = \kappa_g - \bar{\kappa}$, where $\bar{\kappa} = \sum_{g=1}^{G} \kappa_g / G$.

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estimation method in order to accommodate the transformed dummy variables in a complicated model. The existing approaches to derive the normalized regression equation are discussed in Yun (2005a).

[13] This paper assumes the simple average of coefficients of dummy variables is used in order to derive the normalized regression equation. Though it is easy to derive a normalized regression using the average of the dummy variables' coefficients weighted by the share of each group, this has the implication that the sum of the product of the dummy variables and their coefficients should be zero, which is not attractive for the Oaxaca decomposition (Yun, 2005a).

$$\sum_{g=1}^{G} \sigma_{D_g \kappa_g^*, y} = \sigma_{D_1 \kappa_1^*, y} + \sum_{g=2}^{G} \sigma_{D_g \kappa_g^*, y}$$

$$= \sigma_{\kappa_1^*, y} - \sum_{g=2}^{G} \sigma_{D_g \kappa_1^*, y} + \sum_{g=2}^{G} \sigma_{D_g \kappa_g^*, y}$$

$$= -\sum_{g=2}^{G} \sigma_{D_g \kappa_1^*, y} + \sum_{g=2}^{G} \sigma_{D_g \kappa_g^*, y}$$

$$= -\sum_{g=2}^{G} \sigma_{D_g \kappa_1, y} + \sum_{g=2}^{G} \sigma_{D_g \kappa_g, y}$$

$$= \sum_{g=2}^{G} \sigma_{D_g \kappa_g, y}$$

Note that $\sigma_{\kappa_1^*, y} = 0$ since $\kappa_1^*$ is a scalar, and $-\sum_{g=2}^{G} \sigma_{D_g \kappa_1, y} = 0$ since $\kappa_1 = 0$.

Table 1. Mean Wages and Inequality Measures (Former East Germany, Men)

| | Mean | VLOG | Theil | Gini | CV | Log-Diff. |
|---|---|---|---|---|---|---|
| 1990 | 8.292 | 0.086 | 0.045 | 0.158 | 0.322 | 0.656 |
| | (100.00) | (100.00) | (100.00) | (100.00) | (100.00) | (100.00) |
| 1991 | 12.014 | 0.137 | 0.084 | 0.211 | 0.462 | 0.841 |
| | (144.89) | (160.09) | (187.04) | (133.39) | (143.38) | (128.15) |
| 1992 | 13.767 | 0.145 | 0.094 | 0.204 | 0.541 | 0.761 |
| | (166.03) | (169.66) | (209.47) | (128.80) | (168.15) | (115.89) |
| 1993 | 15.668 | 0.151 | 0.087 | 0.215 | 0.477 | 0.883 |
| | (188.96) | (176.21) | (194.84) | (135.77) | (148.23) | (134.58) |
| 1994 | 16.699 | 0.117 | 0.062 | 0.186 | 0.388 | 0.842 |
| | (201.40) | (136.67) | (139.45) | (117.51) | (120.61) | (128.29) |
| 1995 | 17.295 | 0.145 | 0.081 | 0.204 | 0.458 | 0.825 |
| | (208.59) | (169.71) | (181.31) | (129.09) | (142.31) | (125.65) |
| 1996 | 18.280 | 0.135 | 0.078 | 0.205 | 0.439 | 0.896 |
| | (220.47) | (157.93) | (173.30) | (129.19) | (136.23) | (136.46) |
| 1997 | 18.191 | 0.146 | 0.082 | 0.209 | 0.458 | 0.872 |
| | (219.39) | (170.38) | (183.21) | (132.07) | (142.13) | (132.83) |
| 1998 | 18.878 | 0.161 | 0.091 | 0.223 | 0.479 | 0.924 |
| | (227.67) | (187.66) | (204.16) | (140.79) | (148.78) | (140.82) |
| 1999 | 18.917 | 0.148 | 0.098 | 0.223 | 0.522 | 0.880 |
| | (228.15) | (172.36) | (219.89) | (140.81) | (162.13) | (134.15) |
| 2000 | 18.080 | 0.135 | 0.072 | 0.207 | 0.405 | 0.924 |
| | (218.05) | (158.13) | (161.48) | (130.87) | (125.82) | (140.82) |

1. Hourly wage rates in terms of 1995 constant German Mark.

2. VLOG, Theil, Gini, CV and Log-Diff. are variance of log-earnings, a version of Theil index, the Gini coefficient, coefficient of variation and log-wage differentials between top 10% and bottom 10%, respectively. Theil's index uses the equation $1/n\sum_{i=1}^{n}(Y_i/\mu_Y)\log(Y_i/\mu_Y)$, where $Y$, $\mu_Y$, and $n$ are, respectively, wages (level), mean wages, and number of observations.

3. Standardized inequality measure (1990 = 100) is reported in parentheses.

Table 2. Sample Means

| | 1990 | | 1994 | | 2000 | |
|---|---|---|---|---|---|---|
| Wages (constant 1995 DM) | 8.292 | (2.670) | 16.699 | (6.486) | 18.080 | (7.326) |
| Experience | 20.846 | (11.274) | 20.131 | (10.073) | 22.407 | (9.845) |
| Education (year) | 12.258 | (2.351) | 12.335 | (2.298) | 12.554 | (12.269) |
| Occupation | | | | | | |
| Scientist/Manager* | 0.192 | (0.394) | 0.164 | (0.370) | 0.233 | (0.423) |
| Office/Business/ Service | 0.152 | (0.359) | 0.195 | (0.397) | 0.193 | (0.394) |
| Blue Collar | 0.655 | (0.475) | 0.641 | (0.480) | 0.574 | (0.494) |
| Firm Size | | | | | | |
| - <20 * | 0.107 | (0.309) | 0.287 | (0.452) | 0.296 | (0.457) |
| 20 - <200 | 0.206 | (0.405) | 0.353 | (0.478) | 0.415 | (0.493) |
| 200 - <2000 | 0.347 | (0.476) | 0.198 | (0.399) | 0.129 | (0.335) |
| 2000+ | 0.340 | (0.474) | 0.162 | (0.368) | 0.160 | (0.367) |
| Industry | | | | | | |
| Public Administration* | 0.058 | (0.234) | 0.091 | (0.287) | 0.088 | (0.283) |
| Energy/Water/Mining | 0.074 | (0.262) | 0.053 | (0.224) | 0.033 | (0.179) |
| Chemicals/Synthetics | 0.071 | (0.257) | 0.031 | (0.173) | 0.038 | (0.192) |
| Iron/Mechanical | 0.167 | (0.373) | 0.144 | (0.351) | 0.134 | (0.341) |
| Electrical/Clothing | 0.189 | (0.392) | 0.110 | (0.313) | 0.129 | (0.335) |
| Construction | 0.131 | (0.337) | 0.264 | (0.441) | 0.238 | (0.426) |
| Sales | 0.050 | (0.219) | 0.089 | (0.285) | 0.088 | (0.283) |
| Transportation/Postal | 0.130 | (0.337) | 0.100 | (0.300) | 0.071 | (0.256) |
| Finance/Education/ Health /Legal | 0.114 | (0.317) | 0.099 | (0.299) | 0.150 | (0.357) |
| Service | 0.016 | (0.125) | 0.020 | (0.140) | 0.032 | (0.175) |
| Sample Size | 1011 | | 764 | | 663 | |

Standard deviations are reported in parentheses.

* indicates a reference group in the regression analysis.

Table 3. Regression Results of Earnings Equations (Normalized Equations)

| | 1990 | | 1994 | | 2000 | |
|---|---|---|---|---|---|---|
| Constant | 1.387* | (0.075) | 2.045* | (0.097) | 2.042* | (0.102) |
| Experience | 0.017* | (0.003) | 0.021* | (0.005) | 0.015* | (0.006) |
| Exprience$^2$ / 100 | -0.030* | (0.007) | -0.043* | (0.011) | -0.027* | (0.012) |
| Education (year) | 0.039* | (0.005) | 0.042* | (0.006) | 0.052* | (0.007) |
| Occupation | | | | | | |
| Scientist/Manager | 0.070* | (0.019) | 0.074* | (0.024) | 0.080* | (0.025) |
| Office/Business/ Service | -0.050* | (0.017) | -0.061* | (0.021) | -0.048* | (0.024) |
| Blue Collar | -0.020 | (0.015) | -0.013 | (0.021) | -0.031* | (0.023) |
| Firm Size | | | | | | |
| - < 20 | -0.068* | (0.020) | -0.135* | (0.020) | -0.185* | (0.022) |
| 20 - <200 | -0.000 | (0.016) | -0.048* | (0.017) | -0.043* | (0.020) |
| 200 - <2000 | 0.019 | (0.013) | 0.048* | (0.021) | 0.133* | (0.027) |
| 2000+ | 0.050* | (0.014) | 0.135* | (0.024) | 0.096* | (0.027) |
| Industry | | | | | | |
| Public Administration | 0.040 | (0.033) | 0.010 | (0.036) | 0.008 | (0.044) |
| Energy/Water/Mining | 0.104* | (0.029) | 0.108* | (0.045) | 0.148* | (0.061) |
| Chemicals/Synthetics | 0.030 | (0.030) | -0.056 | (0.056) | -0.043 | (0.057) |
| Iron/Mechanical | 0.049* | (0.021) | 0.004 | (0.029) | 0.053 | (0.033) |
| Electrical/Clothing | -0.006 | (0.020) | -0.024 | (0.033) | 0.039 | (0.035) |
| Construction | 0.035 | (0.023) | 0.120* | (0.026) | 0.055 | (0.030) |
| Sales | -0.057 | (0.035) | -0.096* | (0.036) | -0.124* | (0.040) |
| Transportation/Postal | 0.044 | (0.023) | -0.070* | (0.035) | -0.012 | (0.044) |
| Finance/Education/ Health /Legal | -0.023 | (0.025) | 0.018 | (0.035) | 0.012 | (0.035) |
| Service | -0.216* | (0.060) | -0.015 | (0.071) | -0.135* | (0.062) |
| Adjusted $R^2$ | 0.223 | | 0.270 | | 0.306 | |
| F Value | 18.11* | | 17.58* | | 18.13* | |
| Sample Size | 1011 | | 764 | | 663 | |

1. Standard errors are reported in parentheses, and * means statistically significant at 5%.

2. In the usual equations, the reference groups are scientist/manager for occupation, size less than 20 for firm size and public administration for industry.

3. Adjusted $R^2$ and F value are computed from estimating the usual equations.

Table 4. Decomposing Changes in Wages (1990-2000 and 1990-1994)

| | 1990-2000 | | | | 1990-1994 | | | |
|---|---|---|---|---|---|---|---|---|
| | Char. Effect | | Coeff. Effect | | Char. Effect | | Coeff. Effect | |
| Total | -0.008 | (-1.0) | 0.761* | (101.0) | -0.022* | (-3.3) | 0.706* | (103.3) |
| Constant | | | 0.655* | (87.0) | | | 0.658* | (96.2) |
| Excluding Constant | -0.008 | (-1.0) | 0.106 | (14.0) | -0.022* | (-3.3) | 0.048 | (7.1) |
| Human Capital | 0.026* | (3.5) | 0.135 | (18.0) | 0.008* | (1.1) | 0.059 | (8.7) |
| Experience | 0.026* | (3.5) | -0.043 | (-5.7) | -0.012* | (-1.8) | 0.078 | (11.4) |
| Experinece$^2$/100 | -0.011* | (-1.5) | 0.017 | (2.3) | 0.017* | (2.4) | -0.063 | (-9.2) |
| Education | 0.011* | (1.5) | 0.160 | (21.3) | 0.003* | (0.4) | 0.045 | (6.5) |
| Occupation | 0.002 | (0.3) | -0.004 | (-0.5) | -0.004* | (-0.6) | 0.003 | (0.5) |
| Scientist/Manager | 0.003* | (0.4) | 0.002 | (0.3) | -0.002* | (-0.3) | 0.001 | (0.1) |
| Office/Business/ Service | -0.002* | (-0.3) | 0.000 | (0.0) | -0.002* | (-0.3) | -0.002 | (-0.3) |
| Blue Collar | 0.002 | (0.2) | -0.006 | (-0.9) | 0.000 | (0.0) | 0.005 | (0.7) |
| Firm Size | -0.026* | (-3.5) | -0.030* | (-4.0) | -0.024* | (-3.5) | -0.016* | (-2.4) |
| - <20 | -0.013 | (-1.7) | -0.035* | (-4.6) | -0.012* | (-1.8) | -0.019* | (-2.8) |
| 20 - <200 | -0.000 | (-0.0) | -0.018 | (-2.4) | -0.000 | (-0.0) | -0.017* | (-2.5) |
| 200-<2000 | -0.004 | (-0.5) | 0.015* | (2.0) | -0.003 | (-0.4) | 0.006 | (0.9) |
| 2000+ | -0.009* | (-1.2) | 0.007 | (1.0) | -0.009* | (-1.3) | 0.014* | (2.0) |
| Industry | -0.011* | (-1.4) | 0.005 | (0.6) | -0.002 | (-0.3) | 0.002 | (0.3) |
| Public Administration | 0.001 | (0.2) | -0.003 | (-0.4) | 0.001 | (0.2) | -0.003 | (-0.4) |
| Energy/Water/ Mining | -0.004* | (-0.6) | 0.001 | (0.2) | -0.002 | (-0.3) | 0.000 | (0.0) |
| Chemicals/ Synthetics | -0.001 | (-0.1) | -0.003 | (-0.4) | -0.001 | (-0.2) | -0.003 | (-0.4) |
| Iron/Mechanical | -0.002* | (-0.2) | 0.000 | (0.1) | -0.001* | (-0.2) | -0.007 | (-1.0) |
| Electrical/Clothing | 0.000 | (0.0) | 0.006 | (0.8) | 0.000 | (0.1) | -0.002 | (-0.3) |
| Construction | 0.004 | (0.5) | 0.005 | (0.6) | 0.005 | (0.7) | 0.022* | (3.3) |
| Sales | -0.002 | (-0.3) | -0.006 | (-0.8) | -0.002 | (-0.3) | -0.003 | (-0.5) |
| Transportation/ Postal | -0.003 | (-0.3) | -0.004 | (-0.5) | -0.001 | (-0.2) | -0.011* | (-1.7) |
| Finance/Education/ Health /Legal | -0.001 | (-0.1) | 0.005 | (0.7) | 0.000 | (0.0) | 0.004 | (0.6) |
| Service | -0.003* | (-0.5) | 0.003 | (0.3) | -0.001* | (-0.1) | 0.004* | (0.6) |

1. Share of changes in log wages, 0.753 (=2.825-2.072) between 1990 and 2000 and 0.684 (=2.756-2.072), are reported in parentheses.

2. * means statistically significant at 5%.

Table 5-1. Decomposition of Changes in Male Inequality (1990-2000)

| | Earning Inequality [a] | | | | Decomposition [b] | | | |
|---|---|---|---|---|---|---|---|---|
| | 1990 | | 2000 | | Char. Effect | | Coeff. Effect | |
| Total | 0.086 | (100.0) | 0.135 | (100.0) | 0.000 | (0.6) | 0.023 | (46.6) |
| Human Capital | 0.013 | (14.7) | 0.020 | (14.9) | -0.001 | (-1.0) | 0.008 | (16.2) |
| Experience | 0.005 | (6.0) | 0.003 | (2.1) | -0.001 | (-2.5) | -0.001 | (-2.2) |
| Experinece$^2$/100 | -0.002 | (-2.7) | -0.001 | (-1.1) | 0.000 | (0.8) | 0.001 | (1.1) |
| Education | 0.010 | (11.4) | 0.019 | (13.8) | 0.000 | (0.6) | 0.009 | (17.3) |
| Occupation | 0.004 | (4.4) | 0.005 | (3.8) | -0.001 | (-1.0) | 0.002 | (3.7) |
| Scientist/Manager | 0.003 | (3.2) | 0.004 | (2.7) | -0.000 | (-0.7) | 0.001 | (2.5) |
| Office/Business/ Service | 0.000 | (0.5) | 0.000 | (0.0) | -0.000 | (-0.3) | -0.000 | (-0.4) |
| Blue Collar | 0.001 | (0.7) | 0.001 | (1.1) | -0.000 | (-0.1) | 0.001 | (1.7) |
| Firm Size | 0.002 | (2.3) | 0.015 | (10.9) | 0.000 | (0.5) | 0.013 | (25.3) |
| - <20 | 0.001 | (1.2) | 0.009 | (6.8) | 0.000 | (1.0) | 0.008 | (15.4) |
| 20 - <200 | 0.000 | (0.0) | -0.000 | (-0.0) | -0.000 | (-0.0) | -0.000 | (-0.0) |
| 200-<2000 | 0.000 | (0.0) | 0.003 | (2.5) | 0.000 | (0.2) | 0.003 | (6.6) |
| 2000+ | 0.001 | (1.1) | 0.002 | (1.7) | -0.000 | (-0.6) | 0.002 | (3.3) |
| Industry | 0.002 | (2.3) | 0.004 | (2.7) | 0.001 | (2.1) | 0.001 | (1.4) |
| Public Administration | 0.000 | (0.1) | 0.000 | (0.0) | 0.000 | (0.3) | -0.000 | (-0.4) |
| Energy/Water/ Mining | 0.001 | (0.9) | 0.001 | (1.0) | -0.000 | (-0.4) | 0.001 | (1.5) |
| Chemicals/ Synthetics | 0.000 | (0.0) | -0.000 | (-0.0) | 0.000 | (0.1) | -0.000 | (-0.3) |
| Iron/Mechanical | 0.000 | (0.3) | 0.000 | (0.1) | -0.000 | (-0.2) | -0.000 | (-0.1) |
| Electrical/Clothing | 0.000 | (0.0) | -0.000 | (-0.1) | -0.000 | (-0.0) | -0.000 | (-0.3) |
| Construction | -0.000 | (-0.2) | -0.001 | (-0.6) | -0.000 | (-0.1) | -0.001 | (-1.1) |
| Sales | 0.000 | (0.4) | 0.002 | (1.6) | 0.000 | (0.4) | 0.002 | (3.3) |
| Transportation/ Postal | -0.000 | (-0.0) | 0.000 | (0.0) | 0.000 | (0.2) | -0.000 | (-0.1) |
| Finance/Education/ Health /Legal | -0.000 | (-0.1) | 0.000 | (0.2) | -0.000 | (-0.2) | 0.000 | (0.9) |
| Service | 0.001 | (0.8) | 0.001 | (0.6) | 0.001 | (2.1) | -0.001 | (-2.0) |
| Residuals | 0.065 | (76.3) | 0.092 | (67.7) | | 0.026 | (52.7) | |

a. Shares of variance of log-wages in 1990 (0.086) and 2000 (0.135) are reported in parentheses.

b. Share of differences in variance of log-wages between 1990 and 2000 (0.050) are reported in parentheses.

Table 5-2. Decomposition of Changes in Inequality (1990-1994)

| | Earning Inequality [a] | | | | Decomposition [b] | | | |
|---|---|---|---|---|---|---|---|---|
| | 1990 | | 1994 | | Char. Effect | | Coeff. Effect | |
| Total | 0.086 | (100.0) | 0.117 | (100.0) | 0.000 | (1.3) | 0.013 | (40.8) |
| Human Capital | 0.013 | (14.7) | 0.015 | (12.8) | -0.001 | (-1.8) | 0.003 | (9.6) |
| Experience | 0.005 | (6.0) | 0.001 | (0.9) | -0.000 | (-1.5) | -0.004 | (-11.3) |
| Experinece$^2$/100 | -0.002 | (-2.7) | 0.001 | (1.2) | -0.000 | (-0.1) | 0.004 | (11.9) |
| Education | 0.010 | (11.4) | 0.013 | (10.7) | -0.000 | (-0.1) | 0.003 | (9.0) |
| Occupation | 0.004 | (4.4) | 0.004 | (3.2) | -0.001 | (-2.0) | 0.001 | (2.0) |
| Scientist/Manager | 0.003 | (3.2) | 0.003 | (2.4) | -0.000 | (-1.5) | 0.001 | (1.7) |
| Office/Bus/Service | 0.000 | (0.5) | 0.001 | (0.5) | -0.000 | (-0.3) | 0.000 | (0.9) |
| Blue Collar | 0.001 | (0.7) | 0.000 | (0.3) | -0.000 | (-0.3) | -0.000 | (-0.6) |
| Firm Size | 0.002 | (2.3) | 0.010 | (8.6) | 0.001 | (3.3) | 0.007 | (22.4) |
| - <20 | 0.001 | (1.2) | 0.005 | (4.6) | 0.001 | (3.1) | 0.003 | (10.8) |
| 20 - <200 | 0.000 | (0.0) | 0.000 | (0.2) | -0.000 | (-0.0) | 0.000 | (0.8) |
| 200-<2000 | 0.000 | (0.0) | 0.001 | (0.8) | 0.000 | (0.7) | 0.001 | (2.2) |
| 2000+ | 0.001 | (1.1) | 0.004 | (3.0) | -0.000 | (-0.4) | 0.003 | (8.6) |
| Industry | 0.002 | (2.3) | 0.005 | (4.0) | 0.001 | (1.8) | 0.002 | (6.7) |
| Public Administration | 0.000 | (0.1) | 0.000 | (0.1) | 0.000 | (0.6) | -0.000 | (-0.7) |
| Energy/Water/ Mining | 0.001 | (0.9) | 0.001 | (0.8) | -0.000 | (-0.3) | 0.000 | (0.9) |
| Chemicals/ Synthetics | 0.000 | (0.0) | 0.000 | (0.0) | 0.000 | (0.1) | -0.000 | (-0.1) |
| Iron/Mechanical | 0.000 | (0.3) | 0.000 | (0.0) | 0.000 | (0.2) | -0.000 | (-1.1) |
| Electrical/Clothing | 0.000 | (0.0) | 0.000 | (0.2) | -0.000 | (-0.0) | 0.000 | (0.6) |
| Construction | -0.000 | (-0.2) | 0.001 | (0.8) | -0.000 | (0.5) | 0.001 | (4.1) |
| Sales | 0.000 | (0.4) | 0.002 | (1.6) | 0.000 | (1.3) | 0.001 | (3.5) |
| Transportation/ Postal | -0.000 | (-0.0) | 0.000 | (0.4) | 0.000 | (0.4) | 0.000 | (1.0) |
| Finance/Education/ Health /Legal | -0.000 | (-0.1) | 0.000 | (0.2) | -0.000 | (-0.1) | 0.000 | (1.1) |
| Service | 0.001 | (0.8) | 0.000 | (0.0) | 0.000 | (0.3) | -0.001 | (-2.6) |
| Residuals | 0.065 | (76.3) | 0.084 | (71.4) | | 0.018 | (57.9) | |

a. Shares of variance of log-wages in 1990 (0.086) and 1994 (0.117) are reported in parentheses.

b. Share of differences in variance of log-wages between 1990 and 1994 (0.031) are reported in parentheses.

Figure 1. Trends in Male Wages: Level and Dispersion (Indexed)

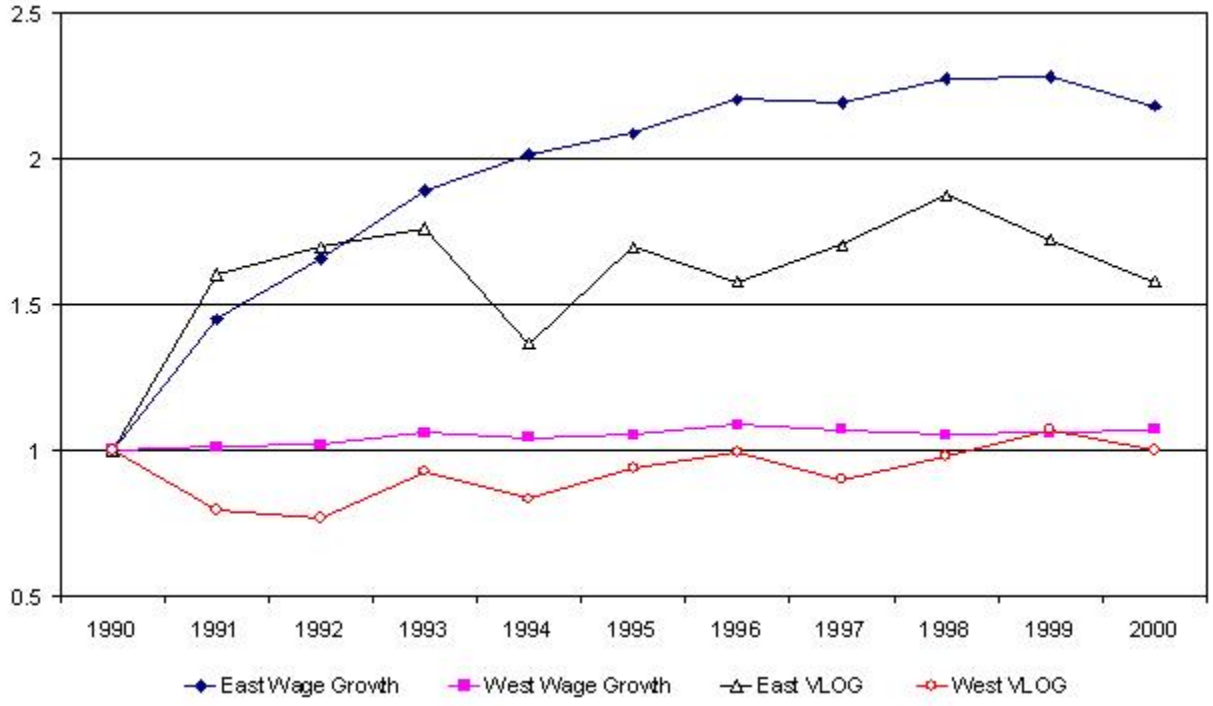


Figure 2. Trends in Female Wages: Level and Dispersion (Indexed)

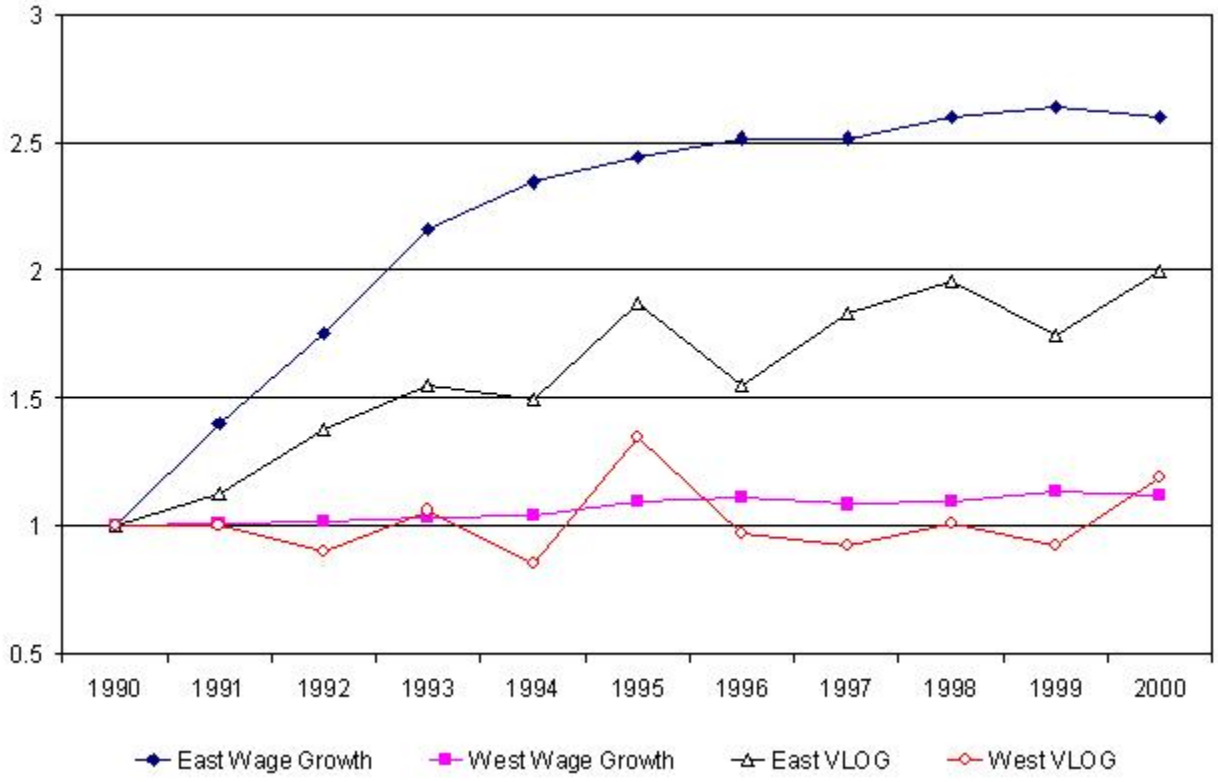


Figure 3. Trends in Male Wage Inequality (East Germany)

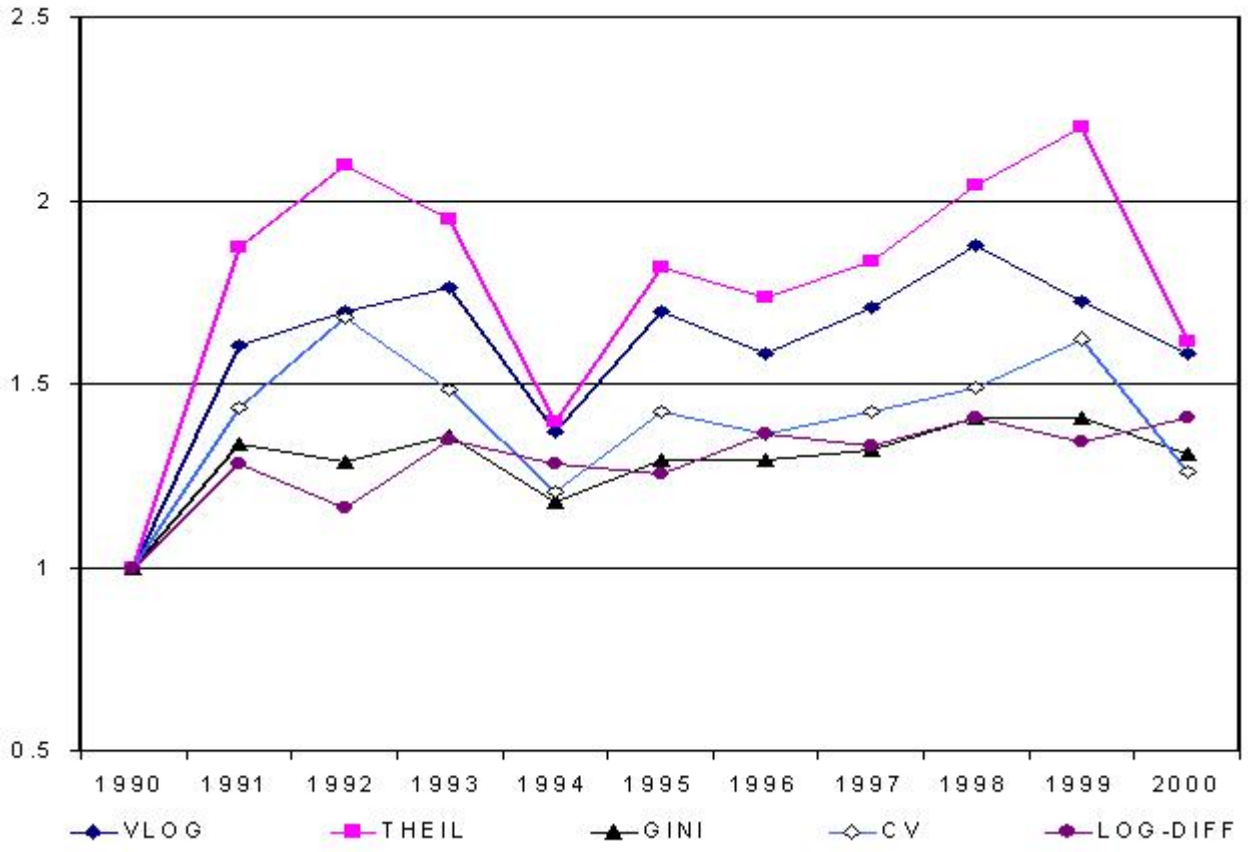


Figure 4. Trends in Male Wage Inequality (West Germany)

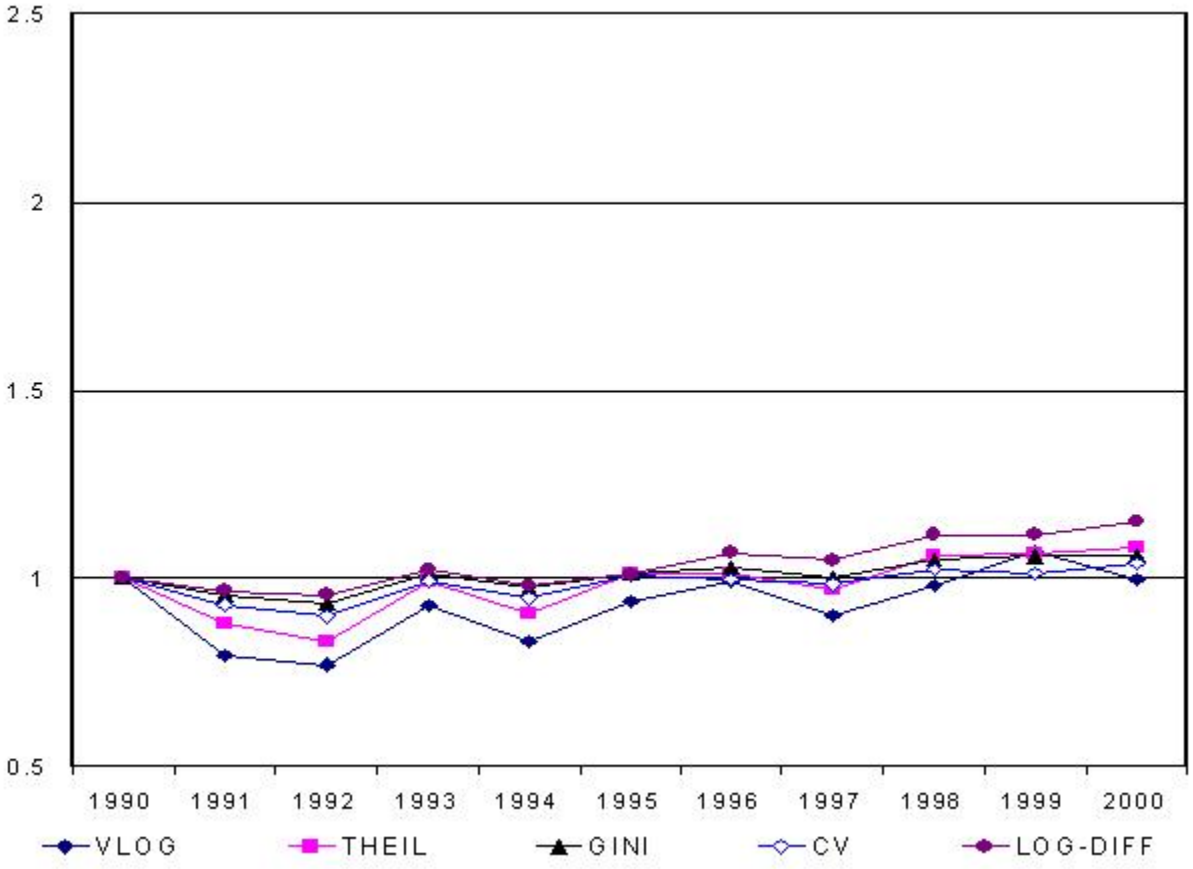


Figure 5. Decomposing the Male Wage Gap between West and East Germany

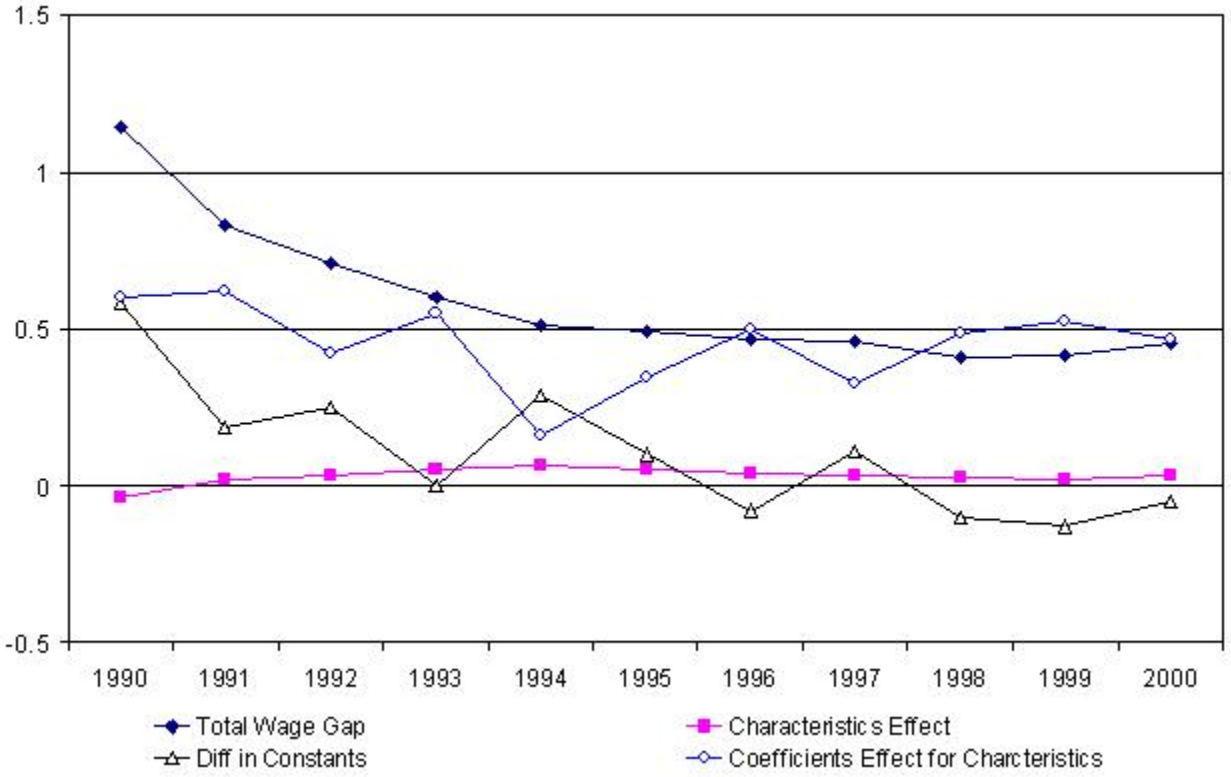


Figure 6. Decomposing Male Inequality Change between West and East Germany

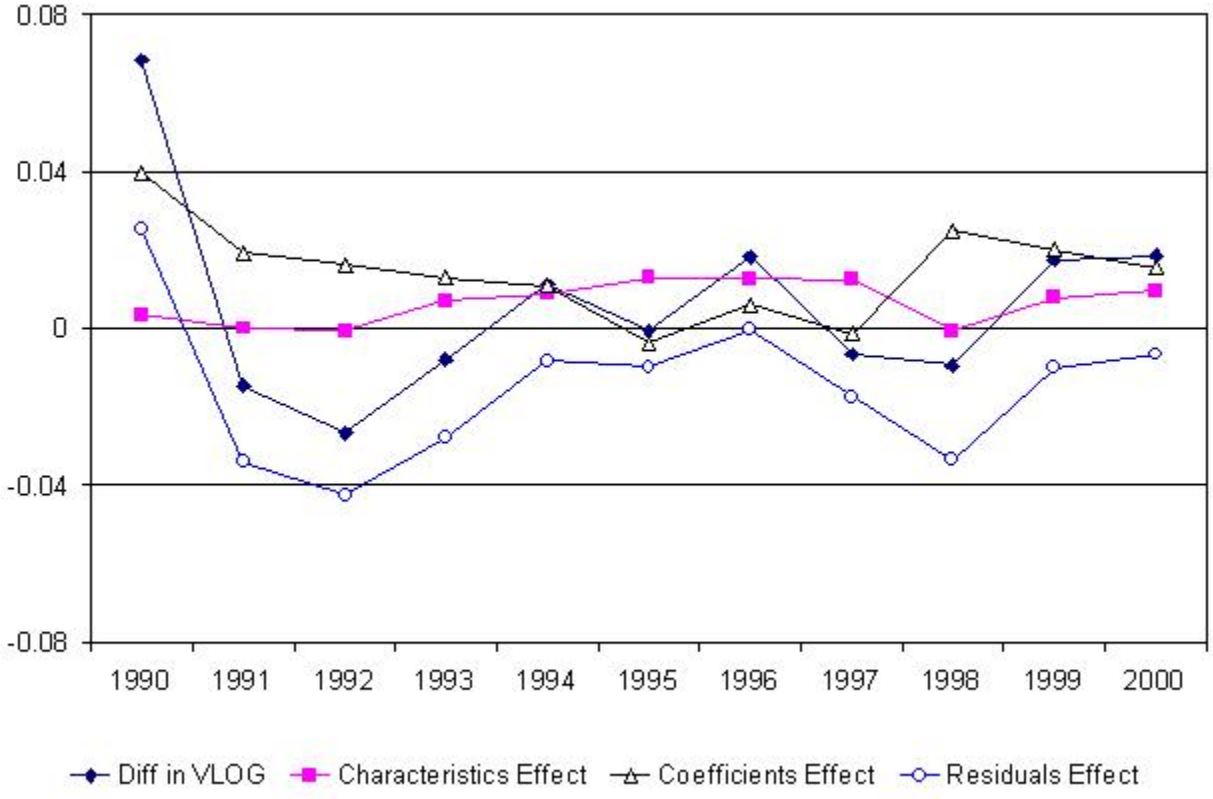


Figure 7. Trends in Mean Wages: East and West Germany (in real Deutsche Marks)

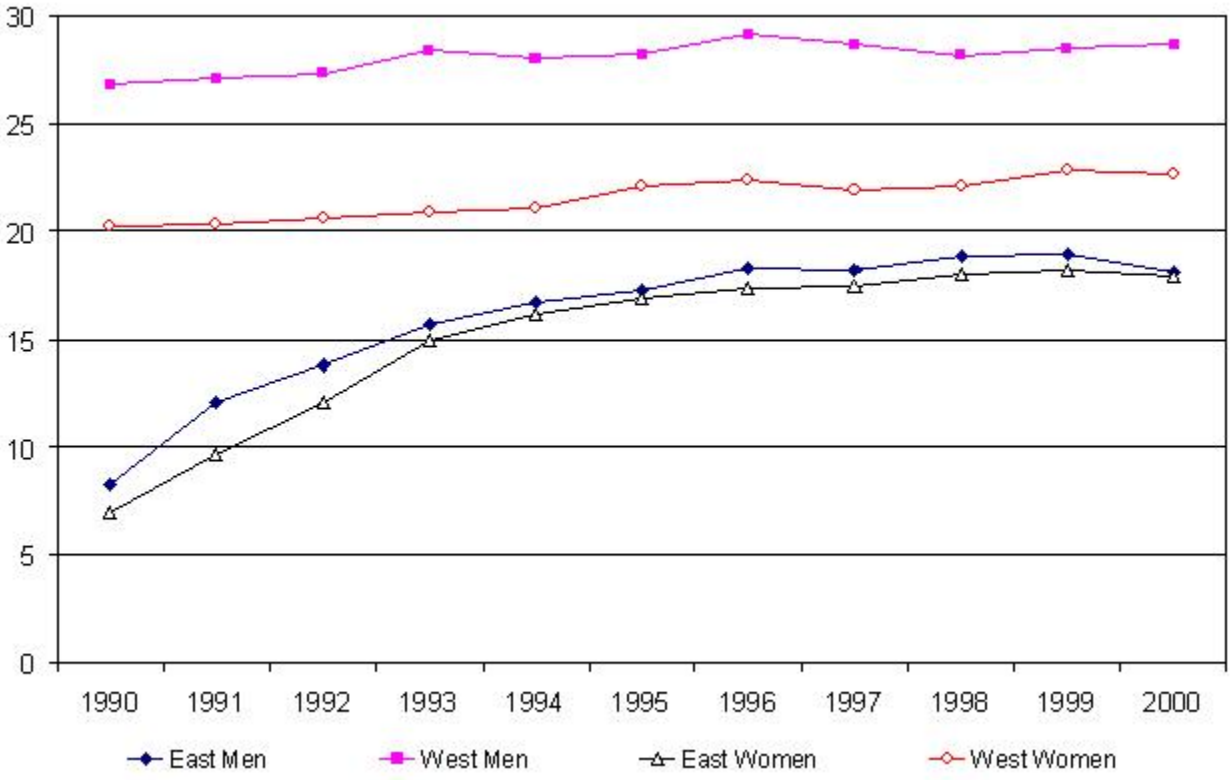
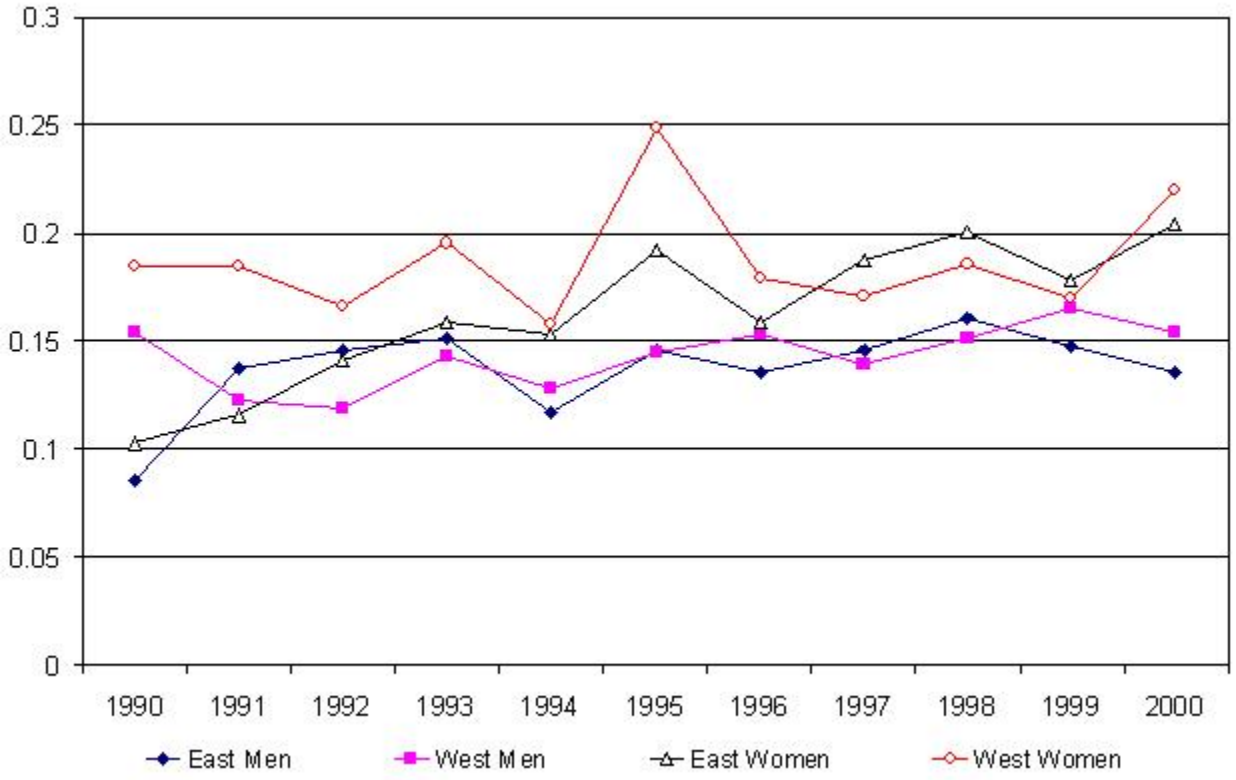


Figure 8. Trends in Wage Inequality (Variances of Log-Wages): East and West Germany



**Extra Tables**

The following tables are not intended for publication. They are included for the convenience of the referee's in case they have questions or concerns over how the non-normalized results look.

Table A-3. Regression Results of Earnings Equations (Usual Equations)

| | 1990 | | 1994 | | 2000 | |
|---|---|---|---|---|---|---|
| Constant | 1.429* | (0.100) | 1.994* | (0.121) | 1.944* | (0.122) |
| Experience | 0.017* | (0.003) | 0.021* | (0.005) | 0.015* | (0.006) |
| Exprience$^2$ / 100 | -0.030* | (0.007) | -0.043* | (0.011) | -0.027* | (0.012) |
| Education (year) | 0.039* | (0.005) | 0.042* | (0.006) | 0.052* | (0.007) |
| Occupation | | | | | | |
| Office/Business/ Service | -0.120* | (0.033) | -0.135* | (0.041) | -0.128* | (0.043) |
| Blue Collar | -0.090* | (0.030) | -0.086* | (0.040) | -0.111* | (0.041) |
| Firm Size | | | | | | |
| 20 - <200 | 0.068* | (0.031) | 0.086* | (0.027) | 0.142* | (0.029) |
| 200 - <2000 | 0.086* | (0.029) | 0.183* | (0.033) | 0.318* | (0.042) |
| 2000+ | 0.118* | (0.030) | 0.270* | (0.037) | 0.281* | (0.041) |
| Industry | | | | | | |
| Energy/Water/Mining | 0.064 | (0.047) | 0.097 | (0.061) | 0.140 | (0.080) |
| Chemicals/Synthetics | -0.010 | (0.047) | -0.066 | (0.071) | -0.051 | (0.077) |
| Iron/Mechanical | 0.009 | (0.042) | -0.006 | (0.049) | 0.045 | (0.058) |
| Electrical/Clothing | -0.046 | (0.041) | -0.034 | (0.052) | 0.032 | (0.060) |
| Construction | -0.005 | (0.043) | 0.110* | (0.046) | 0.047 | (0.058) |
| Sales | -0.097 | (0.050) | -0.106* | (0.052) | -0.132* | (0.060) |
| Transportation/Postal | 0.004 | (0.042) | -0.080 | (0.051) | -0.020 | (0.063) |
| Finance/Education/ Health /Legal Service | -0.256* | (0.074) | -0.025 | (0.085) | -0.142 | (0.082) |
| Adjusted $R^2$ | 0.223 | | 0.270 | | 0.306 | |
| F Value | 18.11* | | 17.58* | | 18.13* | |
| Sample Size | 1011 | | 764 | | 663 | |

1. Standard errors are reported in parentheses, and * means statistically significant at 5%.

2. Reference groups are scientist/manager for occupation, size less than 20 for firm size and public administration for industry.

Table A-4. Decomposing Changes in Wages (1990-2000 and 1990-1994)

| | 1990-2000 | | | | 1990-1994 | | | |
|---|---|---|---|---|---|---|---|---|
| | Char. Effect | | Coeff. Effect | | Char. Effect | | Coeff. Effect | |
| Total | -0.008 | (-1.0) | 0.761 | (101.0) | -0.022* | (-3.3) | 0.706* | (103.3) |
| Constant | | | 0.515* | (68.4) | | | 0.565* | (82.6) |
| Excluding Constant | -0.008 | (-1.0) | 0.246 | (32.7) | -0.022* | (-3.3) | 0.141 | (20.7) |
| Human Capital | 0.026* | (3.5) | 0.135 | (18.0) | 0.008* | (1.1) | 0.059 | (8.7) |
| Experience | 0.026* | (3.5) | -0.043 | (-5.7) | -0.012* | (-1.8) | 0.078 | (11.4) |
| Experinece$^2$/100 | -0.011* | (-1.5) | 0.017 | (2.3) | 0.017* | (2.4) | -0.063 | (-9.2) |
| Education | 0.011* | (1.5) | 0.160 | (21.3) | 0.003* | (0.4) | 0.045 | (6.5) |
| Occupation | 0.002 | (0.3) | -0.014 | (-1.8) | -0.004* | (-0.6) | -0.000 | (-0.0) |
| Office/Business/ Service | -0.005* | (-0.6) | -0.002 | (-0.2) | -0.005* | (-0.8) | -0.003 | (-0.4) |
| Blue Collar | 0.007* | (1.0) | -0.012 | (-1.6) | 0.001* | (0.2) | 0.003 | (0.4) |
| Firm Size | -0.026* | (-3.5) | 0.087* | (11.6) | -0.024* | (-3.5) | 0.050 | (7.4) |
| 20 - <200 | 0.014* | (1.9) | 0.031 | (4.1) | 0.010* | (1.5) | 0.007 | (1.0) |
| 200-<2000 | -0.019* | (-2.5) | 0.030* | (4.0) | -0.013* | (-1.9) | 0.019* | (2.8) |
| 2000+ | -0.021* | (-2.8) | 0.026* | (3.5) | -0.021* | (-3.1) | 0.025* | (3.6) |
| Industry | -0.011* | (-1.4) | 0.038 | (5.0) | -0.002 | (-3.1) | 0.032 | (4.7) |
| Energy/Water/ Mining | -0.003 | (-0.3) | 0.003 | (0.3) | -0.001 | (-0.2) | 0.002 | (0.3) |
| Chemicals/ Synthetics | 0.000 | (0.0) | -0.002 | (-0.2) | 0.000 | (0.1) | -0.002 | (-0.3) |
| Iron/Mechanical | -0.000 | (-0.0) | 0.005 | (0.6) | -0.000 | (-0.0) | -0.002 | (-0.3) |
| Electrical/Clothing | 0.003 | (0.4) | 0.010 | (1.3) | 0.004 | (0.5) | 0.001 | (0.2) |
| Construction | -0.001 | (-0.1) | 0.012 | (1.7) | -0.001 | (-0.1) | 0.030 | (4.4) |
| Sales | -0.004 | (-0.5) | -0.003 | (-0.4) | -0.004 | (-0.5) | -0.001 | (-0.1) |
| Transportation/ Postal | -0.000 | (-0.0) | -0.002 | (-0.2) | -0.000 | (-0.0) | -0.008 | (-1.2) |
| Finance/Education/ Health /Legal | -0.002 | (-0.3) | 0.010 | (1.3) | 0.001 | (0.1) | 0.007 | (1.0) |
| Service | -0.004* | (-0.5) | 0.004 | (0.5) | -0.001 | (-0.2) | 0.005* | (0.7) |

1. Share of changes in log wages, 0.753 (=2.825-2.072) between 1990 and 2000 and 0.684 (=2.756-2.072), are reported in parentheses.

Table A-5-1. Decomposition of Changes in Male Inequality (1990-2000)

| | Earning Inequality [a] | | | | Decomposition [b] | | | |
|---|---|---|---|---|---|---|---|---|
| | 1990 | | 2000 | | Char. Effect | | Coeff. Effect | |
| Total | 0.086 | (100.0) | 0.135 | (100.0) | 0.000 | (0.6) | 0.023 | (46.6) |
| Human Capital | 0.013 | (14.7) | 0.020 | (14.9) | -0.001 | (-1.0) | 0.008 | (16.2) |
| Experience | 0.005 | (6.0) | 0.003 | (2.1) | -0.001 | (-2.5) | -0.001 | (-2.2) |
| Experinece$^2$/100 | -0.002 | (-2.7) | -0.001 | (-1.0) | 0.000 | (0.8) | 0.001 | (1.1) |
| Education | 0.010 | (11.4) | 0.019 | (13.8) | 0.000 | (0.6) | 0.009 | (17.3) |
| Occupation | 0.004 | (4.4) | 0.005 | (3.8) | -0.001 | (-1.0) | 0.002 | (3.7) |
| Office/Business/ Service | 0.001 | (1.1) | 0.000 | (0.0) | -0.000 | (-0.8) | -0.001 | (-1.1) |
| Blue Collar | 0.003 | (3.3) | 0.005 | (3.8) | -0.000 | (-0.3) | 0.002 | (4.8) |
| Firm Size | 0.002 | (2.3) | 0.015 | (10.9) | 0.000 | (0.5) | 0.013 | (25.3) |
| 20 - <200 | -0.000 | (-0.4) | 0.000 | (0.0) | 0.001 | (1.2) | -0.000 | (-0.4) |
| 200-<2000 | 0.000 | (0.2) | 0.008 | (6.0) | 0.000 | (0.8) | 0.008 | (15.4) |
| 2000+ | 0.002 | (2.6) | 0.007 | (4.9) | -0.001 | (-1.5) | 0.005 | (10.3) |
| Industry | 0.002 | (2.3) | 0.004 | (2.7) | 0.001 | (2.1) | 0.001 | (1.4) |
| Energy/Water/ Mining | 0.000 | (0.5) | 0.001 | (0.9) | -0.000 | (-0.2) | 0.001 | (1.8) |
| Chemicals/ Synthetics | -0.000 | (-0.0) | -0.000 | (-0.0) | -0.000 | (-0.0) | -0.000 | (-0.1) |
| Iron/Mechanical | 0.000 | (0.1) | 0.000 | (0.1) | -0.000 | (-0.1) | 0.000 | (0.1) |
| Electrical/Clothing | 0.000 | (0.4) | -0.000 | (-0.1) | -0.000 | (-0.0) | -0.000 | (-0.8) |
| Construction | 0.000 | (0.0) | -0.001 | (-0.5) | 0.000 | (0.0) | -0.001 | (-1.4) |
| Sales | 0.001 | (0.6) | 0.002 | (1.7) | 0.000 | (0.6) | 0.001 | (2.8) |
| Transportation/ Postal | -0.000 | (-0.0) | 0.000 | (0.0) | 0.000 | (0.0) | 0.000 | (0.1) |
| Finance/Education/ Health /Legal | -0.000 | (-0.3) | 0.000 | (0.1) | -0.000 | (-0.7) | 0.001 | (1.4) |
| Service | 0.001 | (1.0) | 0.001 | (0.6) | 0.001 | (2.5) | -0.001 | (-2.5) |
| Residuals | 0.065 | (76.3) | 0.092 | (67.7) | | 0.026 | (52.7) | |

a. Shares of variance of log-wages in 1990 (0.086) and 2000 (0.135) are reported in parentheses.

b. Share of differences in variance of log-wages between 1990 and 2000 (0.050) are reported in parentheses.

Table A-5-2. Decomposition of Changes in Inequality (1990-1994)

| | Earning Inequality [a] | | | | Decomposition [b] | | | |
|---|---|---|---|---|---|---|---|---|
| | 1990 | | 1994 | | Characteristics Effect | | Coefficients Effect | |
| Total | 0.086 | (100.0) | 0.117 | (100.0) | 0.000 | (1.3) | 0.013 | (40.8) |
| Human Capital | 0.013 | (14.7) | 0.015 | (12.8) | -0.001 | (-1.8) | 0.003 | (9.6) |
| Experience | 0.005 | (6.0) | 0.001 | (0.9) | -0.000 | (-1.5) | -0.004 | (-11.3) |
| Experinece$^2$/100 | -0.002 | (-2.7) | 0.001 | (1.2) | -0.000 | (-0.1) | 0.004 | (11.9) |
| Education | 0.010 | (11.4) | 0.013 | (10.7) | -0.000 | (-0.1) | 0.003 | (9.0) |
| Occupation | 0.004 | (4.4) | 0.004 | (3.2) | -0.001 | (-2.0) | 0.001 | (2.0) |
| Office/Business/ Service | 0.001 | (1.1) | 0.001 | (1.1) | -0.000 | (-0.6) | 0.001 | (1.8) |
| Blue Collar | 0.003 | (3.3) | 0.002 | (2.1) | -0.000 | (-1.4) | 0.000 | (0.2) |
| Firm Size | 0.002 | (2.3) | 0.010 | (8.6) | 0.001 | (3.3) | 0.007 | (22.4) |
| 20 - <200 | -0.000 | (-0.4) | -0.000 | (-0.4) | 0.000 | (1.3) | -0.000 | (-1.6) |
| 200-<2000 | 0.000 | (0.2) | 0.004 | (3.0) | 0.001 | (3.1) | 0.002 | (7.7) |
| 2000+ | 0.002 | (2.6) | 0.007 | (6.0) | -0.000 | (-1.0) | 0.005 | (16.3) |
| Industry | 0.002 | (2.3) | 0.005 | (4.0) | 0.001 | (1.8) | 0.002 | (6.7) |
| Energy/Water/ Mining | 0.000 | (0.5) | 0.001 | (0.7) | -0.000 | (-0.2) | 0.000 | (1.4) |
| Chemicals/ Synthetics | -0.000 | (-0.0) | 0.000 | (0.0) | -0.000 | (-0.0) | 0.000 | (0.1) |
| Iron/Mechanical | 0.000 | (0.1) | -0.000 | (-0.0) | 0.000 | (0.0) | -0.000 | (-0.2) |
| Electrical/Clothing | 0.000 | (0.4) | 0.000 | (0.3) | -0.000 | (-0.3) | 0.000 | (0.3) |
| Construction | 0.000 | (0.0) | 0.001 | (0.8) | 0.000 | (0.1) | 0.001 | (2.7) |
| Sales | 0.001 | (0.6) | 0.002 | (1.7) | 0.001 | (2.2) | 0.001 | (2.5) |
| Transportation/ Postal | -0.000 | (-0.0) | 0.000 | (0.4) | 0.000 | (0.0) | 0.000 | (1.5) |
| Finance/Education/ Health /Legal | -0.000 | (-0.3) | 0.000 | (0.1) | -0.000 | (-0.3) | 0.000 | (1.5) |
| Service | 0.001 | (1.0) | 0.000 | (0.0) | 0.000 | (0.4) | -0.001 | (-3.0) |
| Residuals | 0.065 | (76.3) | 0.084 | (71.4) | | 0.018 | (57.9) | |

a. Shares of variance of log-wages in 1990 (0.086) and 1994 (0.117) are reported in parentheses.

b. Share of differences in variance of log-wages between 1990 and 1994 (0.031) are reported in parentheses.