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Firm Specific Wage Spread in Germany - Decomposition of regional differences in inter firm wage dispersion

Bernd Görzig*
Martin Gornig*
Axel Werwatz*

* Deutsches Institut für Wirtschaftsforschung (DIW),
Berlin, Germany

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SFB 649, Humboldt-Universität zu Berlin
Spandauer Straße 1, D-10178 Berlin

Firm Specific Wage Spread in Germany -

Decomposition of regional differences in inter firm wage dispersion[1]

Bernd Görzig, Martin Gornig, Axel Werwatz

All:
DIW Berlin,
Königin-Luise-Strasse 5,
D-14195 Berlin.
Bernd Görzig: Tel: 49 30 89789314, e-mail: bgoerzig@diw.de;
Martin Gornig: Tel: 49 30 897 89352, e-Mail: mgornig@diw.de;
Axel Werwatz: 49 30 89789157, e-mail: awerwatz@diw.de.

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Abstract

The purpose of this paper is to sort out firm-related differences from effects that result from different economic structures. A non-parametric decomposition is used to analyse firm level difference between the wage spread in the two major regions of unified Germany. If firm-specific effects explain wage dispersion between firms, a decomposition of the wage dispersion between firms is necessary. The decomposition can help to find out, whether the economy-wide results for different regions are due to the composition of the regional economies by industries and firm-size, or whether the differences are due to firm-specific influences, like distinctions in market power. For Germany, a considerable part of the difference in the wage spread between the East and the West can be explained by different economic structures. However, by far the greater part of the difference in the wage spread between firms in the two parts of the country results from lower wages paid by firms of the same type in East Germany compared with their counterparts in West Germany.

JEL Classification Numbers:

L16, C14, J30

Keywords:

Productivity, Wage Differentiation, Wage Spread, Firm Wage Levels, Wage Sharing, Non Parametric Analysis, Decomposition

1 Motivation

It is widely accepted in the literature that firm productivity and wage dispersion between firms are inter-related (Lallemand/Plasman/Rycx, 2005). However, different explanations exist for the direction of causality between these two variables. While some authors assume that firms pay higher wages to motivate workers and to improve their productivity ("efficiency wages"), others argue that higher wages might be the result of higher profits of successful firms ("rent-sharing").

Micro-data analyses can be helpful to understand to what extent a differing degree of *unobservable* heterogeneity of labour may explain productivity differences between regions. In particular, the productivity of two workers with the same observable individual characteristics may differ because they are employed by different firms. Some of these firm-related differences may again be attributed to observable firm-characteristics such as industry or firm-size. However, there may remain a purely firm-specific "fixed-effect" on productivity.

The purpose of this paper is to sort out these firm-related differences. If firm-specific effects explain wage dispersion between firms, a decomposition of the wage dispersion between firms is necessary. The decomposition might help to find out, whether the economy-wide results for the different regions are due to the composition of the regional economies by industries and firm-size, or whether the differences are due to firm-specific influences.

In particular, we decompose the wage dispersion between firms into "structural components" related to the composition of firm-types (identified by sectoral affiliation and firm-size) and purely firm-specific influences. This decomposition is carried out for two seemingly distinct major German regions, East- and West Germany. If extended to other countries the decomposition might also help to find out, whether the economy-wide results for different countries are due to the composition of the national economies by industries and firm-size, or whether the differences are due to firm-specific influences. Particularly, for the comparison of the wage dispersion between the several regions, such a decomposition will enhance the knowledge on the influence of wage dispersion on productivity performance of the regions.

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[2] EU KLEMS, Productivity in the European Union: A Comparative Industry Approach, EU Sixth Framework Programme.

In the major market economies, a process of increasing wage differentiation started before 1990, although to very differing degrees. Whereas relatively marked wage differentials had always been evident in the United States, in some European countries, particularly Germany, differences in wage levels remained relatively small (Christensen/Schimmelpfennig, 1998).[3] Meanwhile, the transition economies of Central and Eastern Europe experienced major changes in wage distributions as workers' wages started to vary significantly with enterprise performance (Basu/Estrin/Svejnar, 2004).

In view of these tendencies it might be expected that after reunification East Germany would - parallel to the strong rise in wages that was evident - have experienced a rapid differentiation in wage levels. Starting from a very flat wage structure among both workers and firms (Gornig/Schwarze, 1990; Stephan/Wiedemann, 1990), empirical results indicate that the dispersion of wages among East German workers indeed increased significantly (Franz/Steiner, 1999). Yet, there is little knowledge of how wage differences between firms in East Germany have developed. However, firm data from the statistics on persons employed paying statutory social insurance contributions[4] does indicate that wage differences between firms in East Germany have increased markedly (table 1).

In 2001, the variance was a good 50 % above the 1994 level, so the tendency to greater wage differentiation between firms in East Germany was growing at the end of the 1990s. The average annual rate of change in this variance rose from 5.3 % in the period 1994 to 1998 to 6.9 % between 1998 and 2001, while the growth in the wage level diminished at the same time. The relative variability, measured by the variation coefficient of the wage level between firms, also increased strongly.

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[3] As globalisation progressed, economists argued that greater wage differentiation was needed in Germany, too. The call for adequate wage differentiation runs through several reports of Germany's Council of Economic Experts (the 'Sachverständigenrat' (SVR) - SVR'94, Items 447ff., SVR'99, Item 341). The main emphasis is on differentiation to reflect skills levels (SVR'00, Items 416f.), but with the persistently high level of unemployment, the demands for wage differentiation between firms also grew (Siebert, 1998, SVR'04, Items 704ff.). This is reflected i.a. in the growing number of wage agreements for individual firms and the number of opt-out clauses in the collective agreements for companies in financial difficulties, and in the declining number of companies that are bound by the national collective agreements (Ellgut/Kohaut, 2004).

[4] On the data base see also the remarks in Section 4.

Table 1

Wage Differences between Establishments in East Germany, 1994 to 2001

Jahr		1994	1998	2001
Variance in establishment wage levels	In euro²	284,2	349,9	427,2
Memo item:				
Coefficient of variation	In %	41,0	41,8	45,2
Average wage level for establishments	In euro	41,2	44,8	45,8
Annual average change from previous period in %				
Variance in establishment wage levels			5,3	6,9
Memo item:				
Coefficient of variation			0,5	2,7
Average wage level for establishments			2,1	0,7

[a] Wage level measured as the average day's wage per person employed in the establishment.

Source: Federal Labour Agency, Annual reports for employment statistics.

However, how the degree of wage differentiation between firms in East Germany now reached is to be assessed cannot be deduced from its development alone. It remains an open question whether East Germany has already fully exploited the potential for wage differentiation between firms under market economy conditions, or whether, with fewer firms bound by the collective wage agreements and greater possibilities for making use of opt-out clauses, greater wage differentiation has actually formed there.

In order to classify and assess the degree of wage differentiation between firms now reached in East Germany this paper shows and analyses the differences in the wage differentiation between firms in East and West Germany. For this, first the current state of empirical research into possible explanations of the differences in wages paid by firms will be outlined. In order to quantify the influence of the main determinants of firm wage levels as given in the literature firms of the same size and in the same sector will be compared, using a non-parametric decomposition estimate. So far, this has been used mainly to explain differences in wage levels between men and women, for instance (Nopo, 2004) or between regions (Görzig/Gornig/Werwatz,

2004). Here the approach is widened and applied to an analysis of the East-West comparison of wage levels in firms.

2 Determinants of Firm Wage Levels

The theoretical justification of the demand for greater wage differentiation is the consideration that wages that are not geared to the marginal product cause disequilibria on the labour market and are thus one of the causes of the persistent level of unemployment. In the perfect competition model, equilibrium can only be achieved if the differences in workers' contributions to output corresponding to their *skill levels* are taken into account in different wage levels.

However, in the empirical examination of wage differences between firms doubts have repeatedly arisen (Krueger/Summers, 1988) whether wage differences between firms can be explained exclusively by the heterogeneity of the labour input, even if differences in quality that are not observed are taken into account beside those that are observed. Rather, it has been suggested that a large part of the wage differences that can be observed are due to firm heterogeneity (Gibbons/Katz, 1991; Dickens/Katz, 1987).

The relatively great importance of *firm factors* for differences in wage levels is also confirmed by a large number of more recent studies based on comprehensive employer-employee data sets (Abowd/Kramarz/Margolis, 1999; Winter-Ebmer/Zweimüller, 1999; Goux/Maurin, 1999). The extent to which firm factors are seen as the explanation depends on the method used, but it also depends on the type and size of the control variables used and on the region under examination. Abowd/Kramarz (2000) used an employer-employee data set to study the US federal state of Washington, and concluded that about 50 percent of the observable wage differences were due to firm factors.

The firm determinants that can be shown to have an outstanding influence on the wage level even when a large number of other factors are also taken into account generally include the economic sector and the size of the firm. That also applies to East and West Germany, although not right across the board (Bellmann/Kohaut, 1999).

Sector-specific wage differences are remarkably persistent over time and the structures are similar by international comparison (Krueger/Summers, 1988). The latter is

also confirmed by a more recent comparison of wage structures in France with those in the US federal state of Washington (Abowd/Kramarz, 2000). However, clear differences are evident concerning regulated economic sectors in France. Studies of the new market economies in Eastern Europe (Grundig/Pohl, 2003) have also been able to establish remarkably similar sectoral wage structures there.

There are many theoretical explanations of the influence the company's economic sector exerts on its employees' wage level. Firstly, institutional conditions on the input side are named, like trade union ties or the presence of a works council (Hübler/Jirjahn, 2004). On the other hand, if the data set permits, output side factors are frequently also stressed, like the influence of competition (Nickell/Vainiomaki/Wadhwani, 1994) and market power on product markets (Blanchflower/Machin, 1996; Jirjahn/Klodt, 1999).

The influence of the *firm's size* on its wage level seems to be very stable by international comparison, and it is robust when numerous other explanatory variables in traditional wage equations are taken into account. Moreover, the relation appears to have strengthened (Gerlach/Hübler, 1995). As an explanation of the influence of the firm's size on firm wage differentials, in addition to the influence of employee organisations, which changes with the size of the firm, the different degrees of complementarity of the production factors used and the monitoring expenditure, which also changes with the size of the firm, are named (Troske, 1999). Technological factors, employees' preferences, and working conditions also play a part (Idson/Oi, 1999). Other explanations can be monopsonistic (single buyer) conditions and implicit rent sharing for employees (Green/Machin/Manning, 1996). Brown and Medoff (1989) concluded that 50 percent of the differences in firm size-specific wage differentials were due to personal factors, and in a more recent longitudinal analysis, based on an employer-employee data set for France, Abowd/Kramarz (2000) reached the conclusion that 70 percent of the size-specific wage differences in the "raw" data is due to firm-specific features.

Now that it has been shown, mainly using micro-data sets, that an important part of the observable wage differences is due to firm features, many economists have accepted the conclusion drawn by Blanchflower/Oswald/Sanfey (1996) that the assumption of perfect competition on the companies' factor markets, and above all on their product markets, is not appropriate to explain wage differences. Hence, model

approaches based on *imperfect competition* are becoming increasingly prominent in explaining wages (Abowd/Kramarz/Lengermann/Roux, 2005; Sørensen, 2001).

Increasing attention is also being devoted to the question of implicit rent sharing for employees (Blanchflower/Oswald/Sanfey, 1996; Hildreth/Oswald, 1997). Sørensen (2001) distinguishes between three factors that can affect wage differences between firms. These are differences

- in the marginal product of employees,
- in the employees' bargaining power, and
- in the companies' market power on their sales markets.

Perfect competition on all markets can only be assumed if exclusively the first of these factors is present. On imperfect labour markets (second, above), the influence of trade unions must also be taken into account or that of other factors that give the employees a bargaining position vis-à-vis their employer (Stephan/Gerlach, 2004). Depending on the size of the firm that can affect individual firms, but it frequently affects whole sectors, too.

The case of imperfect product markets (third, above) affects individual firms much more strongly. In assessing rent sharing, it is important to understand that in many cases the employees' bargaining power may possibly depend on the company's market power on its sales markets. If companies are successful on their sales markets owing to their specific market power, irrespective of their size and the sector to which they belong, that can also strengthen the in-house bargaining position of their employees.

Using a data set for France, Fakfakh/FitzRoy (2002) were able to show a rent-sharing effect, after taking into account numerous control variables. Margolis/Salvanes (2001) reach a similar conclusion for France and Norway. Lundin/Yun (2003) have shown for Sweden that the wage level is above average particularly in those firms that are not exposed to intensive competition from imports. Martins (2004) also confirms for Portugal that the rent-sharing hypothesis is significant in explaining wage differences, and that it is robust against other approaches.

Using extensive micro-data for companies, Basu/Estrin/Svejnar (2004) show for the Czech Republic, Slovakia, Poland and Hungary that a major part of the increased wage differentiation after the transition to the market economy can be explained by the implicit sharing of profits - and losses - with employees in this transition phase.

Abowd/Kramarz/Lengermann/Roux (2005) have calculated a quasi rent for individual employees of firms from the difference between wages and their opportunity costs. They conclude that by far the greater part of this depends on firm factors.

A large number of empirical studies have shown that the size of the firm and the sector-specific nature of its sales market are crucial factors influencing firm wage differences. Nevertheless, a number of studies have now clearly shown that beyond these characteristic features of a firm that can be objectively measured, there are wage differences that are evidently closely connected to the firm's success on sales markets. The studies by Abowd/Kramarz/Lengermann/Roux (2005) have shown i.a. that the influence of firm factors on the wage differences between firms is considerable in some cases, within individual sectors as well. Therefore, if the observable firm wage differences are controlled by the influence of the industry and the size of the firm, the rent-sharing hypothesis, which has now been confirmed by many studies, suggests that the remaining wage differences greatly depend on in how far the individual firms succeed in achieving above-average profits through their market power on their sales markets. In that case they will also be in a position to pay their employees above-average wages.

3 Methodology

There is ample empirical evidence for pronounced wage differentials across firms and establishments. These differentials usually can be explained -at least to some extent- by observable establishment characteristics such as size or sectoral affiliation. In the present case, we use these observable characteristics to decompose the difference between East Germany's wage variability across plants and West Germany's wage variability across plants. In particular, we ask whether West-East differences in wage variability can be attributed to observable differences in the composition of plants or rather by differences in wage variability of establishment types that can be found in both parts of the country. Put differently, are West-East differences in wage variability due to the fact that certain plant types (such as large industrial plants) are exclusively or overwhelmingly found in only one part of the country? Or should they be "blamed" on West-East differences in the wage variability between plants of a given, comparable type?

To compare East Germany's wage variability across plants with that of West Germany and to relate it to observable plant characteristics, we basically employ an analysis of variance approach. That is, we use the well-known result that the raw or marginal variance is the sum of the variance of the conditional means and the mean of the conditional variance. In the present setting, we express, for each part of the country, the unconditional variance of plant-level wages as the sum of two sources of conditional variation: the variation of plant-type specific average wages around the unconditional average and the mean of the plant-type specific variances. In the empirical part, plant types are defined as a combination of plant size (one out of 10 possible categories) and sectoral affiliation (one out of 54 possible categories) and are denoted by *x*. Using East-Germany to illustrate the notation, we have

$$\begin{aligned} Var[Y \mid E] &= \sum_{x \in E} \{E[Y \mid x,E] - E[Y \mid E]\}^2 f^E(x) + \sum_{x \in E} Var[Y \mid x,E] f^E(x) \\ &= \underbrace{Var_{x|E}\{E[Y \mid x,E]\}}_{\text{(A-East) Variance of the type specific means}} + \underbrace{E_{x|E}\{Var[Y \mid x,E]\}}_{\text{(B-East) Mean of type specific variances}} \end{aligned}$$

where $f^E(x)$ is the population fraction of establishment type *x* in the East.[5]

The equivalent expression for the West is:

$$\begin{aligned} Var[Y \mid W] &= \sum_{x \in W} \{E[Y \mid x,W] - E[Y \mid W]\}^2 f^W(x) + \sum_{x \in W} Var[Y \mid x,W] f^W(x) \\ &= \underbrace{Var_{x|W}\{E[Y \mid x,W]\}}_{\text{(A-West) Variance of the type specific means}} + \underbrace{E_{x|W}\{Var[Y \mid x,W]\}}_{\text{(B-West) Means of the type specific variances}} \end{aligned}$$

These analysis-of-variance expressions form the basis for analysing the difference between plant specific wage variability in the West and the East. They imply that the difference of the marginal variances[6], $Var[Y \mid W] - Var[Y \mid E]$, may stem from West-East differences either in the "(A)"-terms or the "(B)"-terms:

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[5] The subscript $x \in E$ indicates that the summation runs over all elements *x* belonging to the set E of establishment types found in the East. $Var_{x|E}[\bullet]$ and $E_{x|E}[\bullet]$ denote the variance and expectation of the respective argument with regard to the distribution of establishment types in the East (i.e. the distribution of *X*, given *E*ast).

[6] Formally, the difference of the region-specific variances could be defined by reversing the order, i.e. by considering $Var[Y \mid E] - Var[Y \mid W]$. However, the particular order "West minus East" is suggested by the aim of the present paper: studying the adjustment of Eastern wage variability towards the reference level provided by the West.

$$Var[Y \mid W] - Var[Y \mid E] = \underbrace{\left\langle \underbrace{Var_{X|W}\{E[Y \mid x,W]\}}_{\text{(A-West)}} - \underbrace{Var_{X|E}\{E[Y \mid x,E]\}}_{\text{(A-East)}} \right\rangle}_{\text{Difference of the variances of the conditional means}}$$

$$- \underbrace{\left\langle \underbrace{E_{X|W}\{Var[Y \mid x,W]\}}_{\text{(B-West)}} - \underbrace{E_{X|O}\{Var[Y \mid x,E]\}}_{\text{(B-East)}} \right\rangle}_{\text{Difference of the Means of the conditional variances}}$$

The expressions (A-West) and (A-East) represent the variation of the type-specific average wages around the respective region-specific unconditional mean. They do not directly reflect wage variation between establishments but rather between establishment *types*. Their difference, Δ_{Mean} , therefore primarily reflects "structural" West-East differences, i.e. differences in the composition and structure of establishment types. The expressions (B-West) und (B-East) however contain for any given type the variance of wages across establishments. They are the focal point of this analysis, as they may help to assess the extent to which West-East differences in wage variation can be attributed to West-East differences between establishments of a given, comparable type.

However, West-East differences in the „(B)"-terms may not only be caused by differing type-specific wage variances but also be due to more "structural" causes. This is evident from the definition of these terms which, in the case of East Germany, has the following form:

(B-East): $$E_{X|E}\{Var[Y \mid x,E]\} = \sum_{\underbrace{x \in E}_{(i)}} \underbrace{Var[Y \mid x,E]}_{(iii)} \; \underbrace{f^{E}(x)}_{(ii)}$$

This definition involves (i) the support of the distribution of establishment types, (ii) the share of each type among all establishments in the region and (iii) the type-specific variances. West-East differences in the average type-specific variances can thus arise from three components

(i) establishment types existing in only one part of the country (Special Component),

(ii) establishment types existing in both parts of the country, but with unequal relative frequencies (Type-Structure Component)

(iii) establishment types existing in both parts of the country, but with (strongly) differing type-specific variances (Regional Component).

To capture these three sources of differences between $E_{X|W}\left[Var(Y \mid x,W)\right]$ and $E_{X|E}\left[Var(Y \mid x,E)\right]$, we apply the following decomposition introduced in Nopo's (2002) extension of the well-known work by Blinder (1973) and Oxaca (1973):

$$E_{X|W}\left[Var(Y \mid x,W)\right] - E_{X|E}\left[Var(Y \mid x,E)\right]$$
$$= \underbrace{\Delta_{West} + \Delta_{East}}_{\text{(i) Special components}} + \underbrace{\Delta_{Typ}}_{\text{(ii) Different weights of comparable types of firms}} + \underbrace{\Delta_{Reg}}_{\text{(iii) West-East differences in the variances for comparable types of firms}}$$

For reasons of clarity and legibility, the detailed formal definition of each of these terms is given in part 1 of the appendix.

Δ_{West} and Δ_{East} represent the components of West-East differences in plant-level wage variation due to the fact that certain plant types are found either exclusively in the West or exclusively in the East. If these „exclusive" establishment types are numerous and furthermore exhibit particularly high or particularly low wage variability then they may account for a considerable part of the difference between $E_{X|W}\left[Var(Y \mid x,W)\right]$ and $E_{X|E}\left[Var(Y \mid x,E)\right]$.

Δ_{Typ} represents the component of $E_{X|W}\left[Var(Y \mid x,W)\right] - E_{X|E}\left[Var(Y \mid x,E)\right]$ attributable to West-East differences in the distribution of establishment types common to both parts of the country. It accounts for the possibility that the average type-specific variances may differ between Western Germany and Eastern Germany due to differences in the type's relative weights even if all individual type-specific variances were exactly equal in the West and the East.

Finally, Δ_{Reg} represents the component of the West-East difference in plant-level wage variability due to unequal variances among Western and Eastern establishments of a given, comparable type. Δ_{Reg} may thus be interpreted as the „pure" West-East difference in wage variability, as it is the only component solely based on the West-East-comparison of variances among establishments belonging to the same size class and the same sector. If the variance of plant-level wages is, for instance, considerably higher among Western plants of a given size and a given sector than among their Eastern counterparts then this can –in the light of the discussion of section 2 above- be interpreted as evidence for a greater dispersion of market power, profits and rent-sharing among Western establishments. The components Δ_{West}, Δ_{East} and Δ_{Typ}, however, rather reflect „structural" differences between the Western and

the Eastern part of the economy as they attribute differences in wage variability to differences in the type and (relative) number of establishments in the two parts of the country.

Recalling the „structural“ interpretation attached above to the difference between the variance of type-specific average wages ($Var_{X|W}\{E[Y \mid x,W]\}$ - $Var_{X|W}\{E[Y \mid x,W]\}$), we arrive at the following comprehensive representation of the potential sources of differences between the variances of plant-level wages in Western and Eastern Germany:

$$Var[Y \mid W] - Var[Y \mid E] =$$

$$= \underbrace{\text{Difference of the variances of the conditional means}}_{Var_{X|W}\{E[Y \mid x,W]\} - Var_{X|E}\{E[Y \mid x,E]\}} + \underbrace{\text{Difference of the means of the conditional variances}}_{E_{X|W}[Var(Y \mid x,W)] - E_{X|E}[Var(Y \mid x,E)]}$$

$$= \underbrace{Var_{X|W}\{E[Y \mid x,W]\} - Var_{X|E}\{E[Y \mid x,E]\}}_{\Delta_{Mean}} + \underbrace{E_{X|W}[Var(Y \mid x,W)] - E_{X|E}[Var(Y \mid x,E)]}_{\Delta_{West} + \Delta_{East} + \Delta_{Typ} + \Delta_{Reg}}$$

$$= \underbrace{\underbrace{\Delta_{Mean}}_{} + \underbrace{\Delta_{West} + \Delta_{East} + \Delta_{Typ}}_{}}_{\text{Economic structure components}} + \Delta_{Reg}$$

In the empirical part of the paper the conditional mean functions $E[Y \mid x,W]$ and $E[Y \mid x,E]$ and the conditional variance functions $Var[Y \mid x,W]$ and $Var(Y \mid x,E)$ will be estimated nonparametrically by computing –in both Western and Eastern Germany- the type-specific mean and variance for each establishment type *x* separately. That is, for neither the mean nor the variance any parametric functional form is imposed on its relation to establishment type (measured by a plant’s size and a plant’s sector).

4 The Data

For the purposes of this examination, it is necessary to separate the various structural economic factors that influence the wage differences measured between firms from those that exclusively influence firms of the same type. That depends decisively on how exactly the difference in the composition of the firm types by branch and size of firm in East and West Germany can be evaluated.

It is difficult to find data that is suitable for the purposes of decomposition that it provides representative information on the level of wages in firms, their branch and size, and is compatible for East and West Germany. Sources frequently used for East-

West comparisons, like the ZEW Innovation Panel (Rammer et al., 2003) or the IAB Business Panel (Bellmann, 2002) do differentiate according to these criteria, but owing to the small number of cases covered, they are inadequate for regional comparisons using a non-parametric approach.

However, information on the wage level in individual establishments, their branch and size, and that covers a high number of cases, can be obtained from the annual reports for the employment statistics compiled by the Federal Labour Agency (BA). These statistics are primarily intended to provide information on employees that is relevant for social insurance purposes. Every establishment that employs at least one person paying statutory social insurance contributions is given a number, and these numbers enable the information on the employees to be converted into information on the establishments. Moreover, the establishments in the database so created can also be assigned geographically to East or West Germany through the regional classification of the place of work.

The annual reports for 2001, for example, give information on about 2.4 million establishments with just under 37 million jobs. That is nearly a total coverage, with only the establishments without any employees paying social insurance contributions not included.

However, a number of problems and distortions also arise in using these employment statistics (Fritsch/König/Weisshuhn, 1992). Owing to the statutory requirements for social insurance, a number of persons and establishments are left out. Moreover, the high wage segment is less differentiated, owing to the upper limit for assessment of statutory social insurance contributions. However, these limitations are very much less distorting in the consideration of average wages in establishments here than they are in analyses of individual wage levels. In addition, analyses of establishment wage levels in East Germany benefit in that the above shortcomings in the compilation have not fundamentally changed in the period under review. On a comparison of the variations in the levels of wages in establishments between East and West Germany it must, however, be borne in mind particularly that the upper limit for assessment in East Germany was about 16 % below that in the West in 2001. So indirectly, the variability of the average wages in companies measured is also limited. But since at the same time more than 90 % of the employees paying statutory social insurance

contributions were paid wages below this upper limit, the results on establishment level should be sufficiently informative despite this distortion.

The data for 1994, 1998, and 2001 has been evaluated. The level of wages in establishments is shown as the wage per day per person employed. This has been calculated by dividing the wage by the number of calendar days in the period for which the wage was paid. Differences in the average working time per day in the establishment were not taken into account. The branches the establishments belong to are classified into 54 sectors, according to the sectoral classification used by the Federal Labour Agency (Annex 1). The companies are divided into 10 size classes, and this goes slightly beyond the division usual in the statistics on the producing sector (Annex 2). The combination gives 540 cells with correspondingly different types of establishment, to which the establishments and their wage payments in East and West Germany can be assigned.

5 The Results

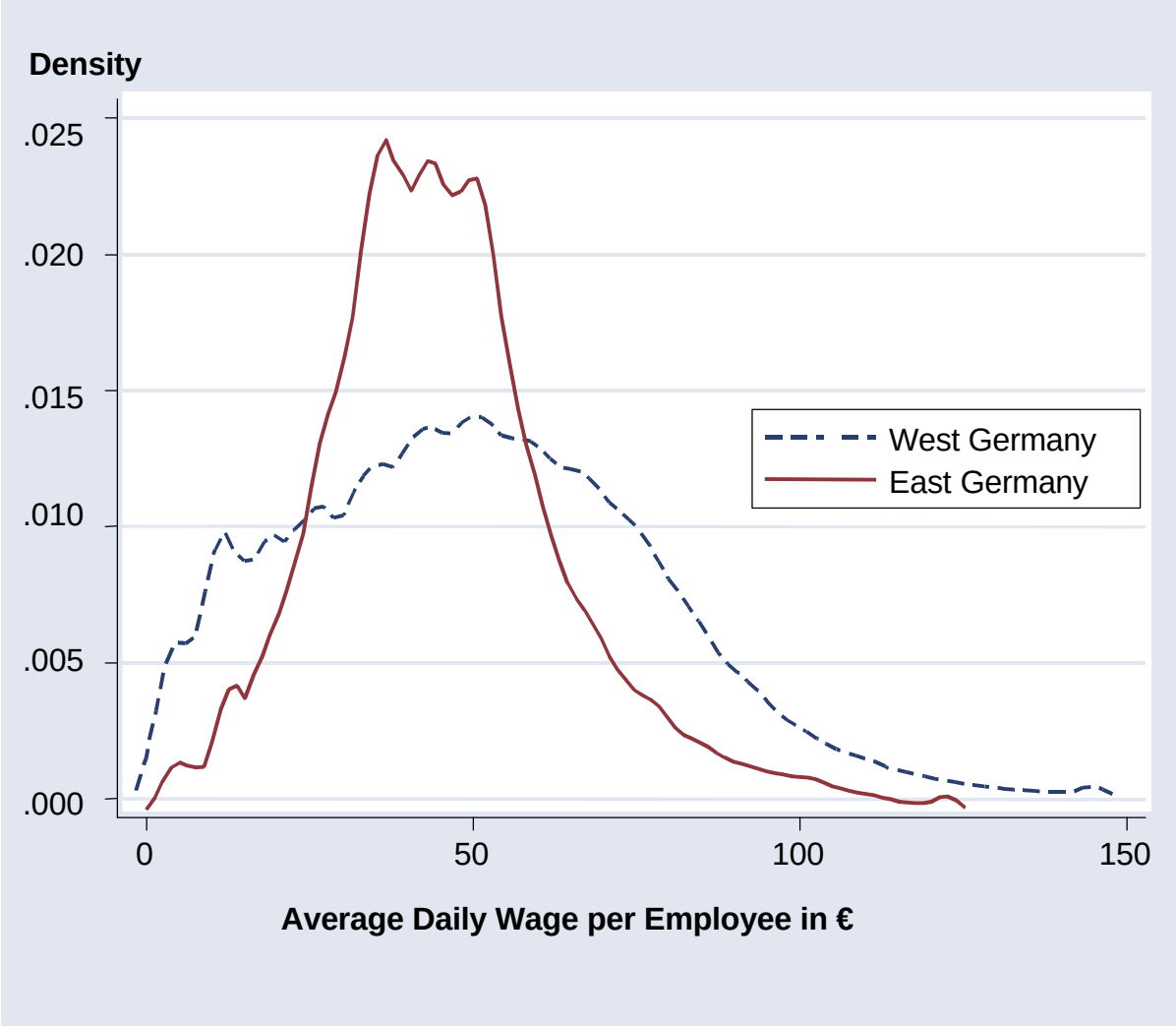
In order to enable an initial estimate to be made of the relative importance of wage differences between establishments in East Germany, core density estimates[7] were made of the distribution of the wages per day paid by the establishments in East and West Germany for 2001. These are compared in Figure 1.

The level of wages in East German establishments quite evidently shows a distribution much more closely around the median than that in West German establishments. The share of establishments in East Germany is much higher in the medium wage segment, while the West German establishments are relatively more strongly represented in the clearly lower and higher wage segments.

[7] The margins of 1.6 in the West and 1.3 in the East were determined with the modification of "Silverman's rule of thumb" proposed in Härdle (2001).

Figure 1:

Core Density Estimate of the Distribution of Establishment Wages in East and West Germany



The evidently lower degree of wage differences between establishments in East Germany can be quantified through a comparison of the variance in wages paid by establishments in the two parts of Germany. In 2001, the variance in the wage level in East German establishments was 427. In West Germany, it reached an amount of 828 in the same year. Measured by the variance, therefore, the differentiation in wages paid by establishments in East Germany is only about half as great as that in West Germany (table 2). In a comparative analysis of the wage differences between establishments in the two parts of the country, however, it must also be borne in mind that the

level of wages is lower in East Germany.[8] However, the relative variability of the establishment wage level, expressed through the coefficient of variation, also indicates a clearly lower wage differentiation between establishments in East Germany.

Table 2:

Wage Differences between Establishments in East and West Germany in 2001

		East Germany	West Germany	Difference East in % of West
Variance in establishment wage levels	**In euro²**	**427,2**	**828,4**	**51,6**
Memo item:				
Coefficient of variation	**In %**	**45,2**	**55,5**	**81,4**
Average wage level for establishments	**In euro**	**45,8**	**51,9**	**88,2**

[a] Wage level measured as the average day's wage per person employed in the establishment.
Source: Federal Labour Agency, Annual reports for employment statistics.

How is the undoubtedly much smaller wage differentiation in East Germany than in West Germany to be explained? Bearing in mind the considerations on the determinants of establishment wage levels, one explanation could be the influence of different economic structures in East and West Germany.

If differences in the composition of the economy by branches and size of establishments play a part, an explanation of the smaller differentiation in wages between establishments could be the differences in wage agreements with trade unions.

But, if there are clear deviations in wage differentiation between East and West Germany for establishments of comparable size and branch as well, this rather points to different forms of rent sharing. This would give greater weight to explanations that see the wage differences between establishments as due to differences in the companies' earnings situations and market power.

[8] The wage gap between East and West Germany is measured here on average for firms and is noticeably lower than if it were calculated on the basis of the averages for the number employed (Görzig/Gornig/Werwatz, 2004). The deviation in the average figures should mainly be due to the fact that the wage differences between East and West Germany are particularly marked in big firms.

To determine the quantitative importance of economic structures for the differences in the variance of establishment wage levels between West and East Germany the amount of the raw difference in the variance of East and West Germany of 401 has been analysed in accordance with the non-parametric decomposition approach shown (cf. table 3).

Table 3:

Components of the Wage Differentiation between Establishments in East and West Germany in 2001

	Variance total	Variance of conditional means	Means of conditional variances			
			Special component		Type structure component	Regional component
			West	East		
		Economic structure components				
Difference between West Germany and East Germany Euro	401,2	125,0	-0,1	0,0	28,1	248,2
Components of the difference in %	100,0	31,2	0,0	0,0	7,0	61,9

Source: Federal Labour Agency, Annual reports for employment statistics.

In the first step, that part of the raw difference in the variance of both parts of Germany was established that results from the variance of the means of the wage level of all 540 sector- and size-specific types of establishment. This component was 125 larger in West Germany in 2001 than in East Germany. So simply differences in the wage spread between each type of establishment in West and East Germany explain 31 % of the total raw difference between the total variances of establishment wage levels. The differences in wages paid by establishments of different size and in different branches are clearly much greater in West Germany than in East Germany.

In addition, differences between the two parts of Germany in the composition of establishments by sector and size, with their typical wage patterns, can also affect the difference in the sum of the variances for each type of establishment. Clearly of minor relevance is the fact that certain types of establishment are only represented in East or West Germany. The special components East and West show values of nearly zero. The negative value for the special component West should be inter-

preted as that the types of establishment that only occur in West Germany show a wage differentiation that is even lower than the average in East Germany.

Structural economic factors provide a greater explanation of the raw difference in the variances in establishment wage levels. That is principally because each type of establishment in both parts of Germany is represented, but the relative number of establishments of each type differs in West and East. This influence is expressed in the type structure component, which amounted to 28 in 2001. That means that 7 % of the raw difference in the variances in establishment wage levels was due to the fact that of the 540 types of establishment considered, those with particularly high internal inter-establishment wage differentiation played a larger part in West Germany than in East Germany.

Altogether, however, even then only just under 40 % of the smaller wage differentiation between establishments in East Germany, measured by the variance, can be shown to be due to structural differences from West Germany. The greater part of the raw difference in the variances in establishment wage levels between West and East Germany is due to the fact that companies of the same branch and size in East Germany show much lower wage deviations than those in West Germany. The regional component, which reflects the deviations in the variance in the same types reached 248 in 2001 and so explains more than 60 % of the raw difference in the variances in establishment wage levels.

The results of the decomposition of wage differences between establishments shown here agree with the latest empirical results on the determinants of establishment wage levels reached in other countries as well (Martins, 2004; Basu/Estrin/Svejnar, 2004; Abowd/Kramarz/Lengermann/Roux, 2005). The branch the establishment belongs to and its size largely determine the level of the wages it pays, since as proxy variables they reflect the influence of the use of different production technologies and different institutional conditions on the labour market. But great differences in the wages paid by establishments within the same branch and size class still remain, and these type-specific wage differences can chiefly be regarded as the expression of the different market power of the establishments on their sales markets.

6 Conclusion

Wage differentiation between establishments in East Germany increased noticeably in the 1990s. Nevertheless, the variance in establishment wage levels is still much lower than in West Germany. If East Germany's wage level and employment level were to be improved, at least against the West, further differentiation in the wages paid by different establishments would appear to be necessary. There is, however, need for adjustment in inter-firm wage differentiation in two directions.

Part of the adjustment needed is in the low wage segment. The share of establishments in East Germany that pay only under-average wages is much lower than in West Germany. But measures that tackle the institutional conditions on the labour market do not appear to be very promising to achieve an increase in the share of low-wage establishments in East Germany. Deviations from the collectively agreed rates downward are already possible to a much greater extent in East Germany than in West Germany, owing to the generally lower number of establishments bound by the collective agreements and the greater number of opt-out clauses.

It must be asked whether the causes of the lack of low-wage establishments in East Germany are not of a different kind. One reason could be the after-effects of the planned economy in the GDR, where wage structures were very homogeneous. In other words, the lesser degree of differentiation is still the expression of economic structures that are changing only slowly in the transition process. Another possible reason could be the connection between the distribution of income and regional demand, for example the demand for simple services. This argument is also used to explain employment gaps between Europe and the United States (Stille/Preissl/Schupp, 2003).

One part of the adjustment needed in wage differentiation in East Germany - and presumably the greater part - is an increase in the share of firms that pay considerably above the average. The importance of these firms for the total wage spread is much greater in West Germany than in East Germany. The results of the decomposition of wage variances have clearly shown that East Germany's shortage here is not primarily the expression of notably different economic structures. Rather, the position of many West German firms in competition on sales markets seems to be so strong, even within the same branch and the same size category, that they can pay wages above the average for firms of their size.

A strategy of greater inter-firm wage differentiation in East Germany would therefore probably only be successful concerning the objectives of employment and income if the competitive situation for firms can be improved across a broad front. Economic policy can support such a process, for instance by promoting innovation in East Germany across a similarly broad front.

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Appendix

Appendix 1:

Detailed exposition of the decomposition of $E_{X|W}\left[Var(Y \mid x,W)\right] - E_{X|E}\left[Var(Y \mid x,E)\right]$.

Using Nopo's (2002) extension of the well-known work of Blinder (1973) and Oxaca (1973) we decompose the difference between $E_{X|W}\left[Var(Y \mid x,W)\right]$ and $E_{X|E}\left[Var(Y \mid x,E)\right]$ into the following four additive components:

$$E_{X|W}\left[Var(Y \mid x,W)\right] - E_{X|E}\left[Var(Y \mid x,E)\right]$$
$$= \underbrace{\Delta_{West} + \Delta_{East}}_{\text{(i) Special component}} + \underbrace{\Delta_{Typ}}_{\text{(ii) Different weight for comparable type of firms}} + \underbrace{\Delta_{Reg}}_{\text{(iii) West-East differences of the variance for comparable types of firms}}$$

Δ_{West}, is the component specific to the West. It represents the part of $E_{X|W}\left[Var(Y \mid x,W)\right] - E_{X|E}\left[Var(Y \mid x,E)\right]$ that can be attributed to those types of establishments that can be found exclusively in the West („*WO*" = „West Only"). Δ_{West} is formally defined as the difference between the average type-specific variance of the kinds of establishments found in the West only, and the average type-specific variance of those Western establishments, whose type is also observed in the East, weighted by the fraction of Western establishments with no match in the East, $P^W(WO)$:

$$\Delta_{West} = \left\{ \sum_{x \in WO} Var(Y \mid x,W) \frac{f^W(x)}{P^W(WO)} - \sum_{x \in WAE} Var(Y \mid x,W) \frac{f^W(x)}{P^W(WAE)} \right\} P^W(WO)$$

Δ_{East} is the component specific to the East. It represents the part of $E_{X|W}\left[Var(Y \mid x,W)\right] - E_{X|E}\left[Var(Y \mid x,E)\right]$ that can be attributed to those types of establishments that can be found exclusively in the East („*EO*"="East Only"). Δ_{East}, is formally defined as the difference between the average type-specific variance of the kinds of establishments found in the East only, and the average type-specific variance of those Eastern establishments, whose type is also observed in the West, weighted by the fraction of Eastern establishments with no match in the West, $P^E(EO)$:

$$\Delta_{East} = \left\{ \sum_{x \in WAE} Var(Y \mid x,E) \frac{f^E(x)}{P^E(WAE)} - \sum_{x \in EO} Var(Y \mid x,E) \frac{f^E(x)}{P^E(EO)} \right\} P^E(EO)$$

Δ_{Typ} represents the part of $E_{X|W}\left[Var(Y \mid x,W)\right] - E_{X|E}\left[Var(Y \mid x,E)\right]$ that can be attributed to unequal distributions in the West and the East of establishment types found in both parts of the country . It arises from the fact that some establishment types are found both in the East and the West („*WAE*“=“West And East”) – but with unequal relative frequencies (different “type structures”). It is formally defined as the sum of the type-specific variances in the West, weighted by the difference of the distributions with which these establishment types are observed in the West and East, respectively::

$$\Delta_{Typ} = \sum_{x \in WAE} Var[Y \mid x,W]\left\{\frac{f^{W}(x)}{P^{W}(WAE)} - \frac{f^{E}(x)}{P^{E}(WAE)}\right\}$$

Finally, Δ_{Reg} represents the part of $E_{X|W}\left[Var(Y \mid x,W)\right] - E_{X|E}\left[Var(Y \mid x,E)\right]$ that can be attributed to the West-East differences in plant-level wage variability among those establishments found in both parts of the country – i.e., the “true” regional variance differential between otherwise observationally identical establishments. It is formally defined as the sum of the type-specific East-West variance differentials, weighted by the fraction with which each type is found in the East::

$$\Delta_{Reg} = \sum_{x \in WAE} \left\{Var(Y \mid x,E) - Var(Y \mid x,W)\right\} \frac{f^{E}(x)}{P^{E}(WAE)}$$

In the empirical part, the variance functions $Var(Y \mid x,E)$ and $Var(Y \mid x,W)$, that are integral parts of all four components, are not assumed to adhere to a particular parametric functional relationship with the establishment type *x*. They will be nonparametrically estimated instead by calculating variances separately for each plant type *x* in both parts of the country.

Appendix 2: Applied Industry Classification

No.	Industry	BA Classifaction
1	Agriculture, forestry, fishing	00 - 03
2	Energy, water supply	04
3	Coal mining	05
4	Other mining	04 - 08
5	Chemical products	09, 10
6	Refining, coke	11
7	Plastics	12
8	Rubber products	13
9	Quarrying	14
10	Ceramics	15
11	Glas products	16
12	Iron and steel	17
13	Non ferrous metals	18
14	Foundries	19
15	Steel mills	20 - 22
16	Steel industry	23, 24
17	Machinery equipment	26, 27
18	Office and data processing equipment	33
19	Road vehicles	28, 29
20	Vessels	31
21	Aircrafts and spacecrafts	32
22	Electrical engineering	34
23	Precision and optical instruments	35, 36
24	Metal products	37
25	Furniture, toys	38, 39
26	Wood	40
27	Wood products	41, 42, 53
28	Pulp and paper	430
29	Paper products	431 - 433
30	Printing	44
31	Leather	45, 46
32	Textiles	47 - 51
33	Clothing	52
34	Food	54 - 56
35	Bevrages	57
36	Tobacco	58
37	Buildings and construction	59, 60
38	Auxiliary construction	25, 61
39	Wholesale trade	620, 621
40	Retail trade	622 - 625
41	Railways	63
42	Other transports	65 - 68
43	Post and telecommunication	64
44	Banking	690
45	Insurances	691
46	Hotels and restaurants	70, 71
47	Education	74 -77
48	Health	78
49	Cleaning, personal services	72, 73
50	Consulting	79
51	Other services	80 - 85
52	General government	91 - 94
53	Private households, NISPH	87 - 90
54	Others	

Appendix 3: Applied Establishment Size Classes

Size class	Number of employees
1	1
2	2 - 9
3	10 -19
4	20 - 49
5	50 - 99
6	100 - 199
7	200 - 499
8	500 - 999
9	1000 - 4999
10	5000 and more

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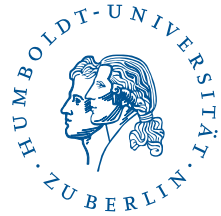

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045 "Firm Specific Wage Spread in Germany - Decomposition of regional differences in inter firm wage dispersion" by Bernd Görzig, Martin Gornig and Axel Werwatz, May 2006.

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