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Economic Restructuring, the Value of Human Capital, and the Distribution of Hourly Wages in Eastern Germany, 1990 to 1994

By Viktor Steiner and Patrick A. Puhani*

Summary

Changes in the distribution and determinants of hourly wages in eastern Germany between 1990 and 1994 are analyzed using the German Socio-Economic Panel (GSOEP-East). To this end, we first calculate standard measures of inequality and decompose the changes in the inequality of hourly wages into the changes between and within socio-economic groups. The economic factors discussed in the literature as influencing the distribution of hourly wages are then summarized and analyzed by way of empirical wage equations. In the discussion of our results, we focus on the change in rewards to human capital during the transition process and the impacts of the industrial structure on wages.

1. Introduction

Conventional wisdom holds that there was little wage differentiation in the former East Germany (GDR) and that the transition into a market economy has necessitated profound changes in the wage structure corresponding to changes in the relative demand for skills brought about by the restructuring process in the eastern German economy. It is also conventional wisdom that collective bargaining agreements have not allowed for the necessary adjustment of wages (see, e.g., Siebert 1992, pp. 124-128; Sachverständigenrat (Council of Economic Advisors) 1993, pp. 235-236). However, faced with ever rising unemployment, the collective bargaining parties in the end agreed to allow effective wages at the firm level to be set below the contract wage under certain circumstances specified in special emergency provisions known as *Öffnungsklauseln*. It is therefore not immediately apparent that the wage structure in eastern Germany is in fact rigid and thus hinders the transition process to a market economy.

For the economic and political evaluation of the transition process it is important to know which socio-economic groups are the winners and losers with regard to their income positions. We expect the losers to be above all older workers, those with qualifications facing a declining demand, those in economic sectors with strongly decreasing employment and — due to their very high participation rates — women in general. By contrast, younger workers, who are more mobile and for whom requalification is still profitable, as well as workers with human capital still highly valued in the market system in economic sectors with strongly increasing demand, are expected to benefit from the transition process.

In this paper¹, the importance of the above-mentioned factors in explaining changes in the distribution and the determinants of hourly wages is explored using microeconomic data. Existing analyses give only partial answers to these questions, as they either refer only to the first phase of transition or focus on other aspects of the income distribution². This study uses the waves of 1990, 1992, and 1994 of the German Socio-Economic Panel for eastern Germany (GSOEP-East). A significant advantage of this data base is that the first wave was collected just before the German economic, monetary, and social union in June 1990. Hence, a comparison between the wage structure of the former East Germany and the one having developed by mid-1994 is possible. We analyze the distribution and determinants of hourly wages in terms of important economic factors, namely human capital acquired through occupational qualification and general work experience, and industrial sector.

The paper is structured as follows. The distribution of hourly wages is described in the next section using kernel density estimates and inequality measures. For important socio-economic groups we also carry out a decomposition of the inequality *within* and *between* groups. Then the determinants of hourly wages are analyzed in more detail by way of empirical wage equations. The empirical results are discussed in more detail, especially with respect to the effects of occupational qualification, work experience, and industry. The paper concludes with a summary and interpretation of the most important empirical results and some implications for economic policy.

2. Descriptive Analysis

Since the first wave of the GSOEP-East refers to the period immediately before the German economic, monetary, and social union in June 1990, it is possible to draw a comparison between the wage structure of the

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¹ This is an abridged version of our original paper. The complete version is available upon request. There is also a complete version available in German (Steiner and Puhani 1996).

² Empirical analyses referring to various aspects of the distribution of the wage and earnings structure in eastern Germany during various phases of the transition process can be found in Schwarze (1991, 1993), Krueger and Pischke (1992), Bellmann (1992), Frick, Hauser, Müller, and Wagner (1993), Hauser (1992, 1995), Bird, Schwarze, and Wagner (1995), Steiner and Bellmann (1995), Steiner and Kraus (1995), and Hauser and Wagner (1996).

former East Germany and the structure established by the middle of 1994³. About 4,000 persons in 2,000 households were interviewed. As our analysis uses real hourly wages, we can include short-time workers into the analysis. Short-time work was widely used to create jobs, especially at the beginning of the transition process (see, for example, Licht and Steiner 1994). As we are interested in market determinants of wages, only gross (or pretax) wages are considered here.

The kernel density estimates of the distributions of the logarithm of hourly wages for 1990, 1992, and 1994 in Figure 1 give a first impression of the distribution of real hourly wages in eastern Germany⁴. Before Reunification the distribution of real hourly wages for both men and women was already roughly lognormal as observed in most market economies. Hence, the equality of incomes during

socialism proves to be a myth, at least as far as the distribution of hourly wages is concerned. However, inequality rose during the transition process, leading to a shift of the wage distribution to the right.

The inequality of hourly wages can also be described by summary statistics. The most common inequality measures are the Gini coefficient and the mean logarithmic deviation (I_0). As the values of the Gini coefficient and I_0 (Table 1) show, the two measures lead to the same conclusion: between 1990 and 1994, inequality increased significantly for males as well as for females. In comparison to more developed economies, the scale of inequality in eastern Germany is indeed still relatively small, but the increase during the relatively short observation period is comparatively large.

Using I_0 , we can decompose general inequality into inequalities within and between different demographic and socio-economic groups (Jenkins 1995, p. 37 f). Economically, the differences in occupational qualification, work experience, and industrial sectors are of primary importance. We distinguish among the following groups:

- by occupational qualification: unskilled, skilled (*Facharbeiter*), highly skilled (*Meister-, Ingenieur-, Fachschulabschluß*), university graduate (*Hochschulabschluß*).
- by work experience: 0 to 9 years, 10 to 19 years, 20 to 29 years, 30 to 39 years, more than 40 years.
- by industrial sector: 12 categories.

As can be seen from the decomposition of I_0 according to these subcategories in Table 1, the major part of total measured inequality can be traced back to the inequality *within* the considered groups for both males and females. The biggest share that can be traced back to differences *between* these groups is found for females classified by occupational qualification. However, the classification by work experience shows that the inequality lies almost entirely within the groups. The increase in total measured inequality during the observation period was likewise not linked to a corresponding increase in inequality between the observed occupational qualification and work experience groups. Gender-specific differences appear in the development of inequality between industrial sectors, which has increased for males but decreased for females.

A sound judgement of the described developments is only possible with the help of an empirical analysis that takes into account potential dependencies of the exogenous factors influencing wages. Such an analysis is carried out in the next section by way of multivariate empirical wage equations.

³ For a description of the GSOEP-East, see Schupp and Wagner (1990); on the collection of income data see Wagner (1991).

⁴ This estimation method is described in Härdle and Müller (1993), for example. We use Gaussian kernels with a width of 0.1 units. These and the following calculations were carried out using STATA 4.0.

Figure 1

**Kernel Density Estimates
of the Logarithm of Hourly Wages**

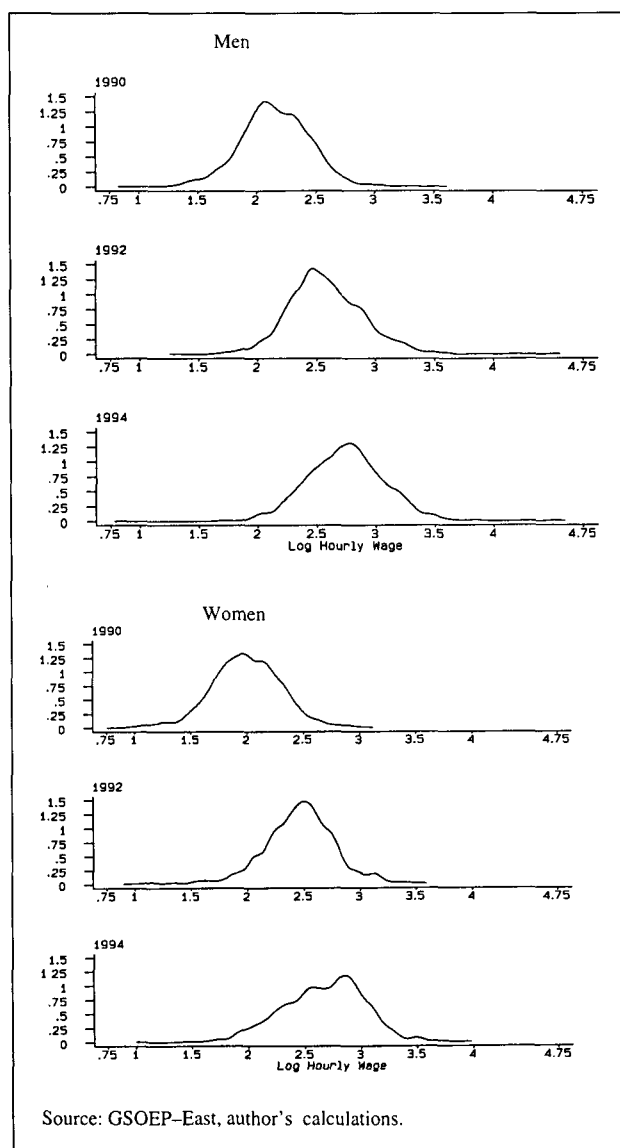


Table 1

Gini Coefficients, Mean Logarithmic Deviations, and Decompositions

	Gini	l_0	Occupational Qualification		Work Experience		Industrial Sector	
			Within	Between	Within	Between	Within	Between
Men								
1990	0.165	45	36	9	43	1	38	7
1992	0.187	58	52	6	58	0	53	5
1994	0.193	62	54	9	62	1	60	3
Women								
1990	0.171	48	31	17	46	2	44	4
1992	0.183	61	44	16	59	1	54	6
1994	0.200	66	51	15	65	1	55	11

Note: $l_0 (1/n) \sum_i \log (\mu/y_i) = \sum_k v_k l_{0k} + \sum_k v_k \log (1/\lambda_k)$, where

- n = sample size
- i = index for individual
- k = index for group
- μ = average hourly wage
- y = hourly wage
- v_k = sample share of k th group
- $\lambda_k = \mu_k / \mu$

Source: Authors' calculations from GSOEP-East data.

3. Empirical Wage Equations

In the following empirical analysis, we try to quantify the relative importance of factors potentially influencing the East German wage structure. The estimates are carried out using data from the GSOEP-East described in the previous section. We include the following explanatory variables: occupational qualification (four categories), work experience, firm size, industrial sector (12 categories), and federal state (*Bundesland*). Since we are mainly interested in structural changes in wage determination during the transition process, the analysis is carried out separately for the years 1990, 1992, and 1994 for males and females.

Estimation results of the wage equations are reported for men in Table 2 and for women in Table 3. To test for potential selection effects, we also estimated the equations using the standard two-step procedure developed by Heckman (1979)⁵. Yet we could not detect any statistically significant selection effect for any of the years examined here. Hence, the estimation results shown in Tables 2 and 3 present estimates without correction for selectivity.

As a comparison of the coefficients of determination (R^2) shows, the share of the explained variance in the total variance of hourly wages is lower for men (between 24 and 35 percent) than for women (between 37 and 42 percent) in all three years. The general increase of the standard error of regression shows that unobserved individual factors

became more significant during the transition process. Since the share of the explained variance is distinctly higher for females than for males, but the standard error of the regression is approximately the same as for males, the total variance of hourly wages must be higher for females. This result is consistent with the inequality measures described in the previous section. One possible explanation for the differences in the coefficients of determination between the sexes is the higher share of public sector employment among female workers (more than 40 percent in 1994): in Germany, wages in the public sector are strongly related to occupational qualification and work experience through pay agreements. On the other hand, unobserved factors have a stronger influence on the wages of men, who are predominantly employed in the private sector.

Because of the semi-logarithmic specification, the regression coefficients shown in Tables 2 and 3 for dummy

⁵ In the first step, the individual probability of being employed is estimated by way of a probit equation. Based on the estimated coefficients, a selection variable — the estimated inverse Mills ratio — is calculated. This enters the wage equation as an additional explanatory variable in the second step. A selection bias actually exists only if this coefficient is statistically significant in the wage equation (Heckmann 1979). The results of the probit and the wage equations corrected for selection effects are available upon request.

Table 2

Wage Equations for Men

Dependent Variable: Log Real Hourly Wage	1990		1992		1994	
	Coefficient	t	Coefficient	t	Coefficient	t
Occupational Qualification (skilled)						
Unskilled	-0.174*	-3.92	-0.038	-0.81	-0.073	-1.73
Highly skilled	0.172*	11.09	0.147*	6.78	0.158*	6.00
University graduate	0.319*	13.57	0.308*	8.22	0.331*	8.84
Work experience (in years)	0.012*	5.30	0.002	0.56	0.007	1.28
Work experience squared/100	-0.024*	-5.16	-0.007	-0.86	-0.015	-1.37
Firm Size (up to 20 employees)						
20-200	0.065*	2.26	0.090*	3.38	0.094*	3.37
200-2,000	0.074*	2.68	0.105*	3.63	0.227*	7.88
> 2,000	0.098*	3.41	0.130*	3.92	0.252*	7.44
Industrial Sector (engineering)						
Agriculture/forestry	-0.272*	-10.80	-0.187*	-4.66	-0.192*	-2.67
Mining/energy	0.086*	3.17	0.173*	4.11	0.068	1.59
Chemicals/plastics/wood/paper	-0.005	-0.19	0.064	1.59	-0.092	-1.72
Stones and clay/construction	0.020	0.78	0.201*	5.45	0.048	1.22
Heavy industry	0.044	1.76	0.022	0.56	-0.056	-1.12
Textiles/food	-0.070*	-2.04	0.035	0.42	-0.035	-0.48
Trade	-0.116*	-3.46	-0.019	-0.42	-0.130*	-2.90
Rail/mail/transport	0.000	0.01	-0.020	-0.54	-0.084	-1.95
Public services	-0.021	-0.90	-0.041	-1.33	-0.025	-0.59
Private services	-0.149*	-2.44	-0.027	-0.48	-0.069	-0.98
Others and missings	-0.041	-1.11	0.108*	2.52	-0.023	-0.48
Federal State (Sachsen)						
Mecklenburg-Vorpommern	0.000	-0.01	0.006	0.21	0.055	1.41
Brandenburg	0.010	0.48	-0.037	-1.33	0.012	0.41
Sachsen-Anhalt	-0.006	-0.29	-0.020	-0.81	-0.044	-1.69
Thüringen	0.026	1.40	-0.091*	-3.52	-0.065*	-2.33
East Berlin	0.036	1.39	0.115*	2.42	0.118*	2.73
Constant	1.933*	48.95	2.410*	46.41	2.527*	38.35
R ²		0.352		0.237		0.296
σ ²		0.059		0.083		0.082
Number of individuals		1,451		1,044		867

Note: For dummy variables, omitted categories are given in parentheses. The standard errors have been adjusted for heteroskedasticity (Huber 1967). Coefficients with * are significant at the 5 percent level.

Source: Authors' calculations using GSOEP-East data.

variables express the *ceteris paribus* approximate wage differentials between the corresponding category and the base category. For example, the coefficient on *unskilled* for 1990, -0.174, shown in Table 2, means that unskilled men have an hourly wage about 16 percent (= $\exp(0.174 - 1) \cdot 100$) lower than skilled workers (*Facharbeiter*) with otherwise the same characteristics⁶. Accordingly, highly skilled workers received an hourly wage 17 percent higher than

skilled workers under socialism, whereas — even in the "Workers' and Peasants' Republic" — a worker with a university degree received an hourly wage at least a third above that of a skilled worker. Female wage differentials

⁶ For coefficients large in absolute value, the approximation of the wage differential by the coefficient becomes increasingly inaccurate.

Table 3

Wage Equations for Women

Dependent Variable: Log Real Hourly Wage	1990		1992		1994	
	Coefficient	t	Coefficient	t	Coefficient	t
Occupational Qualification (skilled)						
Unskilled	-0.202*	-6.67	-0.175*	-3.47	-0.213*	-4.03
Highly skilled	0.286	16.27	0.193*	9.16	0.199*	8.20
University graduate	0.436*	15.84	0.426*	10.85	0.376*	9.62
Work experience (in years)	0.012*	5.38	0.015*	3.49	0.005	0.97
Work experience squared/100	-0.024*	-4.68	-0.029*	-2.91	-0.005	-0.43
Firm Size (up to 20 employees)						
20-200	0.114*	4.59	0.096*	3.53	0.165*	5.75
200-2,000	0.115*	4.71	0.172*	6.06	0.227*	7.77
>2,000	0.140*	5.14	0.207*	6.33	0.268*	7.36
Industrial Sector (engineering)						
Agriculture/forestry	-0.114*	-3.19	-0.058	-0.71	-0.019	-0.25
Mining/energy	0.111*	2.68	0.196*	2.48	0.351*	4.65
Chemicals/plastics/wood/paper	0.057	1.51	0.115	1.91	0.312*	4.68
Stones and clay/construction	0.090	2.68	0.176	1.91	0.312*	4.68
Heavy industry	0.032	0.86	0.001	0.01	0.010	0.14
Textiles/food	0.005	0.15	-0.070	-0.89	-0.004	-0.04
Trade	0.025	0.89	0.016	0.22	0.000	-0.01
Rail/mail/transport	0.051	1.45	0.077	1.06	0.204*	3.09
Public services	0.070*	2.54	0.125	1.83	0.226*	4.42
Private services	0.088*	2.20	0.053	0.71	0.083	1.37
Others and missings	0.062	1.16	0.053	0.68	0.074	1.16
Federal State (Sachsen)						
Mecklenburg-Vorpommern	0.039	1.60	0.078*	3.08	-0.012	-0.31
Brandenburg	0.015	0.74	0.018	0.67	0.011	0.39
Sachsen-Anhalt	-0.008	-0.42	0.005	0.16	-0.017	-0.51
Thüringen	0.007	0.34	-0.011	-0.37	-0.046	-1.50
East Berlin	0.073*	2.64	0.080	1.93	0.119*	3.42
Constant	1.634*	40.12	2.021*	27.06	2.203*	30.40
R ²	0.407		0.367		0.422	
σ^2	0.058		0.077		0.082	
Number of individuals	1,310		911		775	
Note: For dummy variables, omitted categories are given in parentheses. The standard errors have been adjusted for heteroskedasticity (Huber 1967). Coefficients with * are significant at the 5 percent level.						
Source: Authors' calculations using GSOEP-East data.						

under socialism were even more pronounced, especially for the highly skilled and university graduates, the latter earning more than one and a half times the hourly wage of skilled workers (*Facharbeiterinnen*).

The development over time of the estimated wage differentials between occupational groups shows that the male *Facharbeiter* skill premium declined significantly relative to the unskilled in the first phase of the transition

process. Although this wage differential slightly increased again between 1992 and 1994 (significant at the 10 percent level) it has not yet reached the starting level. The wage differential between skilled and highly skilled workers was reduced a bit during the observation period, whereas the differential between skilled workers and university graduates increased marginally. For unskilled women, the negative wage differential did not decline between 1990

and 1994, whereas the development of the high-skill premium for women is similar to that of men. Also, the university graduate premium, which before Reunification was significantly larger for women than for men, had converged toward the male level by 1994.

A widely applied specification of the *work experience* variable in the literature is to include it among the regressors together with its quadratic term. According to human capital theory, experience-wage profiles are expected to be concave over the life cycle (see, e.g., Franz 1991, p. 103). This case would arise in our specification with a positive coefficient on the linear and a negative one on the quadratic term. We expect the human capital acquired in the form of general work experience to have been devalued during the transition process. Hence, we would expect the already relatively flat experience-wage profiles to become even flatter after Reunification.

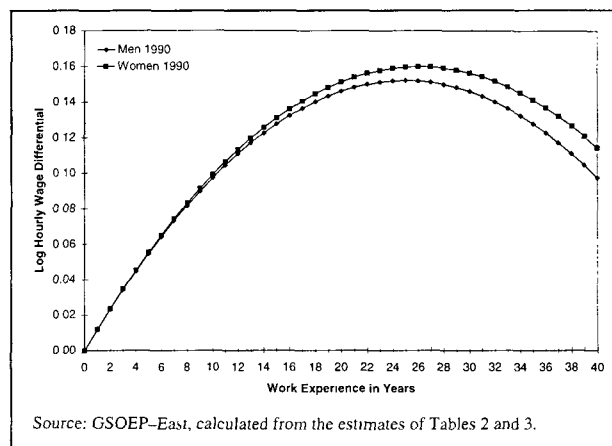
This belief is confirmed by our estimation results, at least for men. In Figure 2, we graph the experience-wage profiles estimated for 1990 for both males and females. The graphs do not show any significant gender-specific differences and are relatively flat compared to the former West Germany and other market economies. They are also similar to the results obtained by Krueger and Pischke (1992) for the former East Germany using a different data set. Statistical tests on the coefficients of both the linear and the quadratic terms of the work experience variable show them to be insignificant for men in 1992 and 1994, meaning that work experience no longer influences wages. By contrast, the corresponding tests for women imply that their experience-wage profiles in 1992 and 1994 do not differ from those before Reunification.

It is remarkable that the transition process has so far been associated with a devaluation of male, but not female, human capital gained by general work experience. As our examination of potential selection effects has shown, this does not appear to be due mainly to women with a lot of work experience, whose earning power decreased during transition, leaving the labor force or becoming unemployed. Also, we have at least partly controlled for shifts in the economic structure (industrial sector and firm size) that could have changed the gender-specific revaluation of general human capital. Therefore, an economic explanation for the gender-specific differences in the revaluation of work experience cannot be given at this stage.

As the estimation results for 1990 show, larger firms already paid *ceteris paribus* higher wages under socialism. However, this differential increased for both men and women during the transition process. In 1994, large companies (more than 2,000 employees) paid about 30 percent higher wages than small firms (up to 20 employees). Since this large wage differential exists in spite of controlling for human capital and industrial sector, we suppose that the wage determination process is either characterized by serious market imperfections or nonprofit-maximizing behavior. The market imperfection argument may be

Figure 2

Estimated Experience-Wage Profiles



Source: GSOEP-East, calculated from the estimates of Tables 2 and 3.

substantiated by the "shirking" variant of the efficiency wage theory. It is also possible that trade unions and work councils, which are more prevalent in large enterprises, achieved wage gains in excess of the general pay agreements in their industry. On the other hand, the fact that comparable wage differentials by firm size also persist in western Germany and other more or less competitive labor markets speaks in favor of the market imperfection hypothesis⁷. The alternative explanation of nonprofit-maximizing behavior seems plausible only for public sector firms. Unfortunately, since our data base contains no information on ownership of the firm, we cannot test for this possibility.

Except for relatively low payments in the agricultural and forestry, trade, and services sectors, sectoral wage differentials were low in the former East Germany in 1990. Industry wage differentials as typically found in western Germany (see, e.g., Möller and Bellmann 1995) or other developed economies have not developed during the transition process either. On the other hand, there seems to be tough competition in the labor markets of industrial sectors with strongly expanding demand, especially in the construction, trade, and private services sectors, with little room for wage increases⁸. This may also explain the marked decline of the positive wage differential of the construction sector between 1992 and 1994. On the other hand, neither in the still oversized public sector nor in the obsolete heavy industry has a noticeable pressure on wages been exerted. This

⁷ Gerlach and Hübler (1995) summarize theoretical approaches to the relationship between firm size and wages and also present an empirical analysis for western Germany.

⁸ It should be noted, though, that the aggregation of sectors, which is necessary because of too few observations in some sectors, can lead to somewhat vague results. This, for example, also applies to the category "private services," which includes, among others, financial services and window cleaning.

shows once more that in sectors with powerful unions and little competition, the relative position of wages can be maintained even during fundamental structural shifts in the economy.

Finally, the estimation results for 1990 show that, controlling for the different industrial mix and human capital of the employees, there were no regional wage differentials in the former East Germany. As expected, the reunited labor market of Berlin brought about stronger wage increases in the former East Berlin than in the other states of eastern Germany. Yet the negative regional wage differential for the state of *Thüringen*, a booming industrial region, comes as a surprise. Within the context of our estimates this can be explained only by the fact that part of the regional wage differentials is already accounted for by the industry dummies. Accordingly, the comparatively low wage level in the state of *Mecklenburg-Vorpommern* is mainly explained by the approximately 20 percent lower wage level in the agriculture and forestry sector, which is still predominant in this region.

4. Conclusions

The results of our empirical analysis of the changes of real hourly wages in eastern Germany between 1990 and 1994 have important implications for the economic and political evaluation of the adjustment toward a market economy as well as its impact on the distribution of hourly wages.

While real wages in eastern Germany rose sharply, there was also a clear increase in inequality. The upper ranks of the income distribution saw the highest increases in real wages although there were also marked improvements for the lower ranks. Hence, the situation has become more critical from a purely distributional perspective, although the distribution of earnings in the former East Germany was far from equal. Over the whole period, the inequality among females was higher than among males.

The largest part of inequality can be traced back to inequality *within* as opposed to *between* socio-economic groups, which we have classified according to occupational qualification, work experience, and industrial sector. Although this was already the case under the old regime, the relative importance of inequality within groups has increased markedly during the transition. This was to be expected since, unobserved individual factors such as ability to work under pressure, motivation, and adaptability should have greater importance under the market system than under socialism.

Substantial wage differentials between occupational groups already existed in the former East Germany. University graduates earned substantially higher wages than persons with a vocational background, and unskilled workers

received the lowest wages during socialism, too. Hence, the equality of earnings under socialism turns out to be a myth. During the transition, the university graduate wage premium decreased slightly for women, whereas the vocational qualification of *Facharbeiter* was revalued. This revaluation would have been expected given the contents of training and education under socialism, the relative scarcities, as well as the industrial restructuring process. By contrast, for males the skill premium of the *Facharbeiter* relative to being unskilled declined. Here the labor market seems to have played its allocative function only partly.

Under the old regime, wages rose at a decreasing rate with increasing work experience, as is also typical for western Germany and other developed economies. However, the experience-wage profiles in the former East Germany were relatively flat and — in contrast to other economies — did not differ between men and women. During the transition, the human capital acquired through general work experience has been completely devalued for men, but women have not yet experienced a devaluation. These gender-specific differences cannot be explained by potential selection effects or by changes in the industrial structure, and we could not find an intuitive explanation for these differences within this study. As the loss of employment by older workers would have meant significant and persistent falls in incomes, the massive use of early retirement schemes as a labor market and social policy instrument for this group makes sense for the first phase of the transition process. The possibility of mitigating these reductions in potential earnings through active labor market policies, especially retraining, seems limited for older workers due to the relatively short amortization period remaining for a human capital investment.

We find diverse results concerning the impact of industrial structure on the development of wages. Large companies paid higher wages in the former East Germany, too. These firm size differentials widened further during the transition. We could not establish whether this development is related to higher productivity, the greater influence of trade unions in larger enterprises, or market imperfections through efficiency wages or political factors. As one would expect higher productivity to prevail mainly in new firms, and new firms are mostly small, even in eastern Germany, the productivity argument seems rather implausible. Market imperfections and political factors probably also explain the development of wage differentials between economic sectors. Wage differentials have diminished in industries strongly exposed to competition, whereas there has been no pressure on wages in the public sector and sectors more sheltered from competition. This development is undesirable from an allocative point of view. However, the possibilities for political intervention are very limited here due to the German constitutional law of independent collective bargaining.

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