LABOR FORCE PARTICIPATION AND GENDER WAGE GAPS IN EAST AND WEST GERMANY

By

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Submitted to

Central European University

Department of Economics and Business

In partial fulfillment of the requirements for the degree of Master of Arts in Economics

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Budapest, Hungary

2018

Abstract

The unique isolated development of West and East Germany during more than four decades formed different environments for labor force participation of individuals and regional specific labor inequality dynamics. The current thesis investigates the employment trends and gender wage gaps evolution in two regions starting from the first years of the transition period. The technique applied for the wage decomposition is the classical Oaxaca-Blinder decomposition with the Heckman two-stage procedure as an extension to correct for the selectivity issues. The correction method takes into account the participation decision of the individuals and helps to construct the inverse Mill's ratio to amend the wage equations. Results display significant selectivity into employment among women, fast convergence in employment rates between West and East Germany, and persistent over 1992-2016 period gender wage gaps.

Acknowledgments

I would like to thank my supervisor, Andrea Weber, for valuable feedback and advice given throughout my work. I also thank my family and friends for their love, patience, support, and for being there no matter the distance. Last but not least, I would like to express my gratitude to CEU community for the great environment and inspiration.

Table of Contents

1. Introduction

Inequality analysis in general and gender wage gaps research in particular take important part in policy making and development of sustainable economic system in any country. Labor market inequality and under-representation of some groups on the market is approached as a serious disruption and have significant socio-economic consequences, thus, the topic attracts attention of the number of researchers, policy makers, community leaders and general public. In this regard, Germany is a unique country for the analysis, as it went through a period of drastic transformation, which makes it an interesting subject for analysis and important case study for countries with similar historical background.

Overall focus of this thesis is on analyzing German labor market through 1992-2016 period. The country came through separation into West (former Federal Republic of Germany) and East (former German Democratic Republic) Germany and was reunified in 1990. The available dataset (starting from 1992 for East Germany) gives an opportunity to study the transition dynamics up unlit 2016. The unique isolated development of both regions during more than four decades formed different environments for labor force participation, regional labor inequality dynamics, and gender wage gaps development. Therefore it is more reasonable to approach the wage gap analysis for the country by studying the peculiarities of the two regions simultaneously.

In Europe, gender inequality in labor markets is tackled at European Union level, which affects all the members including Germany, and Member State level. To promote an equal treatment among genders the European Commission developed *"Strategic engagement for gender equality 2016-2019"*[1], where it focuses on men and women economic independence, equal pay,

[1] Strategic Engagement for Gender Equality 2016-2019. Available at: https://ec.europa.eu/anti-trafficking/sites/antitrafficking/files/strategic_engagement_for_gender_equality_en.pdf.

equality in decision-making, and other areas. Recently the general trend for women in Europe has been recorded as increasing in labor force participation, however women still tend to be employed less than men, engaged in lower-paid sectors, and have fewer paid hours[2]. Additionally, a strong social attitudes still prevail in many countries towards the housekeeping and raising children role for women. In Germany, approximately 1/3 of surveyed population agrees with statement that "the main role of a woman is to take care of her home and family"[2]. On the state level, Germany has been taking various actions to reduce gender inequality and balancing women labor force participation by introducing various programs. In 2007, Germany adopted a parental leave reform, which aimed to encourage more fathers to take a parental leave[2]. In 2015, Germany introduced Parental Allowance Plus, which provided financial incentives for both parents to work part-time[2].

Employment levels in Germany for the years 1984-2016, as displayed in Figure A1 (in the Appendices), has moderately changed for the total population. Total labor force participation rate has slowly declined over the years from about 72% to 66%, repeating a global trend for many OECD countries (World Bank data[3]). However, employment statistics had different trends for women and men. While men participation slightly declined to 66%, the relative ratio of female to male labor force participation increased significantly, which resulted in a big jump from 58% to 84% in ratio. The change evidences for increasing role and engagement of women in the labor market and brings change to the gender composition of workers in the entire country. Though, the difference in employment levels for men and women persist and have various reasons. On average it is common that men and women differ in human capital characteristics, and thus have different

[2] 2018 Report on Equality Between Women and Men in EU. Available at: http://ec.europa.eu/newsroom/just/item-detail.cfm?item_id=615287
[3] World Bank official webpage. Available at: https://data.worldbank.org/indicator

representation on the labor market. For example, women and men tend to have different education levels. Also, there exist gender difference in employment history. Usually, women are more likely to take middle and long-term breaks from employment due to family reasons, which result in less cumulative work experience and some deterioration of professional skills. Moreover, women often look for more flexible jobs and as a result occupy a majority of part-time positions.

In this thesis I aim to study labor participation dynamics and gender wage gaps over the period of 1992-2016 years for both West and East Germany. Such a wide period of time for the analysis would help to see the development of the labor market through the key transition and post-transition adjustment periods. The focus of analysis is on a parallel comparison of the employment and gender wage gaps evolution in West and East Germany. For these purposes I apply classical Oaxaca-Blinder decomposition which builds on assumption that wage rates demonstrate the individuals' productivity and human capital characteristics (Mincer, 1974). Also, special attention is paid to the extension of Oaxaca-Blinder method though Heckman correction for selection into employment. Despite some restrictions of the Oaxaca-Blinder method, its extension allows analyzing the development of gender wage gaps, and comparing its evolution for two regions.

The outline of the rest of the thesis is as follows. Section 2 is the literature review on the existing papers related to the wage decompositions. Section 3 goes through the methodology applied in this research, outlining the Oaxaca-Blinder decomposition and Heckman two-stage correction procedure. Section 4 gives an overview on the used data and provides a concise description of the available sample. The estimated results are presented and discussed in the Section 5. Decomposition results are displayed for unadjusted and adjusted gender wage gaps in order to get consistent estimates for the decomposition. Finally, Section 6 contain main conclusions of the performed work.

2. Literature overview

The topic of the gender wage gaps remains a widely researched area as the phenomenon of different earnings persists over time across various countries, and the literature on it has developed significantly with different sorts of extensions to the analysis.

Empirical evidence on wage decompositions shows that over the period of last two decades, the wage gap between women and men in OECD countries has been decreasing, however, it is still present. Weichselbaumer and Winter-Ebmer (2005) show that the gaps have decreased from around 65% to 30% over 1960-90s, and mainly due to the better endowment levels for women (improved education and training levels, accessibility). Blau and Kahn (2003) in their cross-country analysis for US, UK and some European countries came to the results that the difference between genders averaged to approximately 0.307 log points in 1980-90s. They argue several factors to be the reasons for the gaps: women on average have lower participation rates and shorter working experience (and tenure) and tend to work in different from men occupations and sectors. Additionally, they highlight that the institutional framework in each country drives the inequality differences across countries.

When analyzing gender wage gaps, researchers try to look into the reasons behind the wage differences and understand if they are due to the gender-specific characteristics, due to existing discrimination attitudes on the market or other factors. Blau and Kahn (2000, 2003) reasoned in their cross-country study that countries with relatively high wage rates and differences in rewards among industries tend to have bigger gender wage gaps.

Important block of literature concentrates on the potential biases in the wage differences estimation and the potential ways of dealing with it. One of the first methodological papers to tackle the selectivity issues were Heckman (1974, 1979) and Gronau (1974). Among empirical papers,

for example, Olivetti and Petrongolo (2008) emphasize that different factors may affect the employment selection across countries, which lead to formation of nonrandom samples. The authors mention that across countries the selection into employment is different due to such factors as: role of household composition and social norms in a country, which affect participation; labor demand side and attitudes towards the female hiring, which may influence the employer decision and as a result the arrival rate and the wage levels for men and women. Olivetti and Petrongolo illustrate the importance of accounting for non-random selection into workforce by showing the negative correlation between gender wage gaps and gender employment gaps. The estimates suggest that the selection into employment accounts for approximately 45% of the gender wage gaps, showing that partially the reason for high gaps existence in some countries is in female low participation rates and mainly high-wage earners.

Literature specifically dedicated to the wage inequality in Germany varies a lot by the time period analyzed, region of focus (West or East), and decomposition techniques applied. However, the findings report that main features of the labor market in Germany are large share of women working part-time, and the country has a special taxation scheme for married partners (Gallego-Granados and Geyer, 2015). Remaining one of the few countries who maintain the joint taxation system, Germany evidence the market consequences of it in higher marginal rates for usually women-wives, and brings more pressure into the participation decision, which influences the behavior and selection into employment. In Beblo et al. (2003) authors perform techniques of decomposition and correction for selectivity for several EU countries including entire Germany. From Oaxaca-Blinder decomposition results for Germany, the unadjusted wage differentials authors explain by about 50% with endowment characteristics. The Heckman two-stage procedure for selectivity presents the correction term as a negative coefficient and proves to be statistically

significant, meaning that with correction for selectivity the wage gaps would be lower than the initially observed.

More specific branch of literature typically concentrates on West or East Germany region. Historically, the results for average estimates show that Eastern European countries and East Germany particularly have lower gender wage gaps of approximately 0.178 log point, while for example, West Germany has around 0.32 log points around 1990s (Blau and Kahn, 2003). A more recent study looks into the development of the gender wage gap in West Germany over the period of 2001-2006, and shows that wage inequality stays strong and gender wage gaps remain almost constant (Antonczyk et al. 2010). This is argued to be due to the significant decrease in labor associations' participation, the role of collective bargaining has been decreasing and contributing to the wage inequality increase. Overall, authors show that only the low skilled women evidence some improvement in endowments level and some decline in gender wage gap.

Separate attention is paid to the development of labor market in East Germany. On average, after reunification and during the transition period the wages for eastern women had risen relatively to men's, however, women employment rates decreased significantly. Hunt (2002) argues that half of the narrowing in the gender wage gap in early 1990s is due to the dropout of less skilled and educated women. Such decline in labor participation the author explains by fall in demand for low-skilled workers in general, and adds that it is a natural consequence of changing from full employment of communism system. Hunt also adds that among the factors that influence participation, the decrease in childcare availability is not a crucial factor for leaving jobs.

The early transition period in Germany is also studied by Kohn (2006), where the results of the research reveal increasing wage dispersion for women and especially pronounce evidence for the East Germany. Performed decomposition shows that differences in the composition of the

workforce had small impact on the observed wage differentials between East and West Germany, but changes in human capital had more input in wage changes over time.

The existing extensive literature usually explores the wage inequality through several geographical focuses: cross-country studies of European countries, more specific research on sub-groups, or focus on a single state. The research for Germany, especially that including the late 1990s time horizon, usually concentrates on one of the regions West or East Germany. Only limited number of studies include the analysis of the evolution of two regions, though it remains an important field for understanding the dynamics of conversion and adaptation of two different economic systems through transition changes. Therefore, in this thesis I attempt to compare gender wage gaps and labor participation trends for both West and East Germany, and draw conclusions based on the analysis that extends up to 2016 year.

3. Methodology

3.1. Oaxaca-Blinder decomposition

To examine the gender wage gap this analysis concentrates on classical Oaxaca-Blinder (1973) decomposition method, which is widely used in related studies. Oaxaca-Blinder technique applies linear regression models (OLS) to decompose the mean outcome differences in wages through construction of counterfactuals for one of the groups (gender, race, income level, etc.). Besides, some extensions to the method is applied to address the issue of self-selection into the labor markets (selectivity correction), more specifically, decomposition is corrected with Heckman two-stage correction procedure (Heckman 1979). In this thesis decomposition of gender wage gaps is be performed for West and East Germany separately, to compare the development of gender gaps in both regions.

Oaxaca-Blinder decomposition starts with the estimation of the group-specific wage regression models separately for males and for females. The OLS estimation of the wage equation for any given group provides the estimates of the wage structure applicable to that group (Oaxaca 1973). The following log-linear wage regression model is considered:

$$\ln(wage_i^g) = X_i^g \beta^g + \varepsilon_i^g \quad (1)$$

where $\ln(wage)_i^g$ is sample mean of logarithmic wage; X_i^g is a vector of controls, which affect individual wage; ε_i^g is an idiosyncratic error term; and g is the group indicator (gender).

The results from the equation (1) are further used to answer the main question in the wage gap analysis: how much of the mean outcome difference (R) between gender specific equations defined by actual group differences in the predictors, and how much is defines by just belonging to a specific group:

$$R = \mathrm{E}[\ln(wage^M)] - \mathrm{E}[\ln(wage^F)] = X^M \beta^M - X^F \beta^F \quad (2)$$

where $\mathrm{E}[ln(wage^g)]$ denotes the expected value of wages.

Using separately estimated OLS equations for groups from equation (1), Oaxaca-Blinder (1973) method for the wage gap decomposition rearranges equations (1) and (2) into the following:

$$[\ln(wage^M) - \ln(wage^F)] =$$

$$= [\ln(wage^M) - \ln(wage^{*F})] + [\ln(wage^{*F}) - \ln(wage^F)] \quad (3)$$

$$= (X^M - X^F)\beta^M + X^F(\beta^M - \beta^F) \quad (4)$$

where X and $\ln(wage^g)$ are sample means of X and logarithmic wages; $\ln(wage^{*F}) = X^F\beta^M$ is the hypothetical assumption – counterfactual – meaning that current wage structure faced by males also applies to females, as if in the absence of discrimination.

In equation (3) the first term $[\ln(wage^M) - \ln(wage^{*F})]$ is the potential difference in wages as if women had wages based on the same characteristics as men. The second term $[\ln(wage^{*F}) - \ln(wage^F)]$ illustrates the difference between hypothetical women wage (non-discriminatory wage) and the actual mean wage (potentially discriminatory). This approach was formalized in Oaxaca (1973) by developing the concept of a discrimination coefficient (D):

$$D = \frac{Wm/Wf - (Wm/Wf)^*}{(Wm/Wf)^*} \quad (5)$$

where Wm/Wf is the actual (observed) male to female wage ratio; and $(Wm/Wf)^*$ is the male to female wage ratio in the absence of discrimination.

The decomposition, which is shown in equations (3), (4) and (5), is performed from the viewpoint of males as the reference group, where it is assumed that β^M is a non-discriminatory

coefficient vector applied to female characteristics. Given the sample characteristics (descriptive Appendices), where male wages on average accedes female wages, the above approach would be relevant for this research.

The presented equations illustrate that the raw *wage gap* (2) equals to the sum of an *endowment effect* (difference in $X's$) plus a *remuneration effect* (difference in $\beta's$) (4). In other words, the standard technique separates wage gap into two parts: *explained* by differences in human capital endowments (or determinants of wages such as education and work experience), and the part that remains *unexplained* by those differences in determinants. *Unexplained* part captures the differences in remuneration and also known as a 'discrimination effect', however, the term of 'unexplained residual' may be more appropriate as mentioned by Weichselbaumer and Winter-Ebmer (2003b).

For the purposes of the this thesis the Oaxaca-Blinder method is chosen as the most relevant and applicable, though, it suffers from several deficiencies[4], which partly will be addressed in this thesis. First of the drawbacks is that Oaxaca-Blinder method concentrates only on the decomposition at the means, and cannot be extended to the distributional wage study. This restriction conceal important differentiation among the distribution points, which otherwise would help to understand more specific wage gap drivers. Second drawback is that the method is based on quite strict assumptions, which imply linear relationship between the dependent and independent variables; also the error term ε is assumed to be conditionally independent of the set of controls X, and the violation of the assumptions would produce inconsistent estimates. Third

[4] Fortin, Lemieux and Firpo (2010).

drawback is that the method itself does not account for non-random selection into the labor market, however Heckman two-stage extension of decomposition corrects for selectivity issue.

The sample includes employed and unemployed workers to avoid endogenous selection, which may arise if only working individuals are included and if unobservables in the wage equation and in the participation equation are correlated. The technique to account for selection issues is shown in next sub-section.

3.2. Heckman correction. Adjusted wage gaps.

Among population (sample contains both employed and unemployed) it is common to observe special preferences for professions and different propensities to choose more lucrative jobs (especially relevant for men, Boudarbat and Montmarquette 2009), or working for more hours (full-time vs. part time). These individual preferences motivate the decision-making on labor market participation. Consequently, this creates selection into working environment. When selecting into a labor market, individuals do not form random groups anymore, but employed group systematically differs from unemployed group. Various literature suggests positive or negative selection for females into employment and much less for men (Olivetti and Petrongolo, 2008); where positive selection would mean that employed women on average would earn more than currently unemployed women, if the latter group would decide to work.

Widely used method to correct for selectivity bias is Heckman correction procedure. This type of selection adjustment is widely applicable to the decomposition analysis, and I apply this technique in the following analysis.

Given that women are non-randomly choosing to participate or not to participate in a labor market, the absence of non-working women in a wage distribution affects the inference of wage

gap analysis. Therefore, the Heckman (1977, 1979) sample-selection model aims to correct for the non-random selection into employment. In the Heckman correction procedure for gender wage differential analysis, wage and employment (labor force participation) equations are considered:

$$Lfp_i^g = E_i^g \gamma^g + u_i^g \tag{6}$$

$$\ln(wage_i^g) = X_i^g \beta^g + \varepsilon_i^g \tag{7}$$

where Lfp_i^g is the latent variable associated with being employed, E_i^g is a vector of determinants of employment, X_i^g is the vector of determinants of market wages, γ^g and β^g are associated parameter vectors, u_i^g and ε_i^g are the i.i.d. error terms that follow bivariate normal distribution (Neuman and Oaxaca, 2003). Then the probability function of employment is as follows:

$$Prob(Lfp_i^g > 0) = Prob(u_i^g > -E_i^g \gamma^g) = \Phi\,(E_i^g \gamma^g) \tag{8}$$

where Φ (*) is the standard normal c.d.f. As from the collected data only the wages for employed are observed, meaning $Lfp_i^g > 0$, the expected (E[*]) wage of a worker is:

$$\mathrm{E}[\ln(wage_i^g) \mid Lfp_i^g > 0] = X_i^g \beta^g + \mathrm{E}[\varepsilon_i^g \mid u_i^g > -E_i^g \gamma^g] = X_i^g \beta^g + \theta^g \lambda_i^g \tag{9}$$

where θ^g is an estimate of $\rho\sigma_\varepsilon$ (and ρ is the correlation between unobservables from participation equation (u_i) and unobservables from wage equation (ε_i); σ_ε is the standard deviation of ε_i); and λ_i^g is a mean estimate of inverse Mills' ratio. For the decomposition method, the male wage structure will be taken as the non-discriminatory, so the equation (9) will be estimated separately for males and females.

Two-stage correction I will start from running a labor force participation probability model as shown in equation (10). This allows the next step – computing the inverse Mills' ratio (λ_i^g), which will be an additional control covariate in wage regressions. The equation for labor force participation probability model should include the variables that have the most impact on participation decision:

$$Lfp_i^g = \alpha + \beta_1 Age_i^g + \beta_2 Age_i^{2g} + \beta_3 Married_i^g + \beta_4 HH\ Income_i^g + \beta_5 N^o\ Children_i^g + \quad (10)$$

$$+ \beta_6 Mother\ benefits_i^g + \beta_7 Childcare_i^g + u_i^g$$

Then the two-stage selectivity correction modifies the decomposition into adjusted wage gap decomposition by taking into account existing selectivity bias (Neuman, Oaxaca, 2004):

$$[\ln(wage^M) - \ln(wage^F)] = (X^M - X^F)\beta^M + X^F(\beta^M - \beta^F) + (\theta^M \lambda^M + \theta^F \lambda^F) \quad (11)$$

First two terms are as mentioned above the endowment and remuneration effects. The last term in equation represents the selectivity bias effect. As a result, after the labor force participation equation is estimated, and the wages function is re-estimated with the inverse Mills' ratio, one of the techniques to deal with the selection effects in (11) is to subtract selection bias from the overall differential. Consequently, the standard Oaxaca-Blinder decomposition can be performed for the adjusted differential, and the correction would account for the whole differential (Neuman, Oaxaca 2004). This type of approach to decomposition correction is simple and used in many applications of the Oaxaca-Blinder decomposition.

4. Data and descriptive evidence on gender gaps

The data for this thesis research was requested from the German Institute of Economic Research[5]. The database used for the analysis is the "German Socio-Economic Panel" (G-SOEP), which is a longitudinal survey for former Federal Republic of Germany (FRG or West Germany) from 1984 and for former German Democratic Republic (GDR or East Germany) from 1990 till present (as of now last surveyed year available is 2016). The dataset collects representative micro-data to measure socio-economic stability and developments in living conditions across the country. Over the years of data collection by the Institute, the longitudinal survey was enriched by multiple sociological, economic and political related questionnaires. The survey is nationwide, and covers around 830,000 individuals across the entire Germany. (Table of used controls is included in Appendices).

G-SOEP provides well-detailed data, collected through the decades with a distinction between West and East Germany, which is particularly important for the purposes of this thesis. The G-SOEP dataset has special format compressed data version, which instead of survey's wave-specific data offers well-documented variables pooled across all available years. The advantage of such dataset for this particular research is that it allows conducting the analysis on the income inequality development (specifically the wage gap) by two dimensions: by gender (Male/Female) and by region (West/East Germany). The parallel comparison of the evolution of gender wage gaps for West and East Germany is displayed through the entire research.

Similarly to the general practice in the literature, the sample is restricted to the 25-55 aged group (both employed and unemployed), excluding students and pensioners, military servants, and

[5] German Institute of Economic Research. Available at: https://www.diw.de/en

self-employed individuals, due to different factors affecting their wages. Including employed and unemployed workers allows conducting the analysis of a decision-making on labor market participation of the individuals. The age group restriction excludes the excessive effects, which potentially can be caused by education and retirement decisions and may influence participation of individuals (Beblo et al. 2003). Focus on only civilian wages exclude military servants, who have different from civilians wage structure.

As a result, the representative sample consists of around 50,000 individuals, which gives a rich set for performing the analysis. The labor market status is presented in the Table 1. It is notable that total labor market participation in Germany decreased significantly, from 81% in 1992 to 58% in 2016. The decrease was mainly driven by significant change in employment fractions for East Germany, especially female employment. The male participation in 1992 in the East part was mainly similar to the West male statistics, 94% and 88%, respectively. However, female participation was historically much higher in East Germany, 89% compared to 65% in West Germany, and dropped by 2016 to approximately the same levels, 61% and 59%, respectively.

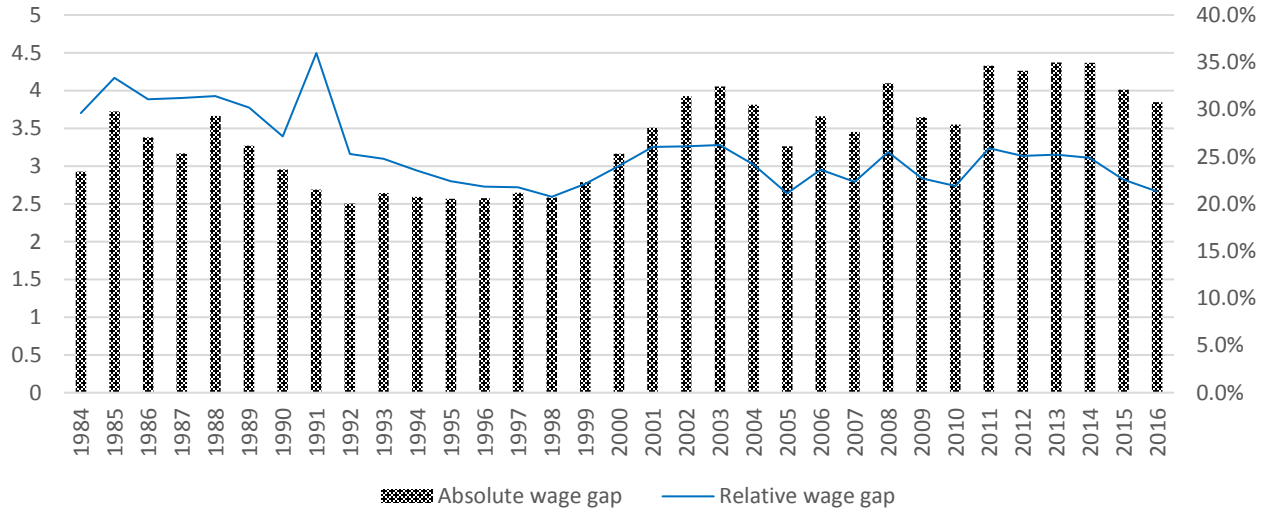
Table 1. Labor market participation of population in West and East Germany

	West		***East***		***Total Germany***
Year	***Male***	***Female***	***Male***	***Female***	***Total***
1992	88%	65%	94%	89%	81%
1998	86%	65%	89%	75%	77%
2004	85%	73%	81%	77%	79%
2010	82%	68%	78%	73%	74%
2016	56%	59%	56%	61%	58%
Total	**76%**	**65%**	**78%**	**74%**	**71%**

Source: Stata output

The more general representation of the wage differences for the sample are shown in Figure 1. The figure shows raw wage differences for the whole population of Germany. While these aggregate numbers give a picture of general wage gap development in the country, they mask the differences for separate groups / regions within the country. Due to the long period of separation between West (former FRG) and East (former GDR) parts, the labor markets of two regions went through different development, and even after the reunification in 1990 both regions still evidence different gender wage patterns.

Figure 1. Average raw gender wage differences for total Germany, wage per hour



Relative wage gap = Absolute wage gap / average male wage rate
Source: Stata output

The more specific analysis of the raw wage differences is illustrated in Figure 2, which shows the absolute gender differences in wage per hour rates separately for both West and East Germany. As can be seen from Figure 2 the wage gap in terms of regions dimension is more than twice as large in West Germany than in East Germany. Also, for both regions it increases over the years with common spikes around 2002-2004.

Figure 2. Absolute gender wage differences in West and East Germany

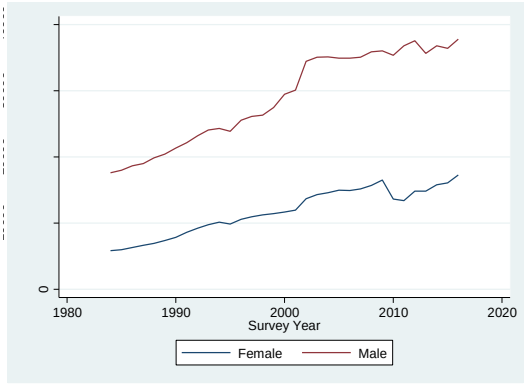
Source: Stata output

As shown in Figure 2 and Figure 3 the mean annual wages for male and female groups (panel A, B) differ significantly both in West and East Germany. The existing gap can be partially explained by the non-equal amount of hours the two gender groups work on average (panel C, D). Therefore, two gender groups have different working experience, different deterioration rate of professional skills, tenure acquiring levels, which all together influence the financial reward.

Taking into account a rich set of factors, females on average prefer to work less hours and usually opt for more flexible working schedules (part-time vs. full-time). However, it can be noted that over the decades the difference between mean wages only increases, while the number of hours tend to be more similar. The opposite trends in relationship between wage differences and hours worked suggest additional reasons to be present.

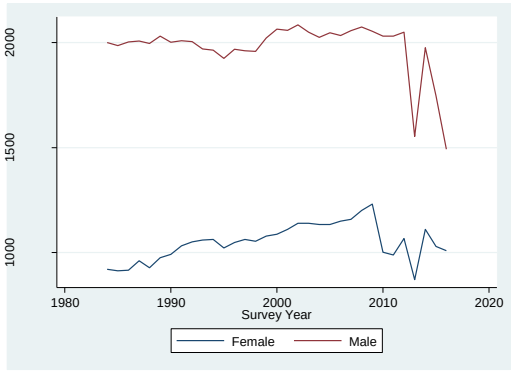
Figure 3. Mean annual wages and hours worked by gender

Panel A: annual wages, West



Panel B: annual wages, East

Panel C: hours worked, West



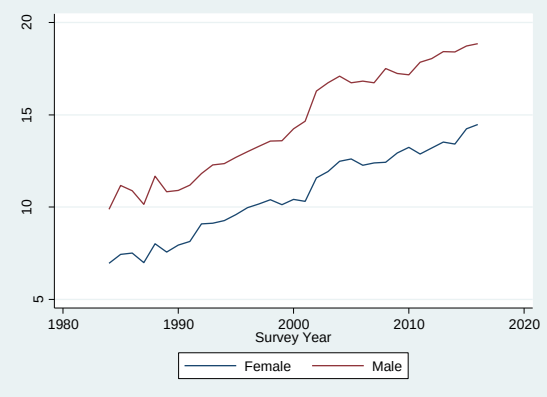
Panel D: hours worked, East

Source: Stata output

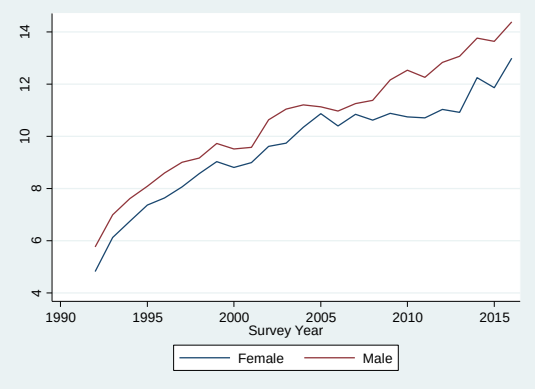
Figure 4 illustrates the difference in gender wage rates per hour by region, where it is clearly seen that the gap for West Germany is approximately twice as big as the one for East region. Additionally, Figure 4 shows that wages per hour develop differently in two regions, but within one region male and female wages evolved mainly in parallel (usually subject to common macroeconomic changes, and have similar growth trends), though in East Germany the gap has been increasing since 2008.

Figure 4. Mean wages per hour by gender

West Germany



East Germany



Source: Stata output

Interestingly, on average males and females in East Germany are more educated than males and females in West Germany, but these differences are shrinking over time and for men in both regions in 2015-2016 it is reaching zero. Notably, by gender dimension, on average in East Germany females are more educated than males, and in West Germany this difference in shrinking to zero (Figure in Appendices).

In this research the analysis is performed based on Oaxaca-Blinder decomposition, which considers the decomposition for gender groups at the mean. However, in the literature it is common to address other methods as well. For example, the Juhn, Murphy and Pierce (1993) method is analyzing wage gaps across the whole distribution. For descriptive purposes, in Appendices included figures that show the distributional descriptive approach, which would add a different dimension to the research by accounting the income level groups analysis for gender wage gaps in West and East Germany.

5. Estimation results

5.1. Basic wage regressions

In contrast to the equation (1) from previous section, where two equations are performed separately for male and female groups, it is also informative to perform pooled regression model, which would include the gender dummy variable and pool all the set of variables into regression. Linear regressions for dependent log(*wages*) with set of variables, and the year dummies fixed effects show a direction of the relationship and a significance of independent variables for dependent log(*wage*) variable. To estimate gender wage gaps a wide range of literature relies on Mincer's (1974) human capital earnings equation, which connects log(*wage*) to gender, education level, experience, and other labor market related variables. For the purposes of this research analysis, the basic and extended variations of the Mincer's equation are displayed in Table 2.

The basic model has gender dummy, region identifier (West or East), their interaction, and fixed effects controls. The extended models include additional controls ($X'\beta$), which have effect on wages: experience (and experience squared), years of education, work type dummy (full or part time job), marital status, number of children under 18, childcare services usage, income from secondary employment (additional job), dummy for being in an occupation previously trained for, occupation type dummies, and year fixed effects. Below in Table 1 the OLS estimation of basic and extended regressions are illustrated with robust standard errors to take into account heteroscedasticity bias.

The coefficients of main interest are β_1 for the gender dummy (0 if male and 1 if female), and β_2 for region dummy (0 if West and 1 if East). Coefficient β_1 shows to what extent females are paid less (or more) compared to males, and it is expected to be negative; while β_2 coefficient shows to what extent population in East is paid less (or more) compared to population in West. In addition,

the coefficient β_3 expands the interpretation of the results. Interestingly, extensions to M1 and M2 show that controlling for more factors decrease the magnitude of gender variable, and increase the magnitude of region variable, while it does not change the statistical significance of the controls.

The presented estimates prove to be robust to the inclusion of the additional independent variables. Almost all of them are significant except for nationality control variable (the dummy variable distinguish between German and non-German nationalities).

Table 2. OLS wage regressions for Mincer equation

Ln(wage)	Basic M		Extended M1		Extended M2	
	Coefficient β	***SE***	***Coefficient β***	***SE***	***Coefficient β***	***SE***
Gender	-0.307	*(0.006)*	-0.285	*(0.005)*	-0.281	*(0.005)*
Region	-0.332	*(0.008)*	-0.366	*(0.007)*	-0.356	*(0.007)*
GenReg	0.127	*(0.011)*	0.116	*(0.010)*	0.128	*(0.010)*
Experience			0.038	*(0.0005)*	0.037	*(0.001)*
Exper2			-0.0006	*(1.22E-05)*	-0.00058	*(1.28E-05)*
Education			0.072	*(0.001)*	0.070	*(0.001)*
Part-time			-0.091	*(0.002)*	-0.096	*(0.002)*
Married					0.033	*(0.003)*
Children					0.005	*(0.001)*
Childcare					-4.37E-06	*(8.36E-06)*
Sec. income					-8.10E-06	*(4.91E-07)*
Trained for					0.063	*(0.002)*
Overtime					-0.007	*(0.0003)*
Nation					0.002	*(0.006)*
Year dummies FE	Y		Y		Y	
Occupation FE	N		N		Y	
R^2	0.19		0.33		0.38	

Source: Stata output

As it is expected, the coefficients for β_1 (-0.31) and β_2 (-0.33) are negative, meaning that women compared to men receive lower wages, and in general, population in East Germany has lower wages than the West counterparts. This points to the existence of potential differentiation between genders. The positive coefficient β_3 (0.13) on the interaction term helps to distinguish

between women in two regions, and shows that western women would have larger wage differences in wages compared to men than eastern women.

Other variables such as experience and education, as expected, have positive and significant effect on wages. Such controls as being married and having children confirm that marital status potentially influences the job choice, incentivizing individuals to opt for higher wages to sustain a family budget. Dummy variable, which indicated that individual has been trained for the job (and thus have prior knowledge of the field) logically leads to getting higher financial reward. Receiving childcare support or having second income resources have a negative effect on wages, and intuitively can be explained as a supplement to family finances, and demotivates parents to look for higher wages. Surprisingly, the overtime variable shows the negative relationship with wages. Potential explanation can be that occupations, which allow for paid overtime already decrease the basic wage rates for their employees. Alternatively, the relationship may reflect that smaller wages motivate individuals to take more overtime hours.

5.2.Unadjusted wage gap decomposition

For the Oaxaca-Blinder decomposition of gender wage gap for West and East Germany, the log-linear wage regressions are performed for each gender group in each region. Thus for each of the five years (1992, 1998, 2004, 2010, 2016) there are four wage equations for: women in West and men in West for gender wage gap decomposition in West; women in East and men in East for gender gap in East. These equations repeat the above mentioned wage equation (1) with the extension to include the region of an individual.

As the focus of the research is on the comparison of gender wage gaps between West and East Germany, the decomposition is done separately for both regions. Therefore, the mean wage differences are:

$$R^r = E[\ln(wage^{Mr})] - E[\ln(wage^{Fr})]$$

where E[*Y*] denotes the expected value of wages; and *r* is a region indicator (West or East). To see the development of the gender wage gaps, Table 3 presents the results for the selected years, starting with 1992 as the first available year for both regions and ending with the latest surveyed year 2016.

When comparing two regions, the West Germany had at least twice as big unadjusted wage gaps (range 0.61-0.83) as East Germany (range 0.25-0.44) during all analyzed years. Significantly smaller gaps in East Germany evidence in favor of East Germany in terms of providing more equal financial reward for men and women.

The Table 3 shows that both West and East Germany unadjusted wage gaps persist over the years, with the lowest gap in 1998, when in the West and the East regions the gap dropped to 0.61 and 0.25 log points, respectively. The highest wage gaps are spotted in 2010 for both regions with gaps of 0.83 and 0.44 log points, respectively. As for 2016, some decreasing tendency in wage gaps is present for the regions. Interestingly, in both regions, unadjusted wage gaps were decreasing twice: in the beginning of a transition to market economy in1992-1998 and later in 2010-2016, although remaining relatively persistent.

The increase around year 2010 can potentially be due to the effect of economic downturn from global crisis, and various social programs introduced to engage more low-earning workers (mainly women) into distribution, so the gap would increase. Decrease around year 1998 could be

due to the continuation of transition: large employment drop, potential fall in demand for total labor (affecting men to larger extent), reduction in childcare programs leading to forced employment termination (Hunt, 2002).

Table 3. Unadjusted wage gaps for West and East Germany 1992-2016

	WEST		EAST	
1992				
ln(wage)	***Coefficient***	***SE***	***Coefficient***	***SE***
Difference	***0.67	*0.022*	***0.27	*0.024*
Explained	0.37	*0.018*	0.10	*0.014*
Unexplained	0.30	*0.017*	0.18	*0.020*
1998				
Difference	***0.61	*0.022*	***0.25	*0.031*
Explained	0.29	*0.016*	0.12	*0.021*
Unexplained	0.33	*0.018*	0.13	*0.025*
2004				
Difference	***0.77	*0.019*	***0.28	*0.034*
Explained	0.43	*0.016*	0.15	*0.025*
Unexplained	0.33	*0.017*	0.13	*0.026*
2010				
Difference	***0.83	*0.019*	***0.44	*0.036*
Explained	0.51	*0.018*	0.24	*0.028*
Unexplained	0.32	*0.018*	0.20	*0.030*
2016				
Difference	***0.74	*0.018*	***0.34	*0.039*
Explained	0.43	*0.016*	0.24	*0.029*
Unexplained	0.32	*0.018*	0.11	*0.034*

Source: Stata output

The main output of the unadjusted decomposition, displayed in Table 3, summarizes and shows that approximately half of the gender gap is present due to the human capital characteristics or endowments ("explained" part), while the rest is attributed to the remuneration of these endowments ("unexplained" part). In 2016, for West Germany adjusting female endowments levels to the levels of male would increase women's wages by 0.43 log points ("endowment effect"), which would explain around 57% of the gender gap. For the Eastern women, adjusting to male endowments level would lead to the wage increase by 0.24 log points, explaining approximately 70% of the gap difference.

A significant share of gender wage gaps is attributed to the differences in human capital, which shows systematic difference in labor characteristics between men and women. Commonly, the reasons for difference in endowment levels can be explained by long-term employment breaks for women due to family reasons, and as a result lower education levels and experience. To a lesser degree the unadjusted wage gaps are associated with differences in coefficients or "remuneration effect" (potential "discriminating wages"), however, the unexplained residual constituted significant part of the gaps.

5.3.Adjusted wage gap decomposition

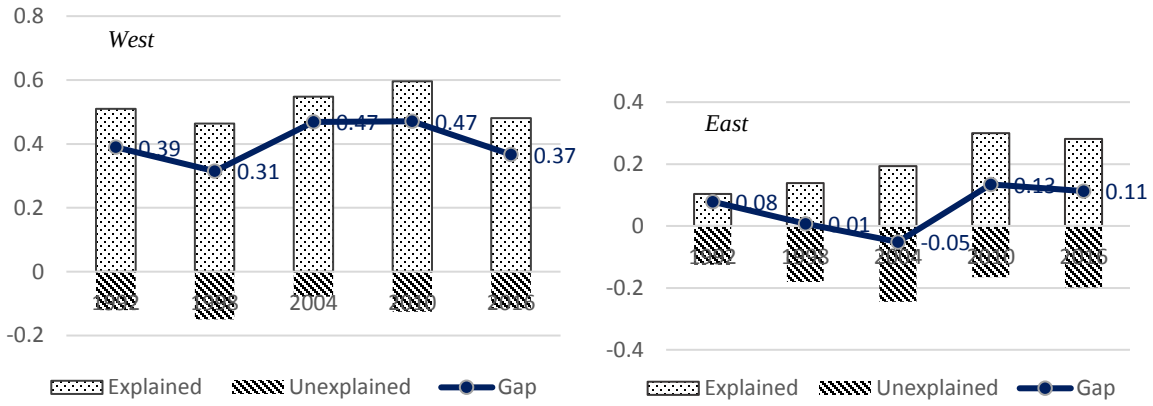
As mentioned above, the selection bias produces inconsistent estimates for the decomposition method, thus, I proceed with decomposing the adjusted wage equations for participation. Figure 5 illustrates the decomposition results corrected for selectivity into employment by Heckman two-stage procedure. While constructing adjusted equations, Mills' ratios for each year and region were negative and statistically significant, pointing to the strong selection for women and downwardly biased wage estimates for OLS regressions. Negative Mill's ratio signals that there is a negative relationship between participation (probit regression) and earnings equations' unobservables. Therefore, unobservable factors that increase the probability of labor force participation would be associated with lower wages. This proves that correcting for selectivity would bring more consistency into estimation analysis.

As with the unadjusted gender gaps, West and East Germany have similar patterns in labor market developments but different magnitudes. Notably, the adjusted wage gaps for West Germany are significantly smaller than previously unadjusted, and a large part of gaps is now attributed to

the "endowment effect" (explained part). Figure 5 shows the recent decrease of the gender wage gaps for West region by 0.1 log point down to 0.37 log points in 2016.

The results for East Germany are more ambiguous, however, similarly to West Germany the adjusted wage gaps are significantly smaller compared to unadjusted, proving selectivity issue for East region. As evidenced by Figure 5, the female population has relatively law difference in wages compared to men. Moreover, in 1998 and 2004 the gender gap was around zero and even took negative number of -0.05 log points, meaning that for East Germany in those particular years women received the same wage level as men and even higher. However, the significance of the decomposition results for East Germany in 1998 and 2004 is marginal. Additionally, the share of remuneration effect in gaps is significant, concealing around half of the unexplained residual.

Figure 5. Adjusted wage gaps for West and East Germany 1992-2016



Source: Stata output

Marginal significance for some of the estimates might be the result of measurement errors in the hours of work available in the data. In the used dataset, the hourly wages are calculated as the ratio of self-reported monthly earnings over the hours worked, where self-reported statistics could be misleading.

Comparison of unadjusted and adjusted wage gaps for Germany reveals that the uncorrected female wages are potentially biased downwards, which generates overestimated wage gaps. For example, in 2016, in West Germany uncorrected wage gap constituted 0.74 log points, while selectivity corrected gap was significantly lower, at 0.37 points. For East Germany, the difference was 0.34 and 0.02 log points, respectively. For women in West Germany the decrease after participation correction is about twice from the unadjusted gaps, but for East Germany the relative decline from unadjusted to adjusted gaps is higher. This can be explained by stronger negative selection into the employment for eastern women, meaning that potential wages for unemployed women in East might be higher than potential wages for unemployed women in West Germany. It is possible taking into account that traditionally, in East Germany women were prepared and trained for labor market similar to man and in the beginning of the transition to market economy (1992) still had high employment rates (89% compared to 65% for West Germany female).

The endowment effect was strong enough in contributing to the gender wage gap both in West and East Germany, though various factors of human capital changed their importance over time. For West Germany such factors as experience and education significantly decreased its share in the wage gap from 1992 to 2016. Large contribution to the decrease of gender wage gap over this time brought the fact of occupying part-time jobs, which evidences for development of more flexible working schedules for women. Having children contributed to the gender gap, and its share remained stable over 1992-2016. For East Germany the tenure variable contributed to the wage gap, and remained significant, while education level decreased the wage gap, though becoming less important factor among others. Having children was and remained a small factor for eastern women in determining the gender wage gaps, which is consistent to the findings of other studied on East Germany.

Despite various unification programs the gender wage gaps have persisted in both regions without stable declining trend, and only slight conversion in 2016. Even some gender inequality increase is evidenced in 1998 and 2004 period, which is consistent with the findings of Antonczyk et al. (2010), Gernandt and Pfeiffer (2007). The endowment part of the wage gap, which remained dominant (contributing to 60-80% of the gap) have been driving up the gaps until 2010, and been at faster increasing rate in East Germany (consistent with Kohn (2006)).

6. Conclusions

Just after the reunification of Germany in 1990 an active transition of East Germany from socialist system to market economy has begun. Among other transformations, the change of eastern wages into West German marks was one of the first steps on the way of adaptation. The contracts varied significantly from 57% of western levels to 83% depending on geographical location and industry (Hunt, 2002). Another sign of conversion to western labor markets was a significant drop in employment rates.

In this work I investigated the labor force participation dynamics for men and women, and gender wage gaps for two regions of Germany. The analysis was conducted with the distinction between West and East Germany to take into account different economic systems, which prevailed in two parts of the country before the reunification. The analysis covered a long span of time (from 1992 to 2016) and presented the long run trends and changes for two regions. The technique applied for the wage decomposition was the classical Oaxaca-Blinder decomposition with the Heckman two-stage procedure as an extension to correct for the selectivity issues. The correction method took into account the participation decision of the individuals and helped to construct the inverse Mill's ratio to amend the wage equations.

The results of the analysis show that strong selectivity for females is present in the restricted sample, making it non-random. Comparison of unadjusted and adjusted wage gaps for Germany reveals that the uncorrected female wages are potentially biased downwards, which generates overestimated wage gaps. With applying the selectivity correcting method, the wage gaps decrease significantly in both West and East Germany. Additionally, the adjusted wage gaps are by 70-74% explained with the endowment characteristics, and only 25-30% are the remuneration effect, with a bit more favorable composition for West Germany.

The labor participation dynamics for men and women in both regions declined with higher decrease rate for women, and both regions employment rates converged to similar level with average of 70% for West and 73% for East Germany. The wage inequality is stronger in West region, while for East region during the late 90s the gap is insignificant. This is a consequence of the socialist economy background and slow transition of East Germany from socialist to a market economy after the reunification. However, over some time there appears the evidence for some convergence in wage gaps between two regions, especially in 2016 when the gender gaps became relatively close (0.37 and 0.11 log points). The East Germany results on gender gaps reflect some degree of egalitarian approach inherited from former ruling socialist system. The slow adjustments to the West Germany highlight still existing differences in wage structures and labor participation composition in two parts of the country.

This thesis results may service to the better understanding of the dynamics of gender wage gaps and employment behavior of individuals with different wage structure, and better targeting of potential economic programs oriented on inequality on labor market.

References

Antonczyk, D., B. Fitzenberger, K. Sommerfeld (2010). "Raising Wage Inequality, the Decline of Collective Bargaining, and the Gender Wage Gap". Labor Economics, Vol. 12, Issue (5), pp. 835-847.

Beblo, M., D. Beninger, A. Heinze, F. Laisney (2003). "Measuring Selectivity-Corrected Gender Wage Gaps in the EU." Center for European Economic Research, Discussion Paper No. 03-74.

Blau F.D., L.M. Kahn (2003). "Understanding International Differences in the Gender Pay Gap". Journal of Labor Economics, Vol. 21, No. 1, pp. 106-144.

Blau, F. D., L. M. Kahn (2000). "Gender differences in pay." Technical report, National bureau of economic research.

Blau, F. D., P. Brummund, A. Y.-H. Liu (2013). "Trends in occupational segregation by gender 1970–2009: Adjusting for the impact of changes in the occupational coding system." Demography 50 (2), 471–492.

Fortin, N., T. Lemieux and S. Firpo. (2010). "Decomposition Methods in Economics." NBER Working Papers 16045.

Fortin, Nicole M. and Bell, Brian and Böhm, Michael J., (2017). "Top Earnings Inequality and the Gender Pay Gap: Canada, Sweden and the United Kingdom". IZA Discussion Paper No. 10829.

Gallego-Granados, P., J. Geyer (2015). "Distributional and behavioral effects of the gender wage gap." DIW Berlin, Discussion Paper No. 1469.

Geist Claudia, (2010). "One Germany, two worlds of housework? Examining employed single and partnered women in the decade after Unification." Journal of comparative family studies 40(3), P.415-437.

Gernandt, J., F. Pfeiffer (2007). "Rising Wage Inequality in Germany". Center for European Economic Research, Discussion Paper, No. 06-019.

Gronau, R. (1974). "Wage Comparisons: A Selectivity Bias". Journal of Political Economy, Vol. 82, No. 6, pp. 1119-1143.

Heckman, J., L. J. Lochner, P. E. Todd (2003). "Fifty Years of Mincer Earnings Regression." NBER Working Paper 9732, National Bureau of Economic Research.

Heckman, J.J. (1979). "Sample selection bias as a specification error". Econometrica, Vol. 47, No. 1, pp. 153–161.

Hunt, J. (2002). "The Transition in East Germany: When is a Ten-Point Fall in the gender Wage gap Bad News?" Journal of Labor Economics, Vol. 20, pp. 148-169.

Kohn, K. (2006). "Rising Wage Dispersion, After All! The German Wage Structure at the Turn of the Century". Institute for the Study of Labor (IZA), Discussion Paper, No. 2098.

Matysiak, A., S. Steinmetz (2008). "Finding Their Way? Female Employment Patters in West Germany, East Germany, and Poland". European Sociological Review, Vol. 24, No. 3, pp. 331-345.

Mincer, J. A. (1974). "Schooling, Experience and Earnings." Chapter "The Human Capital Earnings Function." NBER, pp. 83-96.

Mulligan, C.B., Y. Rubinstein (2008). "Selection, Investment, and Women's relative wages over Time". Quarterly Journal of Economics, Vol. 123, No. 3, pp. 1061-1110.

Neuman, S., R.L. Oaxaca (2004). "Wage Decompositions with Selectivity-Corrected Wage Equations: A Methodological Note". Journal of Economic Inequality, Vol. 2, (1), pp. 3-10.

Oaxaca, Ronald. (1973). "Male-Female Wage Differentials in Urban Labor Markets." International Economic Review, 14(3): 693-709.

Olivetti, C., B. Petrongolo (2008). "Unequal Pay or Unequal Employment? A Cross-Country Analysis of Gender Gaps". Journal of labor economics, Vol. 26, No. 4, pp. 621- 654.

Weichselbaumer, D., R. Winter-Ebmer (2005). "A meta-analysis of the international gender wage gap." Journal of Economic Surveys 19 (3), 479–511.

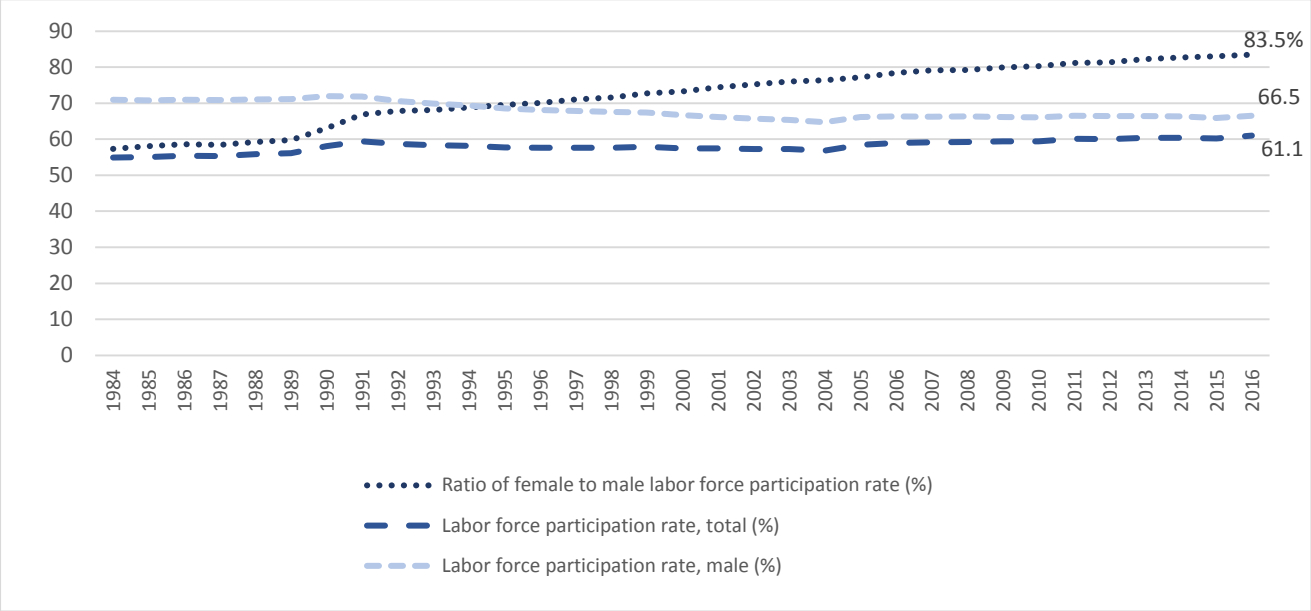
APPENDICES

Table A1. Variables from G-SOEP for regressions

Used variables	Description
lnwagehour	Wages per hour
lnwagesal	Annual wage, salary from labor work
westeast	Dummy for West (0), East (1) Germany
exper, exper2	Experience
aworkhour	Annual hours worked
educ	Education in number of years
worktype	Dummy for Full or Part –time work
married	Marital status, dummy
children	Number of children under 18
childsup	Children support, payments
childcare	Child care support
motherben	Payment benefits for mothers
secincome	Second income, amount
trainedfor	If person was trained for current job, dummy
overtime	Overtime hours per week
	Set of occupation dummies
agricult	-agriculture
energy	-energy
mining	-mining
manuf	-manufacturing
construct	-construction
trade	-trade
transp	-transportation
bank	-bank services
service	-services
nation	Nationality of an individual

Employment trends statistics

Figure A1. Labor force participation in Germany for 1984-2016

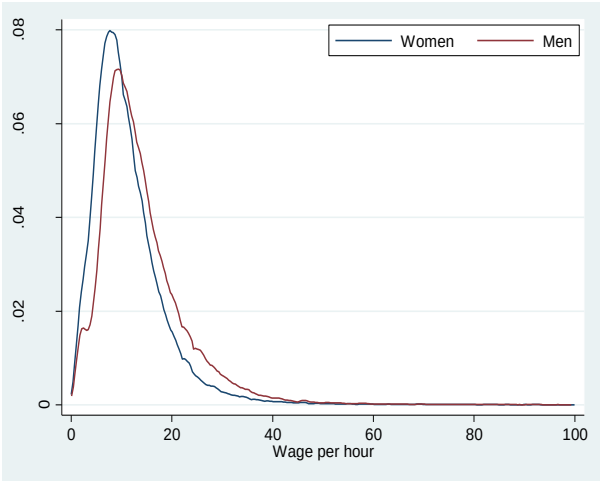


Source: World Bank

Data description

Figure A2. Kernel density of per hour and annual wages

West Germany



East Germany

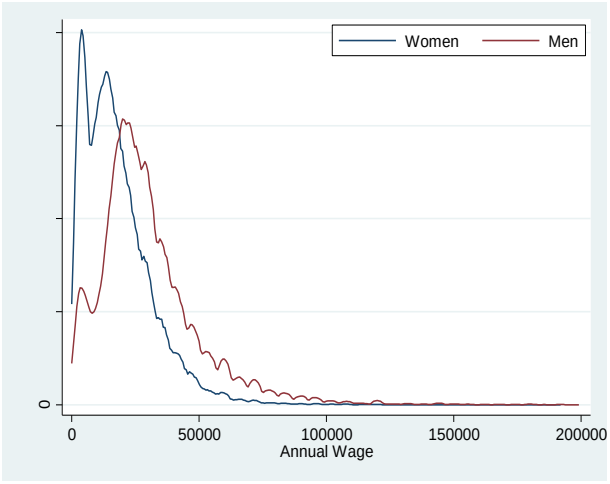
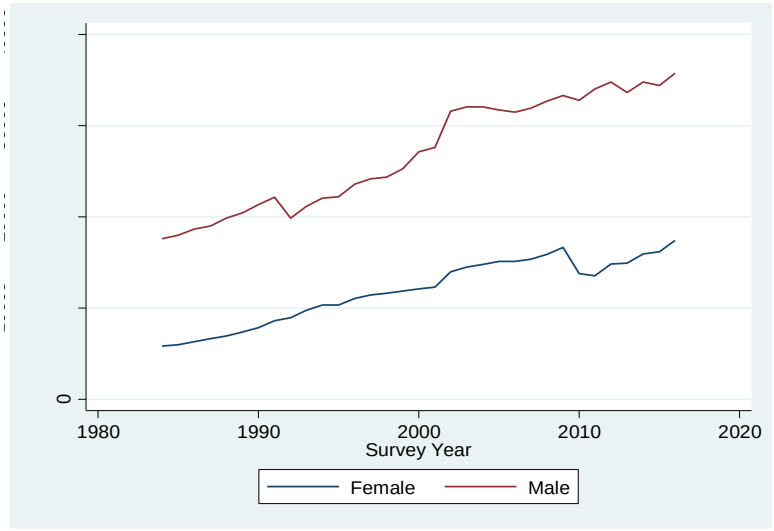


Figure A3. Mean annual wages by gender: total Germany

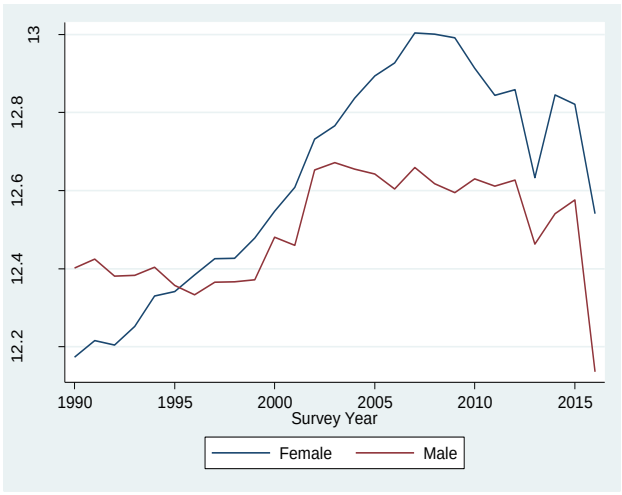


Source: Stata output

Figure A4. Average years of education by gender

West Germany

East Germany



Source: Stata output

Decomposition results

Table A1. Oaxaca decomposition results for West and East Germany 1992-2016.

West			East		
1992					
Ln(wage)	***Coefficient***	***SE***	***Ln(wage)***	***Coefficient***	***SE***
Differential			Differential		
Prediction_1	10.217	*0.002*	Prediction_1	9.402	*0.015*
Prediction_2	10.099	*0.009*	Prediction_2	9.324	*0.051*
Difference	***0.118	*0.009*	Difference	*0.079	*0.053*
Unadjusted	****0.676*	*0.017*	*Unadjusted*	****0.273*	*0.024*
1998					
Prediction_1	10.194	*0.011*	Prediction_1	9.879	*0.019*
Prediction_2	9.879	*0.035*	Prediction_2	9.871	*0.048*
Difference	***0.315	*0.037*	Difference	0.008	*0.051*
Unadjusted	****0.613*	*0.022*	*Unadjusted*	****0.248*	*0.031*
2004					
Prediction_1	10.439	*0.010*	Prediction_1	10.042	*0.023*
Prediction_2	9.970	*0.035*	Prediction_2	10.094	*0.063*
Difference	***0.469	*0.036*	Difference	-0.052	*0.067*
Unadjusted	****0.767*	*0.019*	*Unadjusted*	****0.283*	*0.033*
2010					
Prediction_1	10.460	*0.010*	Prediction_1	10.096	*0.021*
Prediction_2	9.989	*0.038*	Prediction_2	9.961	*0.052*
Difference	***0.471	*0.039*	Difference	**0.134	*0.056*
Unadjusted	****0.828*	*0.019*	*Unadjusted*	****0.442*	*0.035*
2016					
Prediction_1	10.487	*0.012*	Prediction_1	10.147	*0.025*
Prediction_2	10.121	*0.039*	Prediction_2	10.124	*0.066*
Difference	***0.367	*0.040*	Difference	**0.023	*0.012*
Unadjusted	****0.745*	*0.018*	*Unadjusted*	****0.344*	*0.038*

Source: Stata output

Difference = Adjusted gender wage gaps

Unadjusted = Unadjusted gender wage gaps

SE = standard errors