Essays on Gender Pay Gaps and Wealth Concentration

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General Introduction

Motivation

Although the inequality of income and wealth is an old phenomenon, the book "Capital in the Twenty-First Century" by Piketty (2014) re-ignited an intense discussion about their distribution. He shows that the concentration of wealth and income has substantially increased over the last decades. Albeit inequality of income and wealth is an international phenomenon, its extent varies substantially across countries. Germany belongs to the countries with the highest level of inequality in respect to wealth and income in Europe, in particular between gender (Balestra and Tonkin, 2018; OECD, 2018). However, income and wealth differ substantially in their distribution. One potential measure to compare distributions, in particular the inequality of a distribution, is the Gini coefficient. The index takes on values between 0 and 1, with a high value of the Gini coefficient indicating a high level of inequality. Comparing the Gini coefficients for disposable household income and wealth, e.g. 0.29 (2014) and 0.74 (2017) in Germany (Deutsche Bundesbank, 2019; Grabka and Goebel, 2018), respectively, suggests that wealth is substantially more unequally distributed than income. Against this background, it might be appropriate to examine income and wealth separately.

Since German Reunification, the yearly average disposable income has steadily increased from 20,000 euro in 1991 to 24,000 euro in 2016. This, however, mainly results from the considerable income growth of the tenth decile, whose income has increased by 35 % over this period. In contrast, income in the lowest decile has decreased, especially since 1999. Thus, the income gap has substantially increased over this time period (Grabka et al., 2019).

Although disposable income depends on many factors such as transfers or taxes, most importantly it depends on earnings. Earnings, in contrast, depend on wages and working hours. However, even when comparing wages, there remains a substantial gap (Fernandez Kranz, 2006; Fitzenberger, 2012). In particular, wages differ between high- and low-skilled workers (Fitzenberger, 2012) and by age (Statistisches Bundesamt, 2017b). Thus, it is mainly low-skilled and young workers who are affected by low wages at the minimum wage level. Therefore, this gap results from diverging endowments in human capital. According to Becker (1985), the wage level depends on education and experience. That is, in the sense of the *Human Capital Theory*, differences in endowments would justify wage gaps, which occur based on differences in education and experience.

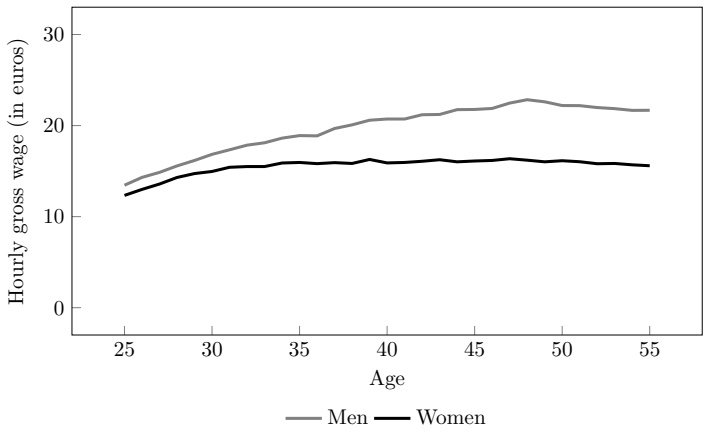
Moreover, wages, especially men's, in West Germany are considerably higher than in East Germany (Fuchs et al., 2019). One potential reason for these regional differences in wages is that sectors are differently located across Germany. The wage level is particularly high in regions where economically powerful industrial firms are located. Since men are more likely to work in the industry sector (e.g. Finke, 2010), they are more affected by the economic strength of the region. In contrast, women tend to work in public or health sectors, which depend less on the economic power of the specific region. Thus, the regional variance in the wage level stems from economic conditions and from different demands for labor.

Further, the German labor market is characterized by remarkable differences in pay between men and women, often referred to as the Gender Pay Gap. In 2018, this gap amounted to 21 % and is caused by numerous factors, including choice of occupations and divergent work experience (e.g. Finke et al., 2017). Thus, female-dominated occupations have, on average, lower wages than male-dominated occupations (Hausmann et al., 2015). However, in most occupations, there still exist significant Gender Pay Gaps within occupations – even after controlling for differences in human capital endowments (Zucco, 2019). In a prominent paper, Goldin (2014) shows that the linearity in earnings may be related to the Gender Pay Gap. That is, the wage gap is particularly high for individuals with an MBA or JD degree, thus, in occupations in which the hourly wage increases with the number of hours worked (non-linear pay). In contrast, in pharmacy, an occupation, where the hourly wage does not depend on the working hours, the Gender Pay Gap is small.

Moreover, wage differences between men and women may result from different positions within occupations. That is, women are under-represented in higher occupational positions (e.g. Holst and Friedrich, 2017; Holst and Wrohlich, 2019; Kohaut and Möller, 2019), while being over-represented in lower occupational positions (WSI, 2019). Since wages increases with the level of the occupational position, the vertical segregation can partly explain the occupation-specific Gender Pay Gap (e.g. Finke et al., 2017). However, even within these occupational positions, men earn 2 percentage points more than women (Finke et al., 2017).

Besides occupations and occupational positions, the Gender Pay Gap emerges from different labor market biographies. This relationship is evident when comparing women's and men's wages over the life course (see Figure 1). While wages of men and women are very similar at the beginning of their careers, the gap increases from the age of 30. The graph demonstrates that men's wages continue to rise, while women's wages stagnate, which translates into an increasing Gender Pay Gap. Since women give, on average, birth to their first child at the age of 30 (Statistisches Bundesamt, 2019), this finding suggests that motherhood and the Gender Pay Gap are interrelated. A recent prominent study by Kleven et al. (2019) provides evidence that parenthood has substantial and long-lasting effects on women's earnings but not on men's. Moreover, the study shows that the motherhood gap is particularly pronounced in Germany and in Austria.

These gaps may result from long employment interruptions after birth and the subsequent part-time work of mothers, while men work full-time steadily. In this context, it is worth mentioning the established role that family leave policies have on the prospective careers of



Source: RDC of the Federal Statistical Office of the Länder, SES, 2014, own calculations. Based on employees between 25 and 55 years. Values are weighted.

Figure 1: Gender specific wage levels over the life course

mothers. Ruhm (1998) demonstrates that when designing paid parental leave, policy makers face a trade-off between high employment rates, and high wages. That is, long parental leaves are correlated with higher employment rates on the one hand, but lower wages on the other. In contrast, shorter parental leave is associated with higher wages but with fewer women returning to the labor market. Therefore, parental leave reforms may have a substantial impact on the Gender Pay Gap.

Against this backdrop, Germany introduced a new parental leave benefit in 2007 ("Elterngeld") and replaced the previous benefit ("Erziehungsgeld"), which targeted medium-income mothers. In the context of the 2007 parental leave reform, the previous means-tested benefit was replaced with an earnings-related transfer that increased the incentives to not work during the first year, especially for high-income mothers. Moreover, it shortened the maximum parental leave from 24 to twelve months, which increased the incentive to work for low-income mothers. Additionally, the parental leave reform introduced a "daddy quota" of two months, i.e. two out of 14 months are earmarked individually to one parent, specifically targeting fathers, encouraging them to take a more active role in child care. Thus, the reform aimed at decreasing the Gender Pay Gap by setting incentives for mothers to return to the labor market one year after giving birth and by encouraging fathers to take parental leave. Subsequently, a number of studies show that the reform positively affected both maternal employment rates (e.g. Bergemann and Riphahn, 2011, 2015; Geyer et al., 2015; Kluve and Schmitz, 2018) and paternal leave uptake (Samtleben et al., 2019). Note that the reform may have a negative effect on the Gender Pay Gap, since it specifically increases employment rates of low-income mothers, which may have a negative effect on the average female wage level. However, it may decrease the Gender Lifetime Earnings Gap (Boll et al., 2017) and the Gender Pension Gap (e.g. Hammerschmid and Rowold, 2019). Although the 2007 parental leave reform could have decreased the earnings gap between men and women, it might have increased the gap between women with high and low prior-to-birth

earnings. The reform targeted women with high incomes before giving childbirth since their benefit increased by (at maximum) 1,800 euro, while women with low prior-to-birth earnings faced marginally higher benefits. Moreover, the reform increased the maximum duration of paid leave by twelve months for high-income mothers but shortened the duration by twelve months for low-income mothers. In addition, parental leave take up for both mothers and fathers also implies that the household can afford to forego on parts of the monthly wage for some months. This, however, is more likely in high-income households than in low-income households. Thus, not surprisingly, only mothers with medium or high prior-to-birth incomes benefited from the positive effects of the reform on employment and job quality in the medium run (Kluve and Schmitz, 2018). Moreover, Geisler and Kreyenfeld (2019) and Trappe (2013) show that paternal leave take up has particularly increased in high-income and high-educated households. Hence, these imbalanced reform effects on gender equality and employments may have increased the wage gap between mothers at the bottom and the top of the wage distribution, and, therefore, may increase income inequality. Thus, the question arises whether different accumulations of life-time earnings translate also in wealth inequality in the long run.

The literature agrees on the fact that income and wealth are correlated across different wealth and income deciles (e.g. Bundesministerium für Arbeit und Soziales, 2015; Corneo et al., 2016; Kontbay-Busun and Peichl, 2014). In the top percentile, however, the impact of heritage on wealth is substantially higher (Corneo et al., 2016). According to survey data, this top percentile owns about 24 % of total wealth in Germany (Vermeulen, 2018). Nevertheless, there is reason to believe that this share is underestimated, since non-response bias in voluntary surveys tends to increase with wealth (Vermeulen, 2018), which is apparent from comparisons of survey data and national accounts (Chakraborty et al., 2018; Chakraborty and Waltl, 2018; Vermeulen, 2016). Therefore, the distribution of wealth might be even more unequal than what the data suggest.

This dissertation is motivated by the aforementioned literature and aims at extending the current state of research with respect to inequalities of wealth and income. In particular, this thesis gives descriptive evidence on the inequality of wealth and in earnings, specifically between men and women. Moreover, this dissertation shows how occupational characteristics and vertical mobility within occupations are linked to the Gender Pay Gap. Further, it provides evidence on the question whether the 2007 parental leave reform had effects on mothers' long-run earnings, and, therefore, also on the Gender Life Time Earnings Gap.

Overview and Summary

To this end, this dissertation consists of four chapters. Chapter 1 to 3 are concerned with income, more precisely with gross wages, and chapter deals 4 with wealth. Table 1 sums up the key elements of these four chapters.

The first chapter is motivated by the large Gender Pay Gap in Germany of 21 %, which varies substantially between occupations. Therefore, this chapter is concerned with the question whether occupational differences are related to these differences. I use data from the Structure of

	Chapter 1	Chapter 2	Chapter 3	Chapter4
Title	Occupational characteristics and the Gender Pay Gap	A question of gender: How promotions affect earnings	Long-term Effects of the German Parental Leave Reform on Mothers' Earnings	Looking for the Missing Rich: Tracing the Top Tail of the Wealth Distribution
Research question	Are occupational characteristics linked with the occupation-specific Gender Pay Gap?	Do promotions have different effects on women's and men's earnings?	Did the 2007 parental leave reform have long-term effects on mothers' earnings?	Does the integration of national rich lists improve the top tail estimation?
Data	SES, IAB task data	IEB	IEB, Microcensus	HFCS, national rich lists, Forbes list
Main findings	The Gender Pay Gap within occupations correlates with the linearity in earnings, tasks, share of leadership positions and public firms	There exists no gender gap in earnings growth due to promotions within firms	The 2007 parental leave reform had positive long-run earnings effects for high-income mothers but not for low-income mothers	National rich lists can improve the estimation of the Pareto coefficient when the list of national USD billionaires is short
Methodological Approach	Correlational methods	Correlational methods	Quasi-experimental methods	Imputation and descriptive methods

Source: Own depiction;

Table 1: Overview and summary of different chapters

Earnings Study (SES) provided by the Federal Statistical Office matched with task information provided by the Institute of Employment Research (IAB) to link individual and occupational characteristics with hourly wages. In a two-step-approach, I first estimate the Gender Pay Gaps within occupations. Second, I descriptively systematize the differences between occupations by explaining the variance in the occupation-specific Gender Pay Gaps. For this systematization, I aggregate information on working conditions at the occupational level. I find that wages between men and women differ less in occupations with more linear earnings and with a low level of routine tasks. Moreover, Gender Pay Gaps are higher in occupations where a high share of employees have supervisory power, which indicates a "glass ceiling". In addition, I find that the share of public firms reduces the inequality in wages between men and women, since these firms are more likely to provide collective agreements.

Thus, chapter 1 provides descriptive evidence on Gender Pay Gaps within occupations, which occur especially in higher occupational positions. The focus of chapter 2 is, therefore, the Gender Pay Gap within occupational positions and aims at examining whether this gap is related to different increases in earnings after promotions for men and women. For this purpose, we draw a subsample from the Integrated Employment Biographies (IEB) that encompasses every individual who has ever worked subject to social security. We find that women's earnings increase more than men's due to the promotion but the descriptive results suggest that men's earnings have already increased before the promotion took place. Thus, the findings indicate that women's earnings growth depends more on promotions than men's. Further, we find that women are less likely to be promoted to higher occupational positions, but the results do not indicate larger gender gaps in the highest occupational positions, which suggests a "glass ceiling" rather than a "sticky floor." However, once we add firm fixed effects to the model gender differences are no longer significant, which may result from collective agreements. Moreover, the findings suggest that mothers are less likely to be promoted to higher positions but that they do not face lower wage increases due to promotions than non-mothers.

These differences in probability of promotions for women with and without children, presented in chapter 2, may partly explain the motherhood gap. In order to reduce motherhood penalties on the one hand and to increase financial stability during the first year after childbirth on the other, Germany has implemented a parental leave reform in 2007, which is the focus of chapter 3. In the context of this reform, the old means-tested parental leave benefit was replaced by a more generous, earnings-related benefit. Moreover, the maximal duration of this parental leave reform has shortened from 24 to 14 months, where two out of these 14 months are earmarked individually to each parent. Therefore, the reform has changed the financial incentives to work during the first two years after childbirth of mothers with high and low prior-to-birth incomes differently. While high-income mothers have post-reform a higher incentive not to work during the first year after birth, low-income mothers are more likely to work during the second year after childbirth. In this chapter, we aim at investigating how these changes in the duration of employment interruptions translate in long-run earnings. We apply a difference-in-difference approach to identify the causal effect, i.e. we compare earnings of first-time mothers who gave birth just before and right after the reform. To net out seasonal effects,

we include the year before. For this purpose, we draw a sample from the IEB that contains the total population of mothers, who gave first birth during this period and who have worked subject to social security before giving birth. We confirm previous results by showing that the average duration of employment interruptions increases for high-income mothers. These longer employment interruptions, however, do not translate into lower earnings. Contrary to what we would expect from the *Human Capital Theory*, we find even positive effects on earnings, which diminish over time. Using data from the Microcensus, we can show that these effects do not come from changes in the working hours or observed characteristics. Further, we can rule out that the effects come from changed fertility patterns or employment stability. There is suggestive evidence that stronger involvement of fathers may have facilitated mothers' return to the labor market, which, by consequence may have had a positive effect on their earnings. The reform, however, has not increased the earnings of low-income mothers.
In chapter 4, we change the focus from earnings to wealth and from the individual to the household perspective, and analyze the top tail of the wealth distribution. In addition to Germany, this chapter also investigates the wealth distribution in France and Spain. We aim at analyzing the wealth distribution by capturing the missing rich. It is a well-established fact that surveys are likely to under-represent the very wealthy. In order to capture the missing rich, we match the Household Finance and Consumption Survey (HFCS), which is provided by the European Central Bank, with rich lists. In particular, we use national rich lists, which cover a larger share of the very wealthy, and the *Forbes* list. Based on this integrated data set, we estimate a Pareto distribution and impute missing rich households. We find that imputing the missing rich, has a substantial effect on the wealth share of the richest 1 %. We also show that national rich list can particularly improve the estimation in countries, where only few dollar billionaires make it onto the *Forbes* list, such as Spain.

Contributions

Using different kinds of data, more precisely household survey data (HFCS, Microcensus), linked employer-employee data (SES) and administrative data (IEB), each chapter makes an individual contribution to the existing literature, which is discussed in more detail within the respective chapters, I will hereafter sum up the main contributions of this dissertation.
First, chapter 1 and 2 highlight the relationship between occupations and the Gender Pay Gap. Previous literature such as Finke et al. (2017) and Hausmann et al. (2015) have shown that an important part of the Gender Pay Gap is related to the fact that female-dominated occupations have on average lower wage levels than male-dominated occupations. However, there exists very few studies on Gender Pay Gaps within occupations. In particular, less is known about the link between occupational characteristics and the Gender Pay Gap. With chapter 1, I first contribute by providing evidence about the variance in the occupation-specific Gender Pay Gap. Moreover, I am able to confirm the negative relationship between linearity in earnings and the Gender Pay Gap for Germany, which Goldin (2014) has found for the U.S. That is, Gender Pay Gaps are particularly high in occupations, in which the hourly wage

depends on the number of hours worked. Moreover, I extend the findings by Goldin (2014) to a more general level: The relationship between the linearity in earnings and the Gender Pay Gap, which she observed in specific occupations such as Pharmacy and MBA, is not random but rather systematical.

The second chapter is – to the best of my knowledge – the first study that investigates the impact of promotions on women's and men's earnings in Germany. Moreover, this paper can contribute substantially to the literature, since we are the first to analyze different levels of promotion. Hence, we are able to analyze whether the potential gender gaps widen or shorten at higher occupational positions. With this distinction, we can considerably contribute to the recent literature in respect to the role of "glass ceiling" and "sticky floors". By finding no gender differences on the firm level, we confirm previous findings by Blau and DeVaro (2007), Booth et al. (2003), and Olson and Becker (1983). The administrative data allows us to observe the entire employment biography, which enables us to compare earnings growth after a promotion to earnings growth in the years before and after the promotions. The results reveal that men's earnings have increased more strongly than women's before the promotion took place. With these findings, we make an important contribution to the literature, since we can show that promotions affect women's earnings more strongly than men's. That is, while women's earnings increase in particular when they get promoted, men's earnings growth is less depending on promotions.

In chapter 3, we make important contributions to the literature on the 2007 parental leave reform. The effects of the reform have been investigated for various outcomes such as fertility (Cygan-Rehm, 2016; Raute, 2019), family living arrangements (Cygan-Rehm et al., 2018), domestic work (Schober, 2014), norm effects (Unterhofer and Wrohlich, 2017; Welteke and Wrohlich, 2019) or child outcomes (Huebener et al., 2019). Since the reform has in particular changed the incentives to work during the first years after childbirth, a large part of literature focuses on labor market outcomes. In particular, the short-term effects of the reform on employment have been analyzed in a number of studies (e.g. Bergemann and Riphahn, 2011, 2015; Geyer et al., 2015). Moreover, a recent study by Kluve and Schmitz (2018) investigates the medium-run effects of the reform on employment and employment stability. However, much uncertainty still exists about long-run outcomes. Further, there exists no research on the impact of the reform on earnings, which might be one of the most fundamental outcomes when evaluating the reform. Therefore, we considerably contribute to the existing literature of research by investigating the effects of the reform on earnings in the short, medium and long run.

Finally, in chapter 4 we rely on a method, which was proposed by Vermeulen (2018). This approach uses both survey data and rich lists, to estimate the Pareto distribution that gives us the Pareto coefficient, which we need to create synthetic households. We then match the wealth information from the synthetic households with the survey data and rich lists to analyze the impact of the missing rich on the wealth distribution. In this study, we use national rich list in addition to the *Forbes* list, and compare the impact of the top tail for different rich list specifications. In doing so, we contribute to the existing literature, since we provide evidence that national rich lists can improve the estimation of the top tail compared to the *Forbes* list,

in particular when the number of national billionaires is small. Moreover, the generated data set can be used for further studies, e.g. in micro-simulation analyses Bach and Thiemann (2016a,b) estimate the impact of an inheritance and wealth tax based on the adjusted wealth distribution.

Chapter 1

Occupational characteristics and the Gender Pay Gap

1.1 Introduction

In 2017, the German Federal Statistical Office reported that the raw Gender Pay Gap (GPG), i.e. the relative wage differences between men and women, is 21 % in Germany. The report shows that occupational choice plays an important role in the GPG (Finke et al., 2017). As shown in Table 1.1, which presents the GPGs in the ten largest occupations in Germany, the GPG varies substantially across occupations: For instance, in Nursing as well as Education and Social Work, women and men have similar wages on average. In contrast, in occupations such as Machine-building and -operating, and Business Organization, the GPGs are very large. In these occupations, men earn on average 25 % and 35 %, respectively, more than women. Hence, the question arises why the GPGs vary so much between occupations and how occupational characteristics are related to these differences.

In this paper, I systematize occupational differences in order to reveal whether, and to which extent, the GPG is linked to occupational characteristics in Germany. Using the Structure of Earnings Study (SES) data from the Federal Statistical Office matched with task information provided by the Institute of Employment Research (IAB), I link individual and occupational characteristics with hourly wages. Applying a two-step-approach, I first estimate the GPGs within occupations. Second, I descriptively systematize the differences between occupations by explaining the variance in the occupation-specific GPGs. For this systematization, I aggregate information on working conditions at the occupational level.

To highlight the relationship between occupational characteristics and the GPG, I show differences in the GPG between different occupations. In the raw data, I observe higher GPGs in occupations with mainly leadership positions and in occupations with interactive and analytical non-routine tasks. Moreover, the data suggest a relationship between the linearity in earnings

Occupation	Gender Pay Gap
Nursing	−0.02
Education and Social Work	−0.02
Cleaning Services	−0.08
Drivers of Vehicles in Road Traffic	−0.16
Warehousing and Logistics	−0.16
Office Clerks and Secretaries	−0.17
Public Administration	−0.20
Average	−0.21
Sales Occupations (without Specialization)	−0.25
Machine-building and -operating	−0.24
Business Organization	−0.35

Source: RDC of the Federal Statistical Office and Statistical Offices of the Länder, SES, 2014, own calculations. Values are weighted and are based on employees between 25 and 55 years.

Table 1.1: Gender Pay Gap in the ten largest occupations in Germany

and the size of the GPG. An occupation is defined as linear if hourly wages are constant along the distribution of working hours. In contrast, persons who are employed in occupations with non-linear earnings face wage premia for longer working hours. Specifically, the data reveal that in particular occupations in the medical sector that have low GPGs, tend to remunerate linearity. In contrast, occupations with non-linear earnings, which are more pronounced in the business sector, have higher GPGs. However, these findings may result from differences in observables.

Therefore, I estimate, in the first step, the adjusted GPG within occupations based on individual characteristics. After controlling for human capital and firm characteristics, the average GPG within occupations is 13 %. While in some occupations women earn more than men (e.g. Civil Engineering or Event Organization), female employees in Legal Services earn 33 % less, while Actresses, female Dancers and Athletes earn even 51 % less than their male colleagues do. Excluding part-time workers from the regression leads to different results, which emphasizes the necessity to include part-time workers when estimating the GPG.

In the second step, I regress occupational characteristics on the GPG obtained in the first step. To measure, whether or not, the linearity in earnings is related to the GPG, I introduce the non-linearity index. This index gives the relative occupation-specific difference in the hourly wage between persons working more than 40 hours per week and those working less than 25 hours. I find that occupations with more linear earnings show less differences between men's and women's wages. Thus, this result extends Goldin's (2014) study, which highlights this link for selected occupations, to a more general level. Moreover, in contrast to the raw data, occupations with more routine tasks have larger GPGs on average. According to the literature, occupations with linear earnings (Goldin, 2014) and with non-routine tasks (Bhalotra and Fernández, 2018) have a higher level of substitution. These relations indicate the importance of substitution when it comes to the GPG: The more employees can replace each other, the less pricey is the absence of a particular employee and the lower is the GPG. Moreover, GPGs are

higher in occupations where a high share of employees have supervisory power, which indicates a "glass ceiling". In addition, I find that the share of public firms reduces the inequality in wages between men and women as these firms are more likely to provide collective agreements. These agreements do not just decrease the leeway in discrimination among workers but might also have positive external effects on other firms. Hence, private companies may reward their employees according to the wage agreements of the public firms.

A considerable literature examines the various reasons for the GPG.[1] Besides the large strand that focuses on gender differences on behavior (Babcock and Leschever, 2003; Bertrand, 2011; Croson and Gneezy, 2009; Niederle and Vesterlund, 2007), many earlier studies focus on sorting. That is, men often earn more than women because they select in better paying firms (Card et al., 2016; Coudin et al., 2018; Goldin et al., 2017) or work in occupations with higher earnings (Blau and Kahn, 2017; Cutillo and Centra, 2017; Ludsteck, 2014; Murphy and Oesch, 2016). But even within occupations, there is still a substantial GPG (Goldin, 2014; Hinz and Gartner, 2005). However, less is known on the occupation-specific GPGs, and more precisely, why they vary substantially across occupations.

My interest on the role of occupational characteristics to explain differences in the GPGs between occupations is based on a study by Goldin (2014). In this paper, she shows that the GPGs in the U.S. labor market vary substantially between occupations and that is linked to the degree to which hourly wages increase with the number of working hours. Hence, in occupations where the wage level is independent of working hours, the GPG is lower than in those occupations where earnings increase disproportionately with the number of hours worked.

There is still uncertainty, however, to what extent these results can be transferred to other labor markets. In this paper, I focus on the German labor market because it is characterized by a high share of part-time work. However, part-time work is a quite female phenomenon: in 2017, 48 % of women and 11% of men worked in part-time (Statistisches Bundesamt, 2018a). Moreover, the role of occupations in Germany is very important as they determine, to a high degree, the professional pathway. Since the German education and vocational training system is highly standardized, apprenticeship training serves as a strong signal for a specific knowledge in one particular occupation. As a result, the number of occupational shifts decreases, while making occupational changes rather complicated (Allmendinger, 1989). Moreover, I extend the analyses of Goldin (2014) by incorporating additional characteristics, such as the distribution of occupational positions and the tasks on the occupational level to describe why the GPGs vary between occupations.

The paper is structured as follows. The next section presents some bivariate correlations between the raw GPG and some occupational characteristics. Section 1.3 is concerned with definitions and the data. Section 1.4 describes the estimation strategy used to analyze the relationship of occupational characteristics and the GPG, which consists of two steps. In the first step, I estimate the occupation-specific GPGs. The second steps aims at systematizing the differences in the gaps across occupations by regressing the GPG on occupational characteristics. Section 1.5 provides the results of the estimation, while section 1.6 discusses the findings.

[1] A large review of the current state of research is given by Blau and Kahn (2017).

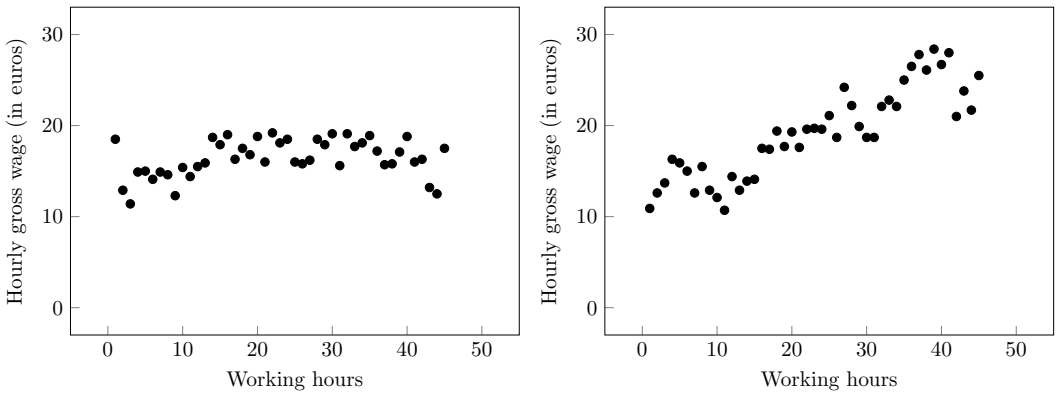
The last section concludes.

1.2 Why the GPG may be linked to occupational characteristics

Before discussing the empirical strategy and results, this section presents bivariate correlations between wages and several occupational characteristics, which highlights the role of occupations when analyzing the GPG.

1.2.1 Linearity of earnings

For the U.S. Labor Market, Goldin (2014) shows that differences in the GPGs between occupations are related to the degree to which hourly wages depend on the number of working hours. In this context, she differs between occupations with "linear" and "non-linear" earnings. In occupations with linear remuneration, hourly wages are independent from the number of hours worked and thus, earnings increase linearly with the number of working hours. In contrast, in occupations with non-linear or convex earnings, wages rise with the number of working hours. Therefore, the earnings increase disproportionately with the hours worked. Goldin (2014) argues that in occupations with non-linear remuneration, presence is of high value and therefore, flexible working hours is costly to the firm as employees are not available at a specific time. Conversely, workers in occupations with linear earnings can easily be substituted by each other such that flexible working hours do not lead to higher costs for the employers. She observes that occupations with linear earnings (e.g. pharmacy) have lower GPGs than those with non-linear earnings (e.g. MBA, JD). As part-time workers are predominantly female, the (non-)linearity of earnings can partly explain why the GPG varies over occupations in the U.S.
The correlation between the linearity of earnings and the size of the GPG may also hold true in the German labor market, as shown in Figure 1.1. Out of the ten largest occupations in Germany, Business Organization is the one with the highest GPG, while Nursing has the smallest (see Table 1.1). Comparing the size of the gross hourly net wages in both occupations by the number of weekly working hours, shows notable differences in the correlation of working hours and wages. Employees in Nursing have, on average, the same wage independent of the numbers of working hours. The average gross wages of persons working 20, 30, or 40 hours is 19 euro per hour. Hence, the remuneration in these occupations is linear. In contrast, the average gross wages in Business Organization increases with the number of working hours per week. That is, employees with 15 hours earn 14 euro, those with 30 hours earn 19 euro and those with 40 hours earn 27 euro per hour. As salaries rise disproportionately with the hours worked, Business Organization is defined as an occupation with non-linear remuneration. These examples show that the wage level is in some occupations more dependent on the number of working hours than in others. Moreover, occupations with non-linear earnings tend to have a higher GPG than occupations with linear earnings. This correlation indicates that the degree of linearity in earnings may be related to the differences in the GPGs between occupations.



(a) Nursing **(b)** Business Organization

Source: RDC of the Federal Statistical Office and Statistical Offices of the Länder, SES, 2014, own calculations; Based on employees between 25 and 55 years.

Figure 1.1: Hourly gross wages by working hours for employees in Business Organization and in Nursing

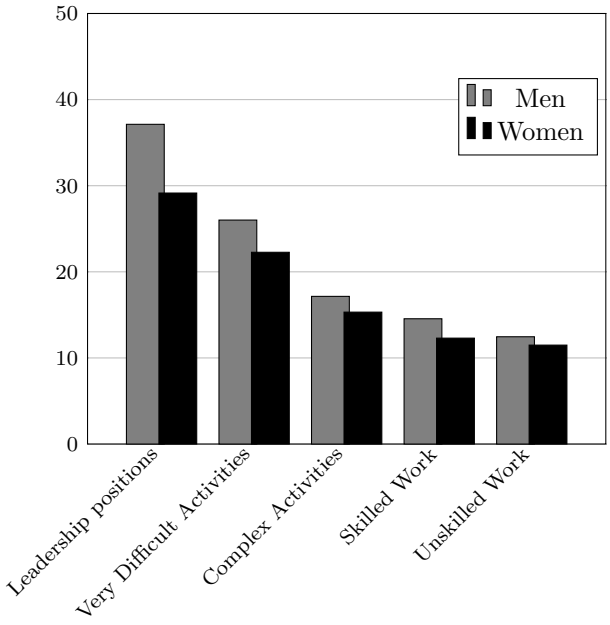
1.2.2 Occupational positions and tasks

Moreover, a considerable literature shows that the GPG is substantially large at the top of the wage distribution (Arulampalam et al., 2007; Blau and Kahn, 2017; Busch and Holst, 2009b; Collischon, Forthcoming; Gallego Granados and Wrohlich, 2018). This finding may be the result of a "glass ceiling," i.e. it is difficult for women to enter top positions. Hence, the variation in the GPG between occupations may be related to the fact that occupations are differently affected by the "glass ceiling."

Figure 1.2 classifies occupations by the mode of the occupational positions, giving the average male and female wage level for occupations that are mostly characterized by leadership positions, very difficult activities, complex activities, skilled work or unskilled work. The graph shows that wage differences between men and women increase with the occupational position. The largest gaps occur in occupations with mainly leadership positions. These descriptive results suggest the existence of a "glass ceiling." As some occupations may be more affected by a "glass ceiling" than others, the share of leadership positions within an occupation may be correlated with the GPG.

In addition, the literature emphasizes the role of tasks to explain the GPG. Black and Spitz-Oener (2010) show that the decrease of the GPG over time is partly related to changes in the work content because of workplace computerization. This is why, the share of non-routine interactive and analytical tasks has increased more for women than for men. In contrast, women's share of routine tasks has decreased stronger than men's. Moreover, computerization decreases the relative price of routine tasks. Thus, the task-based technological change favors women more than men, and is, therefore, partly explaining why the GPG has decreased over time.

However, less is known about GPGs within tasks. Therefore, occupations are grouped on



Source: RDC of the Federal Statistical Office and Statistical Offices of the Länder, SES, 2014, own calculations. Based on employees between 25 and 55 years.

Figure 1.2: Wage level within occupational positions by gender

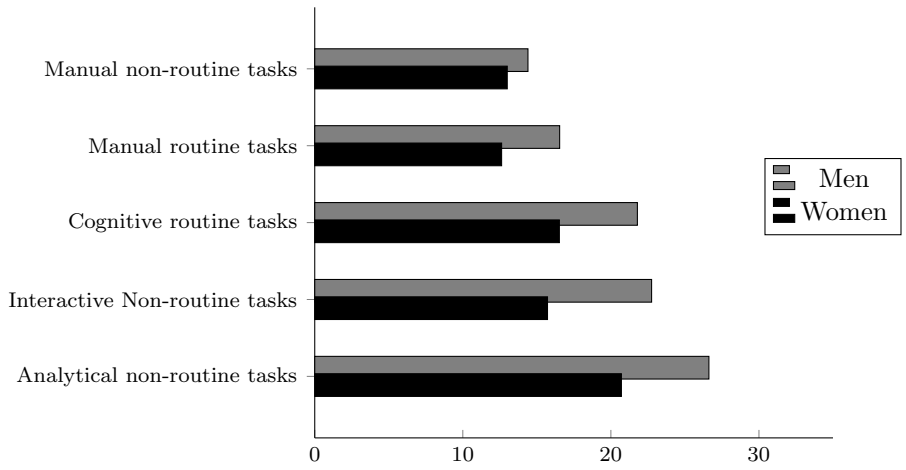
the task that is mainly performed, with Figure 1.3 showing male and female wages within each task. The graph indicates that men's wages differ substantially across tasks: While men earn, on average, 15 euro per hour in occupations with manual non-routine tasks, the male wage level in occupations with analytical non-routine tasks amounts to 27 euro per hour. In contrast, female wages are more constant across tasks, varying between 13 and 16 euro. Only in occupations with analytical non-routine tasks the average hourly wage is above 21 euro. Hence, Figure 1.3 illustrates that the GPG varies across tasks. Moreover, it indicates that these gaps between men and women are mostly related to remarkable heterogeneities of male wages between different tasks.

To sum up, comparing wages between occupations with different occupational characteristics suggests that they may be correlated with the GPG. However, these findings are based on simple group comparisons and may also result from differences in observables. Therefore, the next sections provide more information on the data set and the empirical strategy to test whether, and if so, which occupational characteristics are linked with the adjusted GPG.

1.3 Data and Descriptives

1.3.1 Data Source

The estimation is based on the SES, which is a linked employer-employee data set provided by the Federal Statistical Office. The data set offers detailed information on work characteristics,



Source: SES 2014; Based on all employees between 25 and 55 years.

Figure 1.3: Wage level within main tasks by gender

including earnings and hours worked. The data come from the employers or, in Education and Public Administration and Defense or Social Insurance sectors, from the personnel statistics of the public service (Statistisches Bundesamt, 2018c). In contrast to survey data, the administrative provision of wage information substantially decreases the likelihood of measurement errors. Due to the duty of disclosure, nonresponse, which is often a concern in survey data, does not bias the results (Kapteyn and Ypma, 2007).

The SES are cross-sectional data that are collected every four years since 2006. The data offer information about the employee (e.g. gender and occupation), the employment (e.g. wage and working hours) and the employer (e.g. firm size and public vs. private ownership).

In this paper, I use the 2014 wave, which also provides information on occupational positions, shift work, leadership positions, and overtime hours. The gross sample size of employers exceeds 60,000, while that of employees exceeds 1 million observations (Statistisches Bundesamt, 2018c). This large sample size is a major benefit of the data as it allows detailed analyses within occupations. Another important advantage of the data is that it provides information on working hours. Existing studies (e.g. Gartner and Hinz, 2009; Hirsch, 2013) that estimate the size of the GPG in Germany use administrative data provided by the IAB. As IAB data offer daily wage information but not work hours, the analyses are usually only based on full-time employed persons to make wages more comparable. Restricting the sample to full-time employees not only excludes nearly half of the females[2] but also concentrates on a very selective group of women.

1.3.2 Definitions

i. Hourly wages

The estimation of the GPG is based on hourly wages, which relies on the number of agreed

[2] As mentioned before, the 48 % of the employed women work in part-time (Statistisches Bundesamt, 2018a).

working hours per week plus the number of paid over-time hours. Further, this number is multiplied times 4.3 to determine the number of agreed monthly hours. Finally, the monthly gross earnings, which includes pay for overtime and shift work, is divided by the number of working hours per month.

ii. Occupations

Occupations form the key element of this study and group similar jobs with similar formal training. They are defined based on the three-digit-level[3] and differentiate between 144 occupations, which are given in Table A.2 the appendix. As an example, this definition allows distinguishing between human and veterinary medicine, but not between surgeons and pediatricians.

iii. Tasks

Assuming that the task composition has not changed between 2013 and 2014, I merge the SES with aggregated data on tasks for the latest year (2013) provided by the IAB. This data contain the composition of tasks and the main task within each occupation (see Dengler et al. (2014) for more detail). The tasks are grouped in the following way: Analytically non-routine tasks, interactive non-routine tasks, cognitive routine tasks, manual routine tasks and manual non-routine tasks. An overview of the specific activities within each tasks is presented in Table A.1 in the appendix.

As an example, in the occupation of Education and Social Work, the share of analytically non-routine tasks is 33 %, of interactive non-routine tasks is 51 %, and of manual non-routine tasks is 11 %, while the share of routine tasks in this occupation is rather small. Only 5 % are cognitive-routine tasks and there exist no routine manual tasks. In contrast, industrial occupations such as glass- or ceramic-making have mainly routine manual tasks.

The task-data do not offer information on soldiers. For this reason, I exclude four occupations, which describes different ranks of the German army, from the analysis.

iv. Non-linearity index

To measure the linearity of earnings within occupations, I introduce the non-linearity index. It gives the relative wage gap within occupations between persons working more than 40 hours per week and those working less than 25 hours. The less linear the remuneration within an occupation, the larger is the hourly wage gap between persons working more than 40 and less than 25 hours, and, thus, the higher is the index.

Table 1.2 shows the non-linearity index for the five occupations with the most (non-)linear remuneration of all occupations that have more than 1,000 observations. In these "most linear" occupations, such as non-medical therapy and alternative medicine, sales occupations for drugstore products or journalism, part-time workers earn more than those who work more than 40 hours per week. In contrast, managers who work less than 25 hours per week earn 43 % less than their colleagues with long working hours do.

In comparison to the U.S. labor market, Germany shows similar trends with regard to occupations with (non-)linear earnings: Occupations in the medical sector, such as selling drugstore products or pharmaceuticals or nursing, tend to remunerate more linear, while occupations

[3]The assignment to the different occupations is based on the classification of occupations 2010 (KldB 2010, Paulus and Matthes, 2013).

in the business sector such as business organization or managing are occupations with highly non-linear earnings. This finding emphasizes that despite the international differences between the German and the U.S. labor markets, the conditions within occupations seem to be similar.

Occupation	Linearity (in %)
Occupations in non-medical therapy and alternative medicine	−9.2
Sales occupations (Drugstore products, pharmaceuticals)	−8.2
Doctors' receptionists and assistants	−7.4
Occupations in nursing and obstetrics	−6.2
Occupations in editorial work and journalism	−4.9
⋮	⋮
Occupations in legal services, jurisdiction, and other officers of the court	35.1
Occupations in business organization and strategy	35.9
Teachers and researchers at universities and colleges	37.6
Technical occupations in paper-making and packaging	40.0
Managing directors and executive board members	43.3

Source: RDC of the Federal Statistical Office and Statistical Offices of the Länder, SES, 2014, own calculations.
Note: Linearity index in occupations with more than 1,000 observations; Estimations based on employees between 25 and 55 years. Linearity $= \frac{wage_{>40h} - wage_{<25h}}{wage_{>40h}}$

Table 1.2: Occupations with the most (non-)linear earnings

1.3.3 Descriptive Overview

I restrict the sample to persons between 25 and 55 years of age and exclude trainees and those working less than 9 hours per week. The final sample contains 595,333 employees, of which 290,735 are women. Table 1.3 provides the summary statistics for the entire sample and separately for women and men. With respect to their individual characteristics, men and women differ in their wages, tenure, and the probability of holding a leadership position. As expected, men have significantly higher hourly wages than women. While men earn on average 21.6 euro per hour, the average hourly wage of women is more than 4 euro smaller. Moreover, women tend to work longer in the same establishment than men and are less likely to hold a leadership position. Additionally, the average age is 42 years and 88 % of the sample has a permanent contract.

The majority of the sample (55 %) does not have any A-Levels; instead they have vocational training, with a distinct minority of the sample having completed tertiary education (University: 24 %, Polytechnical school: 3 %). The share of persons without vocational training is slightly smaller than the official numbers in the Microcensus provided by the federal statistical office. As the sample is restricted to the working population, it is better educated than the average population.

One quarter of the (female and male) employees work in East Germany[4]. On average, the

[4]East Germany comprises the new federal states (former GDR) including Berlin, while West Germany make up the old federal states (former FRG)

	Total		**Women**		**Men**	
	Mean	SD	Mean	SD	Mean	SD
			Individual Characteristics			
Hourly wage	19.40	11.04	17.14	8.04	21.56	12.93
Female	0.49	0.50	1	0	0	0
Age	41.89	8.91	41.98	8.95	41.80	8.88
Tenure	12.72	10.55	13.25	10.16	12.20	10.16
Education						
No A-level, No VT	0.07	0.25	0.08	0.27	0.06	0.24
No A-Level, VT	0.55	0.50	0.56	0.50	0.54	0.50
A-Level, No VT	0.02	0.14	0.02	0.14	0.02	0.15
A-Level, VT	0.09	0.28	0.09	0.29	0.08	0.27
Polytechnical degree	0.03	0.17	0.04	0.19	0.03	0.16
University	0.24	0.25	0.23	0.42	0.25	0.44
Permanent Contract (vs. Temporary Contract)	0.88	0.33	0.87	0.34	0.89	0.32
Leadership Position	0.05	0.22	0.03	0.16	0.07	0.26
			Firm Characteristics			
East vs. West Germany	0.25	0.43	0.24	0.43	0.25	0.43
Size of the Establishment	1070.32	2967.16	1055.84	2460.67	1084.14	3380.49
			Occupational Characteristics			
Overtime hours	1.75	1.36	0.70	0.85	1.63	1.58
Shift bonus	31.72	48.14	19.91	36.78	43.00	54.57
Non-linearity Index	0.20	0.12	0.17	0.12	0.22	0.11
Occupational positions						
Supervisory Power	0.13	0.19	0.13	0.18	0.14	0.20
Very Difficult activity	0.24	0.16	0.25	0.16	0.23	0.16
Difficult activity	0.48	0.20	0.48	0.16	0.48	0.19
Skilled work	0.10	0.10	0.09	0.10	0.11	0.10
Unskilled work	0.05	0.10	0.06	0.12	0.04	0.07
Tasks						
Analytical Non-Routine Tasks	0.33	0.22	0.35	0.40	0.31	0.23
Interactive Non-Routine Tasks	0.14	0.15	0.17	0.15	0.10	0.14
Cognitive Routine Tasks	0.28	0.18	0.28	0.19	0.27	0.18
Manual Routine Tasks	0.08	0.16	0.04	0.11	0.13	0.19
Manual Non-Routine Tasks	0.17	0.24	0.16	0.24	0.19	0.24
Share of Women	0.49	0.27	0.64	0.20	0.35	0.26
Public Firms	0.33	0.37	0.40	0.37	0.27	0.35
N	595,333		290,735		304,598	

Source: RDC of the Federal Statistical Office and Statistical Offices of the Länder, SES, 2014, own calculations.

Table 1.3: Summary Statistics

establishment have more than 1,000 employees but men tend to work in larger establishments. The third part of the table shows occupational characteristics. The table demonstrates that women work in occupations with fewer overtime hours and smaller shift bonuses. Furthermore, men tend to work in occupations with a lower level of linearity of earnings. Regarding the distribution of occupational positions, typically employees work in occupations, where the majority has difficult activities and the minority does unskilled work. The distribution of these groups does not differ between men and women. Moreover, the table shows how tasks are distributed across the sample. Employees work mostly in occupations with analytical non-routine (33 %) or cognitive routine tasks (28 %). In addition, men are more likely to work in occupations with manual tasks and women in occupations with more interactive non-routine tasks.
As expected, the summary statistics reveal that women tend to work in female-dominated occupations and men in male-dominated occupations. Further, women are more likely to work in public firms.

1.4 Empirical Strategy

Section 1.2 presented binary relations between occupational characteristics and the raw GPG. However, parts of these wage differences may come from dissimilarities regarding education levels, tenure or firm size. To control for these differences, I estimate the adjusted GPG within occupations as a first step. In the second step, I use occupational characteristics to systematize the variance in the adjusted GPGs between occupations.
Thus, as a first step, hourly wages (y_{ij}) are regressed on age, tenure, education, location of the establishment (East vs. West Germany) size of the establishment, having a leadership position, and having a permanent contract. These variables are summarized in vector X_i. In addition, the model contains gender (δ_i), occupational fixed effects (γ_j), and their interaction (α_j). This interaction term gives the conditional wage differences between men and women within each occupation j, i.e. the adjusted GPG, and, therefore, is the coefficient of interest. The indicators illustrate that each individual i is working in an occupation j.

$$log(y_{ij}) = \beta_0 + \delta_i \; Female_i + \sum_{j=1}^{J} \gamma_j \; Occ_j + \sum_{j=1}^{J} \alpha_j \; Occ_j * Female_i + \mu X_i + \epsilon_{ij} \tag{1.1}$$

However, it is likely that some unobserved preferences are correlated with the explanatory variables, especially with the occupation fixed effects. Hence, persons working as managers may have stronger preferences for professional success, while employees in Education and Social Work may seek a better reconciliation of family and working life. That is, wage differences between those two occupations may also come from selection processes.
In addition, the α_j coefficient might be biased due to different selection processes within occupations. It is possible that in some occupations, such as medicine, men and women select into different occupational sub-groups with diverging wage levels. But women are more likely to select into the relatively low remunerated occupational sub-group of pediatricians as into the

sub-group of surgeons, which has a relatively high wage level (Gesundheitsberichterstattung des Bundes, 2019; Statistisches Bundesamt, 2018b). Therefore, the size of α_j might not necessarily come from discrimination, but might also be the result of (unobserved) selection.
Thus, the estimates of (1.1) would be unbiased if the residuals were orthogonal. But due to the selection within occupations and occupational groups, the condition formulated in (1.2) might be violated. Therefore, the estimated coefficients do not necessarily reflect the causal link between the independent variables and the wage.

$$\mathbb{E}(\epsilon_j | Female_i, Occ_j, Occ_j * Female_i, X_i) = 0 \tag{1.2}$$

The second step aims at systematizing the variance in the adjusted GPG, α_j, between occupations. Therefore, the occupation-specific wage differences, estimated in (1.1), are regressed on different occupational characteristics (δ) such as shift bonus, non-linearity of earnings, and tasks.

$$\hat{\alpha}_j = \beta_0 + \delta C_j + \nu_j \tag{1.3}$$

Selection into occupations also has a crucial impact on the interpretation of the results because it affects both sides of equation (1.3). As mentioned above, it is probable that estimated α_j differs from the true α_j^*. Therefore, the relationship between the true and the estimated coefficient can be formulated as following, where a signifies the measurement error:

$$\alpha_j = \alpha_j^* + a \quad \text{with} \quad a \neq 0 \tag{1.4}$$

Thus, equation (1.3) can be rearranged as follows:

$$\hat{\alpha}_j^* = \beta_0 + \delta C_j - a + \nu_j \tag{1.5}$$

The results of the estimation are only affected if the measurement error a is correlated with the covariates. However, this is very likely, if we think, for example, about the share of women within an occupation. Hence, women working in a female-dominated occupation, such as sales or nursing, may prefer to work in these occupations as they offer a better reconciliation of family and working life due to flexible working hours.[5] Men, in contrast, may work in these occupations for other reasons. It is also possible that women working in male-dominated occupations, like technical occupations in the automotive building industry, is a very selective group. That is, these women might be more ambitious than the average population and, therefore, more labor market attached than men in these occupations.
In addition, the selection into occupations also may affect the right-hand side of equation (1.5). It is possible that persons select into an occupation because it has shift bonuses or, in contrast, other persons may not work in this occupation because it includes shift work.
Because people do not select randomly into occupations, the assumption of orthogonal residuals

[5]However, for the U.S., McCrate (2005) does not find that women have more flexible work hours than men.

does not hold (equation (1.6) and (1.7)).

$$\mathbb{E}(\nu_j|C_j) = 0 \tag{1.6}$$

$$\mathbb{E}(a|C_j) = 0 \tag{1.7}$$

As a result, the estimates of the second step (1.3) are likely to be biased. This is why the coefficients cannot be interpreted in a causal way. However, even if the results come from selection, the estimated coefficients tell us more on wage differences between women and men: The results indicate whether, and if so, which occupational characteristics are correlated to the GPG.

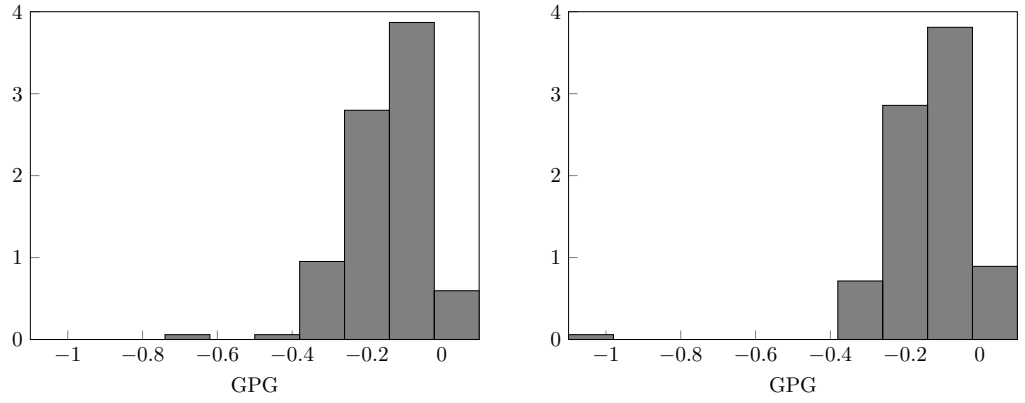
1.5 Results

This section presents the relationship between occupational characteristics and the GPG. First, I present the estimation results of occupation-specific GPGs. In the second step, I descriptively systematize the differences in the adjusted GPGs between occupations. Therefore, I analyze to what extent occupational characteristics can explain the variance in the GPGs.

1.5.1 First step: The GPG within occupations

Figure 1.4 graphs the distribution of the coefficient of interest α_j, estimated in equation (1.1) that gives the adjusted GPG in each occupation for two specification.[6] The first specification shows how the GPGs are distributed if equation (1.1) is estimated for the entire sample (a). The second specification is based on full-time employees only (b).
The results show that there are few differences in the adjusted GPGs between occupations. Moreover, the graphs emphasize that the distribution of the gaps changes slightly if part-time workers are excluded. The GPGs in the full-time sample tend to be slightly smaller. This may be the result of a positive selection of women working in full-time (Gallego Granados, 2019).

[6]The estimation results of equation (1.1) for the entire and the full-time sample, i.e. working more than 32 hours a week, is given in the appendix in Table A.3



(a) Entire Sample **(b)** Full-time Sample

Source: RDC of the Federal Statistical Office and Statistical Offices of the Länder, SES, 2014, own calculations; GPG equals α_j

Figure 1.4: Distribution of the Gender Pay Gap

In addition, the sample selection could affect the estimation results of previous studies (e.g. Ludsteck, 2014), which estimated the occupation specific GPGs based on full-time employees. The results would be biased if the relationship between the occupations, thus the ranking, is affected. Therefore, Table 1.4 presents the occupations with the highest and lowest GPG in both specifications.

In the main specification, which is based on the entire sample, Event Organization and Alternative Medicine have the lowest GPG, which is even positive. That is, in these occupation men earn on average 7 % and 5 % less than women. There are other occupations like Civil Engineering, Education and Social Work, as well as Church Community Work, where women earn more than men. Note that the raw GPG for persons employed in Education and Social Work (see Table 1.1) turns from a slightly negative to a positive value after controlling for observables. Thus, in this occupation the (raw) GPG may be rooted in from different human capital endowments or the fact that men are more likely to hold leadership positions.

However, in other occupations, like paper-making and -processing and in printing technology, women earn 32 % and 30 % less than men. The highest GPG occurs for Actors, Dancers and Athletes, where women earn 51 % less than men. However, these are rather small occupations, where a few outliers can have an outsized impact on the results.

In the second specification, which excludes part-time workers, the ranking changes substantially in some occupations such as food layers. Hence, the selection into full-time might affect occupations differently. This result highlights the importance of adding part-time workers when comparing GPGs across occupations.

	Entire Sample		Only Full-time	
1	0.07	Event Organization	0.10	Floor Layers
2	0.05	Alternative Medicine	0.10	Vini- and Viticulture
3	0.03	Service in Passenger Traffic	0.04	Event Organization
4	0.01	Church Community Work	0.02	Church Community Work
5	−0.01	Occupations in Event Technology	0.02	Drivers of Construction Vehicles
6	−0.01	Presenters and Entertainers	0.01	Building services engineering
7	−0.02	Education and Social Work	0.00	Service in Passenger Traffic
8	−0.02	Sales Occupation: Books and Art	−0.01	Education and Social Work
9	−0.02	Nursing	−0.01	Occupational Health and Safety
10	−0.02	Drivers of Construction Vehicles	−0.01	Nursing
		⋮		⋮
131	−0.26	Artisan Craftworks	−0.24	Sales Occupations: Durables
132	−0.26	Sales occupations: Clothes	−0.25	Photography
133	−0.27	Photography	−0.26	Musical Instrument Making
134	−0.27	Fishing	−0.26	Paper-making and -processing
135	−0.28	Floor Layers	−0.26	Artisans designing ceramics
136	−0.28	Product and Industrial Design	−0.26	Printing Technology
137	−0.29	Metal-Making	−0.28	Metal-Making
138	−0.30	Printing Technology	−0.34	Sales Occupations: Foodstuffs
139	−0.32	Paper-making and -processing	−0.31	Product and Industrial Design
140	−0.51	Actors, Dancers and Athletes	−0.64	Actors, Dancers and Athletes

Source: RDC of the Federal Statistical Office and Statistical Offices of the Länder, SES, 2014, own calculations. The GPG equals the exponential value of α_j minus 1.

Table 1.4: Occupations with the highest and the lowest Gender Pay Gap

1.5.2 Second step: The relationship between occupational characteristics and the GPG

The second step aims at explaining the variance of the GPG across occupations that was obtained in the first step. Therefore, I add occupational characteristics stepwise to the model.
The first row of Table 1.5 includes the average number of overtime hours within occupations. The insignificance of the coefficient indicates that the differences in the GPGs between occupations are not correlated with the number of overtime hours. The summary statistics (see Table 1.3) reveal that men work in occupations with higher over-time hours. This finding suggests that women are less likely to select into occupations with many over-time hours, but once they work in these occupations they do not earn less than men.
The second row shows that the shift bonus amounts correlate slightly negatively with the GPG. That is, the GPG is higher in occupations where shift work has a larger impact on wages. Shift bonus are paid for night work or for work on Sundays and holidays. Assuming that women are more concerned about reconciliation of family and working life (e.g. Blau and Kahn, 2017), they will be less likely than men to work on weekends or at night.
In the third row, the non-linearity index is included in the model. The negative and significant coefficient emphasizes the relationship between linearity in earnings and the GPG, which was indicated in section 1.2. Thus, the larger the relative wage difference between persons, who work less than 25 hours per week, and those working more than 40 hours, the higher is the occupation-specific GPG. As a reminder, women are more likely to work part-time and, there-

fore, are more affected by part-time penalties.[7] This result confirms not only Goldin's (2014) findings but extends them to a more general level: The relationship between the linearity in earnings and the GPG, which is observed in some occupations such as Nursing or Business Organization, is not random but rather systematical.

However, this relationship might not (only) be the result of discrimination but can also come from selection into full- or part-time. In a recent study, Gallego Granados (2019) highlights that positive selection into full-time work has a substantial impact on the part-time wage gap. Hence, lower wages in part-time do not necessarily mean a part-time penalty but can also result from lower productivity.

In specification (IV), the distribution of occupational positions within occupations is added to the model. The results indicate that the GPG is greater in occupations with a large share of employees holding leadership positions, which is also observed in the raw data (section 2). As the link still holds after controlling for observables, this finding suggests the presence of a "glass ceiling" and, therefore, is in line with previous studies (e.g. Arulampalam et al., 2007; Collischon, Forthcoming). In addition, this result broadly supports the work of Busch and Holst (2009b, 2011), which shows higher GPGs in managerial positions. Moreover, the insignificance of the coefficients of the remaining occupational positions reveals that the link between the GPG and the distribution of the occupational positions is not linear but rather represents a penalty for women in leadership positions. In addition to the "glass ceiling", this relationship may also have other causes, such as differing negotiation skills. Previous research shows that women negotiate their wages less successfully than men (e.g. Niederle and Vesterlund, 2007) and negotiating occurs mainly in jobs with supervisory power. Moreover, after including occupational positions, the coefficient of shift bonus becomes insignificant. This result indicates that the correlation between the shift bonus and the GPG in specification (II) and (III) may be driven by occupations with large shift premia and high shares of employees in leadership positions.

Occupational tasks enter the model in the fifth row of Table 1.5. The highly significant coefficients and the large increase of the R^2 emphasize the importance of tasks in explaining differences in the GPG between occupations. The results reveal that the GPG is larger in occupations that have mainly cognitive or manual routine tasks.

The findings is consistent with that of Bhalotra and Fernández (2018), who observe a similar relationship for the Mexican labor market. The authors argue that the level of substitution between men and women, which varies across tasks, can explain the differences in the GPG. Compared to those with manual and routine tasks, occupations with analytical non-routine tasks have a high level of substitutability between genders, which decreases the GPG. Assuming that this link holds more generally, the finding suggest that non-routine tasks have a higher level of substitution than routine tasks. Thus, this relationship underlies the argument of Goldin (2014) saying that the more that workers can replace each other, the lower is the GPG. In contrast, higher GPGs in routine tasks may also result from selection. Adda et al. (2017)

[7] Barns and Preston (2010) show that one reason why women earn less than men is that part-time workers, who are mostly female, have lower probabilities to be promoted. The link between promotions and the GPG is discussed in more detail in chapter 2.

assume that women with a higher preference for fertility select into occupations with manual routine tasks. That is, the GPG in these occupations may come from differences in labor market attachment between men and women. But compared to the raw GPGs within tasks (Figure 1.3) the higher GPGs in routine tasks is surprising. Without controlling for observables, the data reveal the largest (absolute) wage gaps in interactive and analytical non-routine tasks. These differences between the adjusted and the raw GPG indicates that women are either working in generally less remunerated occupations within these tasks or that men have higher endowments of human capital.

In rows (VI) and (VII), the linear and quadratic terms of the share of women is added to the model. The insignificance of both coefficients emphasizes that women earn less than men irrespective of whether they work in a female- or a male-dominated occupation. Like previous studies, I find that a large part of the GPG is linked to the fact that male-dominated occupations are on average higher rewarded than female-dominated occupations (e.g. Levanon et al., 2009 in the U.S., Hausmann et al. (2015) in Germany). However, once they are working in a male-or female-dominated occupation, the size of the occupation-specific GPG does not depend on the share of women.

The last specification includes the share of public owners within occupations to explain the GPG. The coefficient is highly significant, which indicates that public ownership is negatively correlated with the GPG. That is, the size of the GPG depends on whether an occupation is mainly performed in public or private firms. One possible reason for this relationship may be that employees in the public sector are mainly paid in accordance with collective agreements. These contracts ensure that persons with the same work experience and educational degree earn the same, which prevents discrimination. In contrast, in the private sector wages are often negotiated. As women are typically less successful at wage negotiations than men (e.g. Croson and Gneezy, 2009), this might explain why the GPG is higher in the private sector. In addition to collective agreements, the positive relationship between the share of public firms and the GPG may result from selection. Hence, it may be that more labor market orientated men prefer to select private firms. In addition, after including the firm ownership in the model, the coefficient of manual non-routine tasks becomes significant. That is, occupations with mainly manual non-routine tasks have, on average, higher GPGs. This finding is consistent with that of Bhalotra and Fernández (2018) who find lower level of substitutability between men and women in occupations with manual tasks. The result also highlights that this relationship is more likely to appear in occupations that are mainly done in private firms.

Thus, some characteristics like the linearity in earnings, the distribution of occupational positions, tasks, and the share of public owners are related to the size of the GPG. However, in total, occupational characteristics cannot even explain a third of the variance in the GPG. Hence, the major part of the GPG is not linked to the observed occupational characteristics; rather there might exist more characteristics that cannot be observed in the data. As an example, it is possible that the link between within-occupational segregation and the within-occupational GPG is stronger in some occupations than in others. In human medicine, for example, women are more likely to work as pediatricians, while men tend to work as surgeons; the latter having

a higher average wage level (Gesundheitsberichterstattung des Bundes, 2019; Statistisches Bundesamt, 2018b). In the occupation of teachers, in contrast, men are more likely to be math or physics teacher and women are more likely to teach languages (Weeber and Hobler, 2015). This, however, has no effect on their wages, as, due to collective agreements, these are independent of the subject taught.

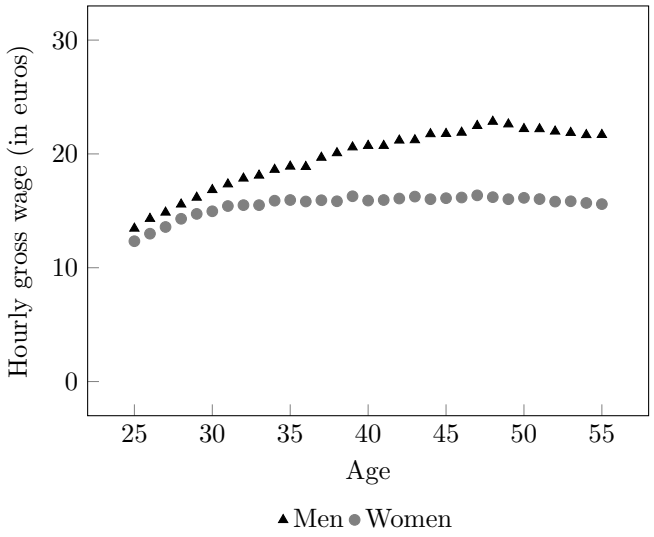
GPG	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
Overtime hours	−0.0084	−0.0032	−0.0025	−0.0022	0.0056	0.0069	0.0063	0.0096
	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)	(0.007)	(0.007)	(0.007)
Shift bonus (in 100 €)		−0.0280*	−0.0030**	−0.0243	−0.0196	−0.0176	−0.0178	−0.0195
		(0.0148)	(0.0143)	(0.0155)	(0.0152)	(0.0158)	(0.0158)	(0.0151)
Non-linearity Index			−0.1353**	−0.1307**	−0.1313**	−0.1274**	−0.1231**	−0.1269**
			(0.0429)	(0.0441)	(0.0427)	(0.0438)	(0.0445)	(0.0425)
Occupational position (Ref: Difficult activity)								
Supervisory Power				−0.0732	−0.1201**	−0.1192**	−0.1112**	−0.1607**
				(0.0580)	(0.0581)	(0.0583)	(0.0600)	(0.0590)
Very difficult activity				0.0180	−0.0261	−0.0235	−0.0139	−0.0672
				(0.0715)	(0.0773)	(0.0778)	(0.0797)	(0.0776)
Skilled work				−0.1243	−0.0631	−0.0630	−0.0496	−0.0404
				(0.1719)	(0.1740)	(0.1746)	(0.1765)	(0.1687)
Unskilled work				−0.0111	−0.0255	−0.0328	−0.0311	−0.0790
				(0.2055)	(0.1970)	(0.1983)	(0.1989)	(0.1905)
Tasks (Ref: Analytical non-routine tasks)								
Interactive non-routine tasks					0.0239	0.0198	0.0194	0.0216
					(0.0356)	(0.0369)	(0.0371)	(0.0354)
Cognitive routine tasks					−0.0655**	−0.0660**	−0.0684**	−0.0658**
					(0.0258)	(0.0259)	(0.0263)	(0.0252)
Manual routine tasks					−0.1020**	−0.1022**	−0.1019**	−0.0976**
					(0.0375)	(0.0377)	(0.0378)	(0.0361)
Manual non-routine tasks					−0.0500	−0.0509	−0.0532	−0.0597*
					(0.0317)	(0.0319)	(0.0322)	(0.0308)
Share of women						0.0162	−0.0559	−0.0708
						(0.0375)	(0.1282)	(0.1226)
Share of women^2							0.0806	0.0918
							(0.1371)	(0.1311)
Public firms								0.1311***
								(0.1371)
Constant	−0.1368	−0.1314	−0.1087	−0.0945	−0.0589	−0.0687	−0.0624	−0.0680
	(0.0119)	(0.0121)	(0.0138)	(0.0309)	(0.0382)	(0.0445)	(0.0458)	(0.0438)
Occupations	140	140	140	140	140	140	140	140
R^2	0.0158	0.0402	0.1056	0.1208	0.2230	0.2241	0.2263	0.2991
R^2_{adj}	0.0087	0.0262	0.0859	0.0742	0.1562	0.1508	0.1464	0.2206

Source: RDC of the Federal Statistical Office and Statistical Offices of the Länder, SES, 2014, own calculations.
Note: GPG equals α_j obtained in the first step; Standard errors presented in parentheses; Significance levels: * p<.1; ** p<.05; *** p<.001

Table 1.5: Results: Second step

1.6 Discussion: What the data cannot explain

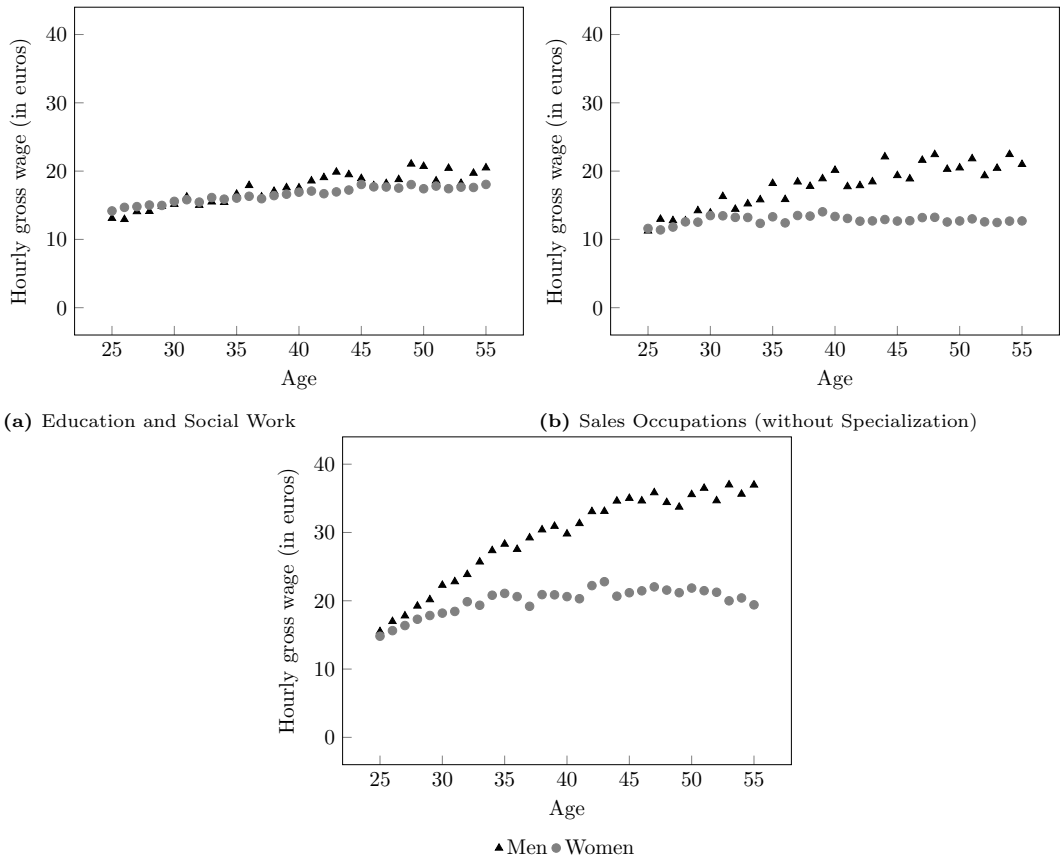
The previous section shows that some occupational characteristics are linked with the GPG but the question arises as to why we still observe substantial differences in the gaps between occupations. To answer this question, it might be useful to take a step back and to look at wage differences in greater detail. By graphing the GPG across age, Figure 1.5 highlights that the wage differences between men and women increases with age. While women until the age of 30 – the average age of the first birth (Statistisches Bundesamt, 2019) – earn nearly the same as men, the GPG increases substantially afterwards. The increase of the GPG is mainly related to the fact that women's wages stay constant after giving birth while men's wages continue to rise. Thus, this gap suggests a relationship between motherhood and earnings and, therefore, may reflect a motherhood penalty.



Source: RDC of the Federal Statistical Office and Statistical Offices of the Länder, SES, 2014, own calculations.; Based on all employees between 25 and 55 years.

Figure 1.5: Hourly gross wages by age

However, the previous findings suggest that these age-specific GPGs alter between occupations. Figure 1.6 plots the male and female wage level by age in Education and Social Work, Sales Occupations (without Specialization) and in Business Organization. In Education and Social Work, an occupation with a very small adjusted GPG of 2 %, there exists barely any wage differences between men and women across life. Until the age of 35, the GPG is even positive and turns into a slightly negative gap. In contrast, in Sales Occupations the difference between the male and the female wage level is quite constant over the different age groups but increases slightly after the age of 35. In Business Organization, the data reveal a substantial increase of the GPG over age. As men's wages continue to raise, the female wage level increases until the age of 32 and stays then constant until the age of 55. But why is the motherhood penalty more pronounced in this occupation than in others? As shown before, Business Organization and



(a) Education and Social Work

(b) Sales Occupations (without Specialization)

(c) Business Organization and Strategy

Source: RDC of the Federal Statistical Office and Statistical Offices of the Länder, SES, 2014, own calculations; Based on all employees between 25 and 55 years.

Figure 1.6: Hourly gross wages by age for employed in Business Organization and Strategy, Sales Occupations and in Education and Social Work

Strategy is a non-linear occupation, and therefore an occupation where full-time employees earn considerably more than part-time workers. Hence, one reason for this motherhood gap might obviously be that women are more likely to work in part-time and, thus, have lower wages. The second reason for this motherhood penalty might become more evident, when looking at men: Their wages increases substantially more between the age of 25 and 40 than between 40 and 55. That is, the first half of the working life has more impact on earnings than the second half. However, this is also the time when couples decide to start a family and is, therefore, a period, in which women tend to have longer career breaks than men. Thus, being absent from the labor market seems to be more costly in this occupation than in others. Nevertheless, note that women earn less men even before the age of 30. Thus, the GPG between the age of 25 and 30 may be the result either of different endowments, discrimination or selection.

To see, to which extent these gaps come from differences in endowments, Figure 1.7 plots the

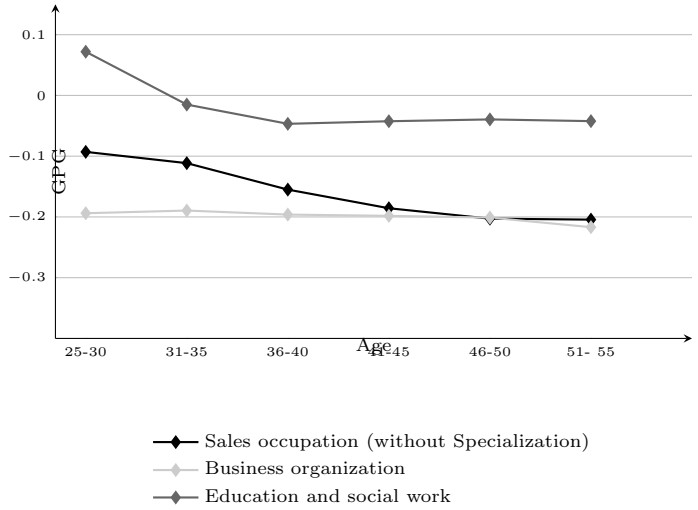
adjusted GPGs within age groups for these occupations.[8] The results support the work of Tyrowicz et al. (2018), which shows that the adjusted GPG increases with age. In Education and Social Work, there exists even a positive GPG for the youngest cohorts, i.e. persons between 25 and 30 years. This finding seems surprising but may result from selection. Giving that Education and Social Work is a female-dominated occupation with a share of women of around 85 %, men working in this occupation may be a very selective group. For all other age groups, there is no (adjusted) GPG. In Sales Occupation, the rising (unadjusted) wage differences between men and women across the age groups come along with an increase of the adjusted GPG. However, the data do not allow analyzing whether this comes from unobserved career breaks, selection or discrimination. Giving that Sales Occupations often have collective agreements, the GPG in the youngest cohort of 17 % is surprising. As most people start to work in this occupation after their vocational training around the age of 18, this gap may also result from (unobserved) fertility decisions and, thus, (unobserved) career breaks or part-time work experience. Finally, the graph plots a constant adjusted GPG of 19 % in Business Organization and Strategy. That is, the adjusted GPG at the beginning of the career is relatively high compared to the other occupations. Moreover, in this cohort the adjusted GPG is nearly the double of the unadjusted (10 %) gap. Hence, the observed wage difference of *only* 10 % comes from the fact that women have better endowments. Even if a part of this adjusted GPG at the beginning of the career may come from selection (e.g. men select into better paying firms), this result suggests that discrimination may be an issue in this occupation. Assuming that this gap comes also from wage negotiations, where women tend to be less successful because of traditional gender roles (Babcock and Leschever, 2003; Mazei et al., 2015), the discrimination may not come through the employer but is rather the result of socialization (Karamessini and Ioakimoglou, 2007).

1.7 Conclusion

The aim of this study is to analyze whether or not, occupational characteristics are able to explain the variation in the GPG in Germany. Based on a two-step approach, I show that the adjusted GPG varies substantially across occupations: The largest gap is observed in the occupation of Actors, Dancers and Athletes (51 %), and in other occupations such as in Event Organization, in contrast, women earn even 7 % more than men.

In the second step, I link the GPG to occupational characteristics such as the share of women or the non-linearity index that gives the relative difference in hourly wages between persons working more than 40 hours per week and those with less than 25 hours. The results reveal that four occupational characteristics that are highly correlated with the GPG: The non-linearity in earnings, the hierarchical composition, the tasks and the ownership of a firm. Hence, the results do not only confirm previous findings from the U.S., where selected occupations with non-linear earnings tend to have higher GPGs, but extends them to a more general level. Moreover, there is evidence of a "glass ceiling" as the GPG increases with the share of persons having supervisory

[8] The model was extended by age-occupation fixed effects and respective interactions with the female dummy.



Source: RDC of the Federal Statistical Office and Statistical Offices of the Länder, SES, 2014, own calculations.; Based on all employees between 25 and 55 years.

Figure 1.7: Adjusted wage gaps within age groups in selected occupations

power. In addition, the result supports the findings from the task-based literature, as it shows higher GPGs in occupations with routine tasks. Both, the negative relationship between the non-linearity in earnings and the GPG and higher wage differences in routine tasks, emphasize the role of substitution: The more that employees can be substituted with other employees, the lower is the GPG. Finally, collective agreements in public firms result in lower wage differences wages between women and men.

However, the model explains only a quarter of the variance in the GPGs across occupations, thus emphasizing that a major part of the GPGs across occupations remains unobserved. Further, information such as actual work-experience in part- and full-time might be correlated with the GPG but cannot be observed in the data. Therefore, the adjusted GPG and, thus, differences between occupations may be overestimated.

Chapter 2

A question of gender? How promotions affect earnings

2.1 Introduction

Indicated by a Gender Pay Gap of 21 %, wage differences between men and women in Germany are the second largest within the EU (Boll and Lagemann, 2018). Among many other reasons, women earn less than men because they work in lower occupational positions than men on average. That is, the difference in the occupational position between men and women explain nearly 5 percentage points of the German Gender Pay Gap, since men are more likely to work in higher positions than women. However, parts of the unexplained Gender Pay Gap is also related to the occupational position, i.e. after controlling for differences in endowments, men still earn 2 percentage points more than their female colleagues within the same position (Finke et al., 2017). The aim of this paper is to analyze whether or not different promotion effects on earnings for men and women can explain the Gender Pay Gap within occupational positions.
Using administrative data from Germany, we are not only able to identify promotions but also to link them with the entire employment biography. We contribute to the literature as being the first who can differentiate between different levels of promotion. In doing so, we can investigate whether the gender gap depends on the level of promotion. Moreover, we are – to the best of our knowledge – the first to analyze gender differences in earnings growth due to a promotion in Germany.
In the following, we refer to promotions as upward changes of the occupational position within the same occupation and the same firm. The identification of promotion relies on the new classification of occupation (KldB 2010) that is observable in our data since 2012, which – in contrast to the prior classification scheme (KldB 1988) – contains additional information on the occupational position. Following Matthes and Vicari (2017), we use a change in this variable to identify promotions. We base this study on unique data from the Institute of Employment

Research (IAB), which is a subsample of the Integrated Employment Biographies (IEB) that encompasses every individual who has ever worked subject to social security. We restrict the sample to full-time employees to make daily earnings more comparable. In total, we observe more than 100,000 individuals, which allows us not only to estimate precise effects but also to compare gender gaps across different subsamples, e.g. women with and without children.

We base our theoretical framework on the considerations of Booth et al. (2003). In this setting, differences in earnings growth can occur for three reasons: a divergent number of job offers, different preferences to stay in the firm or dissimilar productivity. Since the literature indicates that promoted women receive fewer job offers on the one hand, and are more able than men on the other, we formulate two contradicting hypotheses suggesting either a lower or a higher earnings increase for women due to promotion. Moreover, we hypothesize that in particular mothers have a lower earnings growth due to promotion than men because previous studies show that women with children are less likely to change a firm for pecuniary reasons.

Next, we extend this model for different levels of promotions. Again, we argue that the size of the gender gap in earnings growth depends on job offers, the preference to stay in the firm and productivity. Using evidence from a study by Neumark et al. (1996) that suggests that women receive fewer job offers in more prestigious jobs, we expect that the gender gap widens at higher levels of promotions (*Sticky Floor Hypothesis*). However, we anticipate the contrary from the *Glass Ceiling Hypothesis*. That is, since women are less likely to enter higher occupational positions than men, we suggest that those women who achieve these positions, have a higher level of productivity than their male colleagues. Therefore, we would conclude that the gender gap does not increase with the level of promotion. Finally, we derive from the model that the outside wage offer increases with the level of promotion and, therefore, the costs for a higher preference for the firm increases. Since women, in particular mothers, are more likely to stay in the current firm for family reasons (e.g. Webber, 2016), we expect that the gap in wage growth between mothers and men increases with the level of promotion.

To test these hypotheses, we use a pooled OLS regression, where we add the controls stepwise to the model. Thus, by including firm and occupation fixed effects, we can analyze to what extent different selection processes can explain gender gaps.

The descriptive results show that the share of women decreases with the level of promotion, in particular if we include part-time workers. While men and women are equally distributed in the lowest level of promotion, the share of men in the highest position is 70 %. For full-time workers, we observe similar results but with the highest share of women in the intermediate category. In addition, we compare mothers to non-mothers and find that mothers are underrepresented in our sample, in particular in the full-time sample. Moreover, we observe that the share of mothers decreases with the level of promotion. That is, only 30 % of the full-time working women who have been promoted to the highest occupational position have children.

Further, the data reveal that men's wage level is higher than women's. Moreover, we find that men's earnings increase is larger than women's in the year before the promotion took place, while women's earnings growth exceeds men's in the year of the promotion. Therefore, the findings suggest that women's earnings are more depending on promotions while men's

earnings increase even in the absence of a promotion.
In our main specification, i.e. when we exclude part-time workers, we find that women have larger earnings growth than men. However, this gap decreases in size when we add occupations to the model. After controlling for firm effects, the gender gap turns insignificant. Hence, our results highlight the role of collective agreements within firms, which may prevent large difference in earnings growth after promotions between employees. The results are similar if we compare men to childless women.
We do not find that the gap increases with the level of promotion; instead, the results indicate that women are less likely to be promoted to higher occupational positions. Thus, our result indicate a "glass ceiling" rather than a "sticky floor." Moreover, we observe that the effects are less strong if we exclude mothers from the sample, which we interpret as the following: Only few mothers work in full-time and get promoted to higher occupational positions but those who do, represent a highly ambitious group of women. Hence, the results suggest that the higher earnings growth of women, in particular of mothers, compared to men in the highest occupational position may result from differences in productivity.
We further interpret the estimated gender gap as a lower bound, since we argue that we compare men to a more positive selected group of women, i.e. men and women in this sample do not have the same selection processes. First, we restrict the sample to persons who have been promoted, which represents a positive selected group on the labor market for both genders. But given that men are more likely to be promoted, in particular in higher occupational positions, we argue that promoted women might be even more labor market attached (compared to all women) than promoted men (compared to all men). Second, the average wage level in female-dominated occupations is lower than in male-dominated occupations (e.g. Hausmann et al., 2015). By controlling for occupations, we compare either a typical woman with an atypical, less career orientated man, in a female-dominated occupation or a typical man with an atypical, more ambitious woman in a male-dominated occupation. That is, comparing men and women within the same occupation might underestimate the effect of gender. Third, we analyze gender differences in earnings growth for persons working within the same firm. Card et al. (2016) show that men are more likely to select into high-paying firms, which suggests that women who work in high-paying firms might be a positive selected group of women, while men working in low-paying firms might be a negative selected group of men. Thus, comparing men and women working in the same firm might again underestimate the effect of gender. Lastly, we restrict the sample to persons who stay in the firm after the promotion. Since men are more likely to change firms for pecuniary reasons (Albrecht et al., 2018; Fitzenberger and Kunze, 2005; Loprest, 1992; Manning, 2003), those men who stay in the firm might reflect a negatively selected group (out of the promoted men).
With this study, we contribute to the small body of literature examining the relationship between gender gaps and promotions. The first theoretical approach stems from Lazaer and Rosen (1990), who show that women have to be more able than men to be promoted. The authors argue that women have a higher risk of leaving the labor market and, therefore, women have to reach a higher level of skills to be promoted. However, once they have entered the (promoted)

job, they do not face lower wages than men. Based on these theoretical considerations, Booth et al. (2003) extend the model by the "sticky floor" assumption. That is, men and women have the same likelihood of being promoted but men face more outside offers than women, thus, have a higher wage growth than women.

Besides these theoretical considerations, there exists empirical investigations that analyze whether the probability to be promoted differs between genders and whether promotions lead to the same effects on earnings for both men and women. While the literature agrees on the fact that men are more likely to hold leadership positions (Blau and Kahn, 2017; Busch and Holst, 2009b), there is mixed evidence on the relationship between gender and the probability to be promoted. Some studies find that men are more likely to be promoted than women (Blau and DeVaro, 2007; Bronson and Thoursie, 2019; Cobb-Clark, 2001; Cobb-Clark and Dunlop, 1999; Lazaer and Rosen, 1990)[9], others do not find significant differences between men and women (Booth et al., 2003; Lewis, 1986), whereas still others find higher probabilities for women to be promoted (Gayle et al., 2012; Gerhart and Milkovich, 1989; Hersch and Viscusi, 1996).[10]

Previous studies have already examined the impact of promotion on earnings growth of men and women for the U.S. (Blau and DeVaro, 2007; Cobb-Clark, 2001; Olson and Becker, 1983) and the British labor markets (Booth et al., 2003). However, none of the studies has found significant differences in wage growth between men and women. Addison et al. (2014) confirm the result but show that the effects on earnings growth differ slightly between educational groups and career stages.

Thus, by finding no gender differences in earnings growth due to promotions within firms we confirm previous results. Moreover, we contribute to the literature by showing that this finding comes mostly from selection. Thus, women who end up being promoted depict a highly positive selected group of women in the labor market.

The paper is structured as follows. The next section describes the data. Section 2.3 deals with the model, while section 2.4 covers the empirical strategy. Section 2.5 presents the results and the last section concludes.

2.2 Data

We base the estimation on a unique administrative data set from the Institute of Employment Research (IAB). This data set is a 75 % subsample of the total population who had a change in their occupational position between 2012 and 2017 in the Integrated Employment Biographies (IEB), i.e. the population of all individuals subject to social security. The IEB is administrative data based on notifications of the employer, and, therefore, encompasses high-quality information on earnings and on the entire employment biography of all individuals subject to social security. Since employers have to report the employment status for each employee on a daily basis, the data are provided as spells. That is, each spell gives the beginning and the end

[9] These studies relate to promotions within the same firm. However, Neumark et al. (1996) shows that men are to likely to be promoted when they apply to another firm.

[10] Addison et al. (2014) find that the differences of being promoted between men and women depends on the level of education and the career stage.

of the employment and further information such as earnings and occupation. As soon as one of these information changes, e.g. an advancement in the occupational position, the current spell ends and a new spell begins. Because the notification have to be transmitted at least once a year, the maximal duration of a spell is 365 days (366 days in leap years).
A potential drawback of the data are that some occupational changes may not be recorded. Thus, it is possible that persons have been promoted but the employer did not report this change to the security records.[11] Although we might not be able to identify every promotion, we argue that every change that is observable in the data effectively has happened. We assume that employers do not have an incentive to misreport a promotion if it has not really occurred. In addition, we do not expect that the non-reporting of promotions is systematic with respect to gender or earnings. Instead, we think that some employers are more accurate than others (Fitzenberger et al., 2005).

Promotion

Due to a change in the classification of occupations, we are able to observe hierarchical mobility within occupations. Therefore, we define the fifth digit in the classification of occupation (KldB 2010) as occupational position. The data allow disentangling between four positions: 1) Unskilled work; 2) Skilled work; 3) Complex activities; and 4) Very difficult activities and supervisory power.
We define a promotion as an upward change by one category in the occupational position within the same occupation and establishment. We concentrate on promotions in the main employment. Moreover, we restrict the sample to those persons who still work in the same (promoted) occupational position in the spell after the promotion to reduce the impact of potential misreporting. In case, a person had more than one promotion, he or she enters multiple times in the estimation.[12]

Earnings and earnings growth

In an ideal world, we would like to estimate the effect of gender on hourly wage growth. However, the data give only information on daily earnings[13] and on whether the employee works in part- or full-time.[14] Consequently, differences in earnings could also come from divergent working

[11] There is evidence that not every change in the data is recorded. As an example Frodermann et al. (2013) show that employers do not always adjust the working time. Hence, persons who started to work in part-time are still coded as full-time workers.

[12] We use at maximum three promotions per person. However, we do not think that this affects our results as 97 % of the individuals in our sample have only one promotion. In order to consider that persons may have more than one promotion, we cluster standard errors on the personal level.

[13] Since, there is a limit for social security contributions, earnings above this threshold are censored. To impute earnings above the censoring limit, we follow Reichelt (2015).

[14] As these records might be wrong, especially for part-time worker, we adjust working time as follows: First, if the employee earns less than 90 % of the last spell and is coded as full-time employed, we classify her or him as part-time worker, and vice versa. Second, if the full-time daily earnings are less than 40 euro, we change the working time to part-time work. Third, due to the important change in the classification scheme, employers were very likely to validate the records in 2012. Therefore, we assume that the information in 2012 is more correct than the previously recorded. That is, if someone is listed as full-time worker in 2011 with the same earnings as in 2012, when he or she is recorded as part-time worker, we adjust the information in 2011. We apply the same approach for those who are (probably) wrongly coded as part-time worker. Lastly, we adjust the working time

time, which we cannot observe. For this reason, in our main specification, we restrict our sample to full-time employees.
The dependent variable in our model is earnings growth, which we define as the relative difference between the new and the old earnings. The *new* earnings refer to the spell where the person works for the first time in the (promoted) occupational position; the *old* earnings to the last spell before the promotion.

Motherhood

In the data, we do not directly observe if someone has children. Therefore, we use the approach by Müller and Strauch (2017), which allows us to identify motherhood. This method exploits the information on earnings replacement paid by the health insurance. During paid maternity leave the health insurance pays previous earnings for twelve weeks – six weeks before and eight weeks after the estimated date of birth. Based on this information, it is possible to identify the (estimated) date of birth of children for women who have worked subject to social security before giving birth. However, the number of children might be underestimated, as we cannot identify births that took place during employment interruptions, unemployment spells or before entering the labor force.
Moreover, this method can only be applied for women and not for men, since it relies on maternity leave. Hence, we cannot make a statement about fatherhood. Since research shows that parenthood affects mainly mother's careers and not father's (Kleven et al., 2019), we do not think that ignoring fatherhood would affect our results.

Sample

We restrict our sample to persons who had an upward change in their occupational position between 2012 and 2017 within the same firm and the same occupation. We exclude persons who had promotions that last only for one spell[15] and part-time employed persons before and after the promotion.
The summary statistics of our sample given in Table 2.1 reveal that men have, on average, higher earnings pre- and post-promotion. However, the promotion leads to a higher increase in earnings for women than for men, both in relative and absolute terms.
Further, men tend to work in larger firms and have more tenure than women. On average, women have less work experience than men, especially in full-time. In contrast, women tend to have more labor market experience in part-time. Women are, on average, slightly higher educated than men: While men are more likely to have vocational training without A-levels and women are more likely to have vocational training with A-levels.
The comparison of the summary statistics of full-time sample and the one including part-time workers (Table B.3 in the Appendix) reveals that the full-time sample, especially for women,

of mothers following Frodermann et al. (2013). In case a mother has given birth and, subsequently, interrupted employment, we compare her earnings in the first spell of employment with her earnings ten months prior to birth.

[15] Since the duration of a spell does not exceed a year, we do not think that the spell duration affects our result.

is positively selected. Thus, full-time workers have more (full-time) work experience, tenure, and are slightly higher educated. Furthermore, the restriction of working full-time pre- and post-promotion reduces the female sample by 75 % and the male by more than 40 %.

	Total		**Women**		**Men**	
	Mean	SD	Mean	SD	Mean	SD
			Main Variables			
Earnings pre-promotion	107.08	46.81	93.90	40.45	112.66	48.19
Earnings post-promotion	113.80	47.84	101.66	42.46	118.95	49.05
Relative earnings growth	0.09	0.21	0.11	0.23	0.08	0.21
Absolute earnings growth	6.73	22.61	7.76	19.82	6.29	23.68
Level of promotion						
Skilled work	0.37	0.48	0.29	0.46	0.35	0.48
Difficult activity	0.38	0.48	0.51	0.50	0.42	0.49
Very difficult activity & Supervisory Power	0.25	0.43	0.19	0.40	0.23	0.42
			Individual Characteristics			
Age	37.17	9.99	36.52	10.16	37.45	9.91
Work experience (ft, months)	145.50	102.81	111.45	86.94	159.93	105.58
Work experience (pt, months)	14.52	31.26	26.94	47.68	9.26	18.31
Tenure (months)	86.01	90.78	71.07	77.41	92.34	95.18
Share of unemployment experience	0.03	0.07	0.03	0.07	0.03	0.07
Education						
No A-level, No VT	0.06	0.24	0.04	0.20	0.06	0.23
No A-Level, VT	0.28	0.45	0.13	0.33	0.23	0.42
A-Level, No VT	0.03	0.16	0.03	0.18	0.03	0.17
A-Level, VT	0.43	0.49	0.56	0.50	0.47	0.50
Polytechnical degree	0.02	0.14	0.02	0.16	0.02	0.14
University	0.19	0.39	0.22	0.41	0.19	0.40
			Firm Characteristics			
East vs. West Germany	0.20	0.40	0.19	0.40	0.21	0.41
Size of the Establishment	3494.96	8499.93	2289.76	6837.52	4005.93	9065.47
Observations	112,566		33,503		79,063	

Source: IEB, 1976-2017, own calculations.

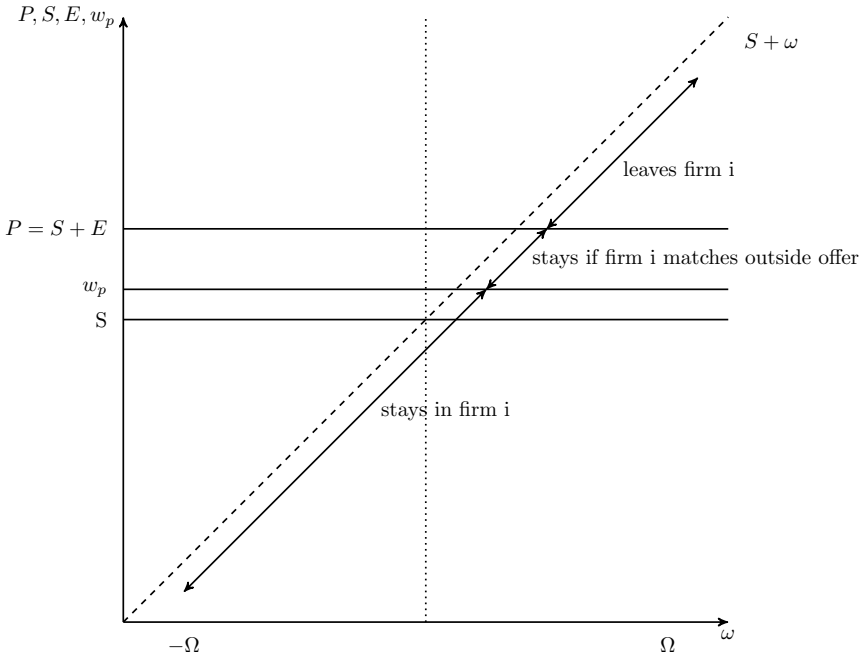
Table 2.1: Summary Statistics

2.3 Theoretical Framework

In this section, we sketch a theoretical model from which we will derive our hypotheses. We base our model on the theoretical considerations of Booth et al. (2003) to investigate why women and men may not have the same increase in earnings due to the promotion. Further, we extend their model by introducing different levels of promotion and analyze in this theoretical setting how the gender gap develops across different levels of promotions.

In this one-period model, we focus on wage processes around promotions, since a large strand of literature has shown that promotions have an important effect on wage growth (e.g. Baker et al., 1994a,b; Frederiksen et al., 2016; Gibbons and Waldman, 1999). Further, Waldman (1984) shows that promotions serve as a signal to other firms about the ability of the employee. Given this signal, the other firms will make wage offers that may be higher than his or her

current wage in firm A, the firm where the employee has worked before being promoted. In the following, the current firm A decides whether or not it matches the outside offer, if not the employee leaves firm A (e.g. Bernhardt and Scoones, 1993; Bognanno and Melero, 2015).
In this framewok, we make some crucial assumptions. First, we assume a fixed skill level S, which is unaffected by the promotion (see Figure 2.1). In addition, we assume that the employer can observe the productivity due to the promotion P, i.e. the sum of the skill level S and the increase in the complexity of the task due to the promotion E, which is the same for every promoted employee. We also assume that the firm A guarantees a (higher) wage w_p due to the promotion. In addition, we introduce ω which reflects both the individual-specific productivity and the preference to stay or leave the firm. While a higher productivity or a preference to leave the firm are indicated by a positive value of ω, ω will take negative value if the employee has a high preference to stay in the firm or a low individual-specific productivity level. Moreover, we introduce outside offers as $S + \omega$. Lastly, we expect that the employer can act as perfectly discriminating monopsonist.



Source: Booth et al. (2003)

Figure 2.1: Bargaining model

Thus, due to the promotion, the employer guarantees the wage w_p, which is higher than the previous wage, which is why we formulate our first hypothesis:

Wage Gain Hypothesis: Wages increase due to the promotion.

Moreover, we infer the following negotiation process: Before the employee starts working in the promoted position, firm A learns whether the employee has outside offers. Since firm A knows

the productivity of the employee due to the promotion, it will match outside offers as long as the wage does not exceed the productivity of the employee. In this model, wage differences arise for three reasons: a divergent number outside offers, other preferences to stay in the firm or different productivity.
Hence, in this model potential wage differences between men and women may come from these three sources. First, there is evidence that women receive fewer job offers than men. One prominent example is the so called *Orchestra Study*. In their study, Goldin and Rouse (2000) refer to the introduction of "blind" auditions in orchestras in the U.S. The authors find that these "blind" auditions increased the probability that a woman reaches the next round by 50 %. Moreover, the share of women has increased from 5 % in the 1970s to 25 % in the 2000s.[16] Further, Baert et al. (2016) investigated the differences in job offers between men and women in a randomized control trial. To this end, the authors sent applications, where they vary between jobs, which imply a promotion and those who do not. They find that women receive 33 % fewer invitations to job interviews if a job implies a promotion. This study suggests that women receive fewer job offers because of their gender. Therefore, we conclude our next hypothesis:

Job Offer Hypothesis: Women's increase in earnings after a promotion is lower than men's because they receive fewer job offers.

A further reason why men and women may not have the same wage growth due to a promotion in this model are potential differences in their productivity. A number of studies has shown that women have to be more able than men to be promoted (Blau and DeVaro, 2007; Bronson and Thoursie, 2019; Cobb-Clark and Dunlop, 1999). Lazaer and Rosen (1990) argue in the sense of statistical discrimination, i.e. employers prefer to promote men and to invest in their careers', since women have a higher risk to leave the labor market.[17] Therefore, we argue that promoted women have a higher productivity than men.

Productivity Hypothesis: Women's increase in earnings after a promotion is higher than men's because they are more productive.

Finally, wage differences between women and men may occur because they differ in their preferences to stay or to leave the firm. For Germany, Hirsch et al. (2010) find that men's labor supply to the firm is more elastic than women's. In a recent study, Webber (2016) shows that marital status and motherhood explain around 60 % of the difference in the labor supply elasticity, since it affects women's but not men's elasticity. The author argues that women prefer to work in a firm, which allows a good reconciliation of family and working life, over a high-paying firm. From these findings, we conclude that women are less likely to leave the firm for

[16]However, previous research has established that the difference in the likelihood depends strongly on the share of women within an occupation. The higher the share of women, the more likely is a woman compared to a man to be invited for a next round (Booth and Leigh, 2010; Kübler et al., 2018).

[17]Thomas (2016) provides evidence for statistical discrimination in the context of promotion. She shows that the introduction of the Family and Medical Leave Act of 1993 has not only increased women's likelihood to return to the labor market but also decreased their likelihood to be promoted. Thus, due to this reform employer have less signals about the productivity of women, hence, the information asymmetry increases and, therefore, employer are less likely to promote women.

pecuniary reasons. Card et al. (2016), who find that women are more likely to work in lower paying firms, support this result. Although Webber (2016) finds that the labor supply elasticity for married childless women is slightly smaller than men's, the effect of children on the labor supply elasticity is much stronger. Thus, we conclude that women with children have a higher preference to stay at firm A for non-pecuniary reasons.

Bargaining Hypothesis: Mothers' increase in earnings after a promotion is lower than men's because they have a lower preference for a higher paying firm.

In the following, we will extend the model by making assumptions about different levels of promotion. Therefore, we introduce a second promotion, which demands more skills and more effort, i.e. $S \leq S'$ and $E \leq E'$. Accordingly $w_p \leq w_p'$ and $P \leq P'$. Further, we assume that ω may change with the level of promotion. That is, having a high preference for a certain firm or the size of individual-specific productivity depends on the level of promotion such that $\omega \leq \omega'$. Since the skill level increases with the level of promotion, we also expect better outside offers (in terms of higher wage offers) in higher levels of promotion ($S + \omega \leq S' + \omega'$) as depicted in Figure 2.2.

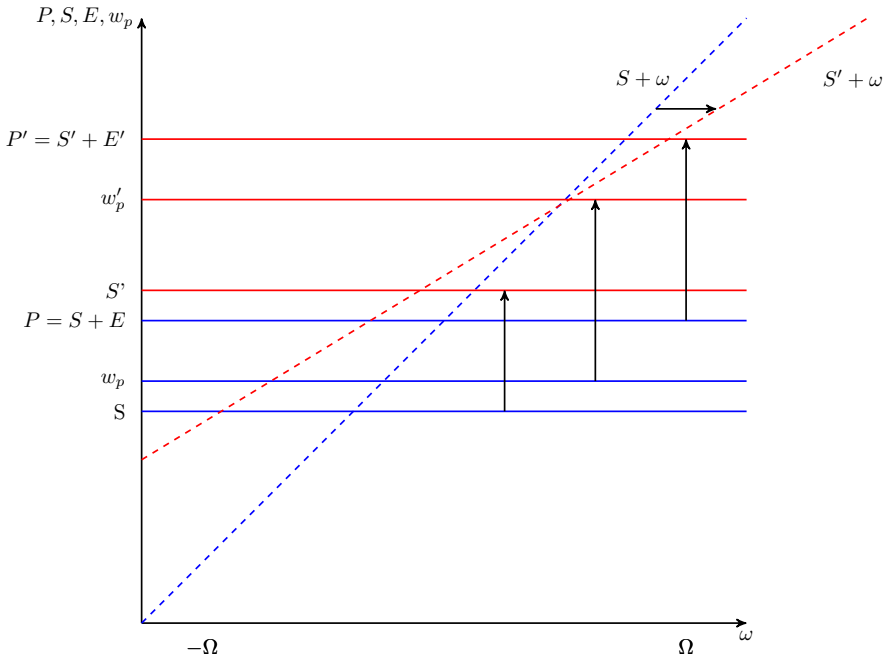


Figure 2.2: Bargaining model for different promotions

Since $w_p \leq w_p'$, we derive from the model that the wage gain due to the promotion increases with the level of promotion. This hypothesis is supported by Caines et al. (2017), who find that there is a positive relationship between the complexity of a task and wage growth. Therefore, we formulate our next hypothesis:

Increasing Wage Growth Hypothesis: The wage growth due to the promotion increases with the level of promotion.

Again, gender differences in the number of outside offers, in preferences to stay in the firm or in productivity can explain different wage growth in the model. We start by hypothesizing that the higher the level of promotion the larger the number of outside offers of men compared to women. We build this hypothesis on an audit study by Neumark et al. (1996). In this study, male and female candidates applied for waiters and waitresses in different restaurants. The authors find that the level of discrimination against women is substantially higher in high-price restaurants than in low-price restaurants. These findings can be interpreted as decreasing job offers for women (compared to men) across the level of occupational positions. Thus, we formulate the following hypothesis:

Sticky Floor Hypothesis: Women's increase in earnings after a promotion (compared to men's) decreases with the level of promotion because they receive fewer job offers the higher the occupational position.

Next, the increase in earnings across different levels of promotion between men and women may differ because they have not the same productivity. The share of women decreases with the level of promotion (Holst and Wrohlich, 2019; Kohaut and Möller, 2019; OECD, 2016)[18] and productivity is equally distributed across gender, especially in the absence of children (Gallen, 2018). Since only the most productive individuals of each gender end up to be promoted (Landers et al., 1996), the gap in productivity (in favor of women) increases with the level of promotion.[19] Once they have reached this position, however, they do not face lower increases in earnings (Lazaer and Rosen, 1990).

Glass Ceiling Hypothesis: Women's earnings growth after a promotion increases (relatively to men's) with the level of promotion because the gap in productivity between women and men increases.

Lastly, we want to discuss why the level of promotion affects the preference to work in a certain firm of women and men differently. Therefore, we refer to the well-established fact that women, in particular if they have children, are more likely to change the firm for non-pecuniary reasons (such as better reconciliation of family and working life), while men are more likely to have turnovers for monetary reasons (e.g. Fuller, 2008; Manning, 2003; Webber, 2016). Moreover, one assumption of the model is that the higher the level of promotion the higher the outside wage offers. Given that mothers feel more responsible for care work than men (Craig and Mullan, 2011; Samtleben, 2019), they have a higher preference to stay in firm A, which is more

[18] Baxter and Wright (2000) argue that the share of women in top position can be very small although the likelihood of women to be promoted (compared to men) does not decrease. They argue that if women's probability to be promoted is smaller than men's but constant across different hierarchy levels, the share of women within each occupational position decreases by construction.

[19] Arulampalam et al. (2007) differ between a Gender Pay Gap that widens at the top of the distribution ("glass ceiling") and at the bottom of the distribution ("sticky floor").

costly in higher occupational levels. In contrast, a low preference for the firm leads to higher bargaining power when it comes to negotiations. Therefore, we hypothesize:

Decreasing Bargaining Hypothesis: Mothers' increase in earnings after a promotion (compared to men) decreases with the level of promotion because costs for a high preference for the current firm increase with the level of promotion.

2.4 Empirical approach

In the following, we want to test these hypotheses by estimating the effect of gender on earnings growth due to promotion. However, this is not trivial, since being promoted might also depend on previous decisions, e.g. the hierarchy structure of the occupation and the firm. By controlling for occupation and firm fixed effects, we want to analyze potential sources of selection.
In the following, we define earnings growth as $\Delta y = (y_t - y_{t-1})/y_{t-1}$, where y_t is the daily earnings in the first spell after being promoted and y_{t-1} reflects the daily earnings in the last spell before the promotion. Gender differences in the wage growth are captured by α. In addition, we differentiate between specific levels of promotion. We assume that unobserved characteristics, such as ambition, might be correlated with the occupational position. That is, persons that are more ambitious might work in a higher occupational position. Moreover, we include some individual-specific observables, such as work experience (in full-time and part-time), tenure, unemployment experience, and schooling. In addition, the model contains firm specific controls (e.g. firm size, region). These control variables are summed up in X_i.

$$\Delta y_i = \beta_0 + \alpha \text{ female}_i + \gamma \sum_{l=1}^{L} \text{occ. position}_l + \mu X_i + \epsilon_i \tag{2.1}$$

To test the *sticky floor*, *glass ceiling* and the *decreasing bargaining power* hypotheses, we include the interaction of the level of promotion and gender. Thus, in equation 2.2, α gives the overall gender gap in earnings growth for persons working within the same level of promotion and ξ reflects differences in the gender gap between the occupational positions.

$$\Delta y_i = \beta_0 + \alpha \text{ female}_i + \gamma \sum_{l=1}^{L} \text{occ. position}_l + \xi \sum_{l=1}^{L} \text{occ. position}_l \times \text{female}_i + \mu X_i + \epsilon_i \tag{2.2}$$

In addition, we control on a further source of selection: occupation.[20] We expect that persons who select into different occupations may differ in their unobservables. As an example, persons working as teachers may differ in their labor market attachment or fertility decisions from

[20] We argue that neither occupation nor firm fixed effects are bad controls (Angrist and Pischke, 2009). Bad controls would be an issue if occupational or firm choices also affect the gender gap, i.e. the share of women within occupations or firms determine the gender gap. It is shown that women are less likely to select into high-paying occupations and firms but there is no evidence that the gender gap correlates with the share of women see chapter 1.

persons working as managers (Adda et al., 2017; Polachek, 1981). In addition, male-dominated occupations tend to be more hierarchical, which increases the likelihood of promotions in these occupations (Busch and Holst, 2009a). Moreover, we expect that occupations differ in their wage growth. Therefore, we include occupation fixed effects to reduce the heterogeneity in the model, since we assume that persons working within the same occupation may be more similar in their unobservables compared to persons working in other occupations. Including occupation fixed effects also allows us to analyze the role of occupations on the gender gap. In equation 2.3, α indicates the gender gap in earnings growth within occupation j after being promoted in occupational position l.

$$\begin{aligned}\Delta y_i = \beta_0 + \alpha\ \text{female}_i + \gamma \sum_{l=1}^{L} \text{occ. position}_l + \xi \sum_{l=1}^{L} \text{occ. position}_l \times \text{female}_i + \mu X_i \\ + \nu \sum_{j=1}^{J} \text{occupation}_j + \epsilon_i\end{aligned} \tag{2.3}$$

In addition, we expect that the selection within firms is also correlated with success on the labor market. More specifically, we assume that differences in earnings, in particular between men and women, come from selection into firms with higher or lower earnings (Card et al., 2016). We also suppose that persons who select into the same firm f are more similar in their unobservables, such as ambition or attitudes towards the future career. We also expect that firms differ in their wage growth because of different collective agreements. Therefore, we add firm fixed effects to our model. Hence, in this case α gives the gender gap in earnings growth within occupation j and firm f after being promoted in the occupational position l.

$$\begin{aligned}\Delta y_i = \beta_0 + \alpha\ \text{female}_i + \gamma \sum_{l=1}^{L} \text{occ. position}_l + \xi \sum_{l=1}^{L} \text{occ. position}_l \times \text{female}_i + \mu X_i \\ + \nu \sum_{j=1}^{J} \text{occupation}_j + \eta \sum_{f=1}^{F} \text{firm}_f + \epsilon_i\end{aligned} \tag{2.4}$$

To test differences in bargaining power between women with and without children, we repeat the estimation for childless women compared to men. In the final model, given in equation (2.4), α gives the difference between men and women who made similar decisions in their life but we do not know the reasons for these decisions. Thus, even though both groups seem to be very similar in their observables, they might differ in their unobservables. For the interpretation of our results, we have, therefore, to keep in mind that we cannot disentangle whether our findings come from differences in productivity or from discrimination.

2.5 Results

The aim of this study is to investigate whether promotions have the same effects on earnings for women and men. The findings, however, also depend on the selection process into those

promotions. Therefore, the first part of this section will descriptively examine whether men and women as well as childless women and mothers are equally distributed within each level of promotion and how men's and women's earnings increase before and after being promoted. The second part deals with the effects on earnings growth.

2.5.1 Descriptive results

In our setting, we focus on full-time employment. However, to describe how promotions are distributed on the labor market, we will first discuss the share of women within each occupational position for the entire labor market, i.e. including part-time workers. These shares are given in the first row of Table 2.2. It is apparent from the table that men and women are nearly equally distributed in our sample (48 % of the sample is female) but the share of women varies across the different levels of promotions. While slightly more women get promoted to "skilled work" (52 %), men are somewhat over-represented in "difficult activity" (share of women: 46 %). In the highest level "very difficult activity & supervisory power," the share of women is considerably smaller: only 29 % of persons who have been promoted to this occupational position are female. Thus, these descriptive findings suggest that men are more likely to get promoted to higher positions.

However, these descriptives may be biased by comparing two different groups: Full-time and part-time workers. Thus, the second row of the table gives the share of women for full-time employed workers. While interpreting the shares, note that the share of women in the total sample is smaller. Only 27 % of the persons who got promoted in full-time is female. Giving the total shares, the distribution in the lower two categories reverses. In the full-time sample, women are slightly under-represented in "skilled work" and in "very difficult activity & supervisory power," where the share of women is 25 %. In contrast, women are over-represented in the level of "difficult activity," indicated by a share of women of 37 %.

In the third and fourth row of the table, we compare mothers to childless women. It is apparent from the table that mothers are underrepresented in the sample compared to the total population, where around 80 % of women have children (Statistisches Bundesamt, 2017a). If we include part-time workers, almost half of the promoted women have children. Comparing the different levels of promotions, however, indicates that the share of mothers decreases with the level of promotion. Thus, the higher the occupational position the lower the probability of women with children (compared to childless women) to be promoted.

Restricting the sample to full-time employees decreases the share of mothers to 33 %. Again, we see that the higher the promoted position the lower the share of mothers. However, the differences between mothers and non-mothers is less pronounced than in the total sample (including part-time workers). The results indicate first that mothers are less likely to be promoted than women without children. Further, the results suggest that mothers are also less likely to be promoted to higher positions.

Besides the differences in probability to be promoted between men and women, it is worthwhile to look at differences in earnings growth between men and women before and after the promotion. Therefore, the left panel of Figure 2.3 plots how the earnings growth of men and women

	Share of women in %		Share of mothers in %	
Level	All	Full-time	All	Full-time
Skilled work	52.0	25.2	49.4	34.9
Difficult activity	45.6	36.5	44.8	32.5
Very difficult activity & Supervisory Power	29.4	24.6	36.4	29.8
Total	47.6	27.3	47.3	32.7

Source: IEB 1976-2017; own calculations. Share of mothers gives the share of women with children in relation to all women.

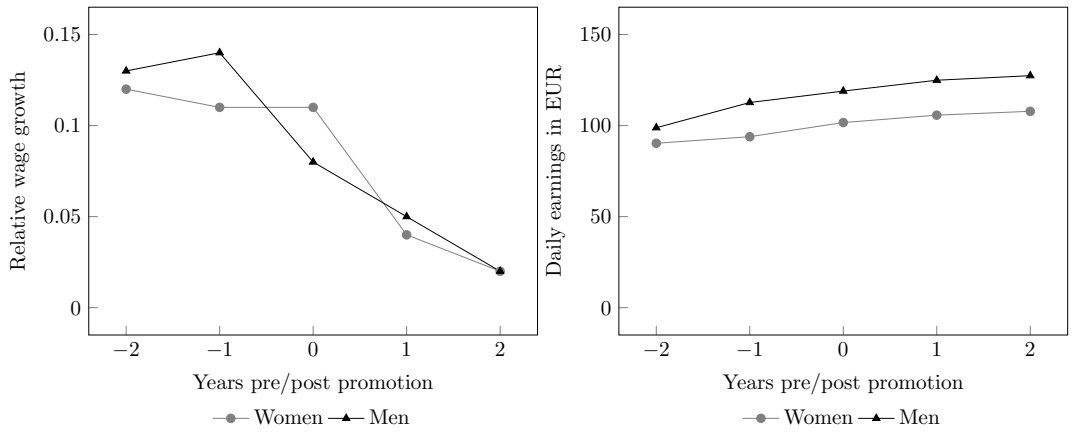
Table 2.2: Share of women within occupational positions including and excluding part-time worker

have evolved during a period of two years before and after the promotion. Two years before the promotion occurs, women's and men's relative wage growth are quite similar. However, one year before the promotion takes place, men's earnings growth is higher than the year before, while women's earnings growth is smaller in this year. In contrast, in the year of the promotion, women's earnings growth exceeds men's. In the years after the promotion, however, there are no observable differences in the average wage growth between men and women. These descriptive results suggest that promotions have a higher impact on women's earnings than on men's, since men's earnings increased strongly even before the promotion took place. Moreover, the decreasing earnings growth over time supports previous studies that find that the wage growth decreases with experience (e.g Lagakos et al., 2018; Mincer, 1974).
The right panel of the figure shows how this relative earnings growth translates into daily earnings. While women's (90 euro) and men's earnings (99 euro) are relatively equal two years before the promotion, men's earnings increase by 14 euro in the second year and women's only by 4 euro. Thus, in the year before the promotion takes place the gender gap in absolute terms is 19 euro. Since women's increase in earnings after the promotion is higher, than men's, the gap in daily earnings decreases to 17 euro. In the years after the promotion, men and women have a similar relative earnings growth but since men's earnings level is higher, the gap rises again to 19 euro in both years. Thus, we can conclude from these descriptive results that women's earnings are on average lower than men's. The promotion decreases the gender gap in absolute earnings in the year of the promotion. However, the gender gap increases again in the years after the promotion.

2.5.2 General gender gap in earnings growth

After observing differences in the likelihood to be promoted, the question arises whether this promotion has the same effect on earnings for men and for women. To answer this question, we add sequentially variables to the model.
In our main specification, we analyze the differences in earnings effects for men and women for full-time workers (see Table 2.3).[21] In the first row, we only include gender in the model and observe a positive effect. Thus, women's increase in earnings due to the promotion is 3

[21]The whole regressions of row (VIII) of Tables 2.3 and 2.4 is given in Table B.4 in the Appendix.



(a) Relative wage growth **(b)** Daily earnings

Source: IEB 1976-2017; own calculations.

Figure 2.3: Earnings growth and earnings before and after promotion

percentage points higher than men's. In the second row, we include the level of the promotion to the model. The results suggest that the differences in earnings growth between men and women is significantly lower in promotions into occupational positions with difficult activities. In contrast, women's earnings growth compared to men's in the level "very difficult activity & supervisory power" is even larger than in the reference group "skilled work."

While adding previous earnings growth does not affect the female coefficient, the gender gap decreases when we add individual controls to the model. Interestingly, controlling for individual characteristics decreases the female coefficient in "very difficult activity & supervisory power," i.e. women within the same occupational positions are more skilled than their male colleagues. Next, we add occupations to the model, which has a considerable effect on the results, since it reduces the gender gap substantially. This result might be driven by the full-time restriction, which represents a positively selected group of women. Full-time working women might be more labor market attached and, therefore, might be less likely to select into occupations that offer a better reconciliation of family and working life but lower wages (Adda et al., 2017). The results for part- and full-time workers confirm this assumption (see Table B.1 in the Appendix): We find that the positive female effect decreases when adding occupations to the model. Further, the negative female coefficient interacted with the occupational position "difficult activity" decreases slightly after including occupations in the model.

In row (VII), we further add firm fixed effects, which leads to an increase of the R^2 from 7 to 54 percent, i.e. nearly 50 percent of the variance in earnings growth can be explained by intra-firm differences in earnings growth. From this, we conclude that differences in earnings growth due to promotion mostly depend on the sorting in firms with high or low earnings growth. Further, the gender gap is no longer significant. That is, once men and women have selected into the same occupation and the same firm, there are no differences in earnings growth e.g. due to collective agreements. Surprisingly, the interaction of the occupational position "difficult

activity" and female is still negatively significant. Thus, women's earnings increasing due to a promotion into "difficult activity" compared to men is smaller than the earnings growth of women compared to men, who got promoted to "skilled work", even if they work in the same occupation and the same firm. Controlling on the year of promotion, does slightly change the results, in particular the interaction of the occupational position "difficult activity" and female is no longer significant. Thus, this result suggests that since the change in size of the coefficient is only marginal, the difference in the gender gap in difficult activities within firms and occupations is not very robust. Further, we estimate the effects of promotions on the absolute increase in earnings and find very similar results (see Table B.2 in the Appendix).

	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
Female	0.025***	0.034***	0.034***	0.028***	0.029***	0.009**	0.003	0.003
	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.005)	(0.005)
Level of promotion (ref: Skilled work)								
Difficult activity		0.021***	0.021***	0.024***	0.023***	0.025***	-0.000	-0.002
		(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.005)	(0.005)
Very difficult activity &		0.006**	0.006**	0.018***	0.020***	0.027***	0.000	-0.000
Supervisory Power		(0.002)	(0.002)	(0.002)	(0.002)	(0.004)	(0.006)	(0.006)
Female*Level of promotion (ref: Skilled work)								
Difficult activity		-0.031***	-0.031***	-0.037***	-0.037***	-0.022***	-0.012*	-0.010
		(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.006)	(0.006)
Very difficult activity &		0.026***	0.026***	0.011*	0.009	0.011	0.008	0.009
Supervisory Power		(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.008)	(0.008)
Constant	0.070***	0.060***	0.060***	0.186***	0.191***	0.185***	0.022	0.164**
	(0.001)	(0.001)	(0.001)	(0.005)	(0.005)	(0.005)	(0.044)	(0.052)
N	84,308	84,308	84,308	84,308	84,308	84,308	84,308	84,308
R^2	0.00	0.01	0.01	0.05	0.05	0.07	0.54	0.55
Earnings growth t_{-1}			✓	✓	✓	✓	✓	✓
Individual controls				✓	✓	✓	✓	✓
Firm specific controls					✓	✓	✓	✓
Occupation fixed effects						✓	✓	✓
Firm fixed effects							✓	✓
Year fixed effects								✓

Source: IEB 1976-2017; own calculations. DV: Relative Earnings growth = $(earnings_{after} - earnings_{before})/earnings_{before}$; Occupations: 3-digit level (KldB2010); Controls: Experience in part- and full-time (single and quadratic), Education (w/o A-levels and voc. training; Voc. Training w/o A-Levels; A-levels, w/o voc. training; A-levels + voc. training; University of appl. science; University), Month of tenure, Age, East/West Germany, Firm size. Sample: Persons who were promoted between 2012 and 2017 within the same occupation and the same firm before and after being promoted and who have worked in full-time before and after the promotion. Women without children and all men. Significance levels:* p< 0.05, ** p<0.01, *** p< 0.001. Standard errors are clustered on the individual level.

Table 2.3: Effect of promotion on (relative) earnings growth, for full-time sample

From the *Wage Gain Hypothesis* we expect that earnings increase due to promotion. The average effect of promotions on earnings is indicated by the constant. As an example, we can see from the constant in row (I) that men's earnings increase by 7 % after a promotion. Since the female coefficient is significantly positive, women's wage growth after promotions is even larger (10 %). Thus, we cannot reject the hypothesis of increasing earnings.

Further, we formulated two contradicting hypotheses, which suggest higher increases in earnings for men (*Job Offer Hypothesis*) or for women (*Productivity Hypothesis*). Indicated by a positive female coefficient in the models without firm fixed effects, the results suggest that women have a higher wage growth due to promotion than men. This confirms the descriptive findings depicted in Figure 2.3. Moreover, the gender differences in the probability to be promoted indicate that women have to be more able than men to be promoted, which is in line with our *Productivity*

Hypothesis. However, once we control for firm fixed effects, gender differences are no longer significant. One potential explanation for this finding is that collective agreements within firms do not allow differences in wage growth.

We argue that our result reflects the lower bound, since we compare full-time working women and men within the same occupation and the same firm, who did not change their employer after the promotion. The main reason for this assumption is that men and women in our setting differ substantially in the selection process. First, we exclude part-time workers from our model in our main specification to make earnings more comparable. Since this restriction affects women considerably more than men and Gallego Granados (2019) shows that women working full-time represent a positively selected group, we argue that full-time working women are more positively selected (compared to all women) than the full-time working men (compared to all men). Comparing the summary statistics of the main specification (Table 2.1) to the one including part-time workers (Table B.3 in the appendix) confirms this assumption since the full-time sample is more experienced and higher educated. The differences between the full-time sample and the sample including part-time workers are more pronounced than for women, e.g. the share of individuals with university degree in the full-time sample is 22 % for women and 19 % for men and the sample with part-time workers 13 % for women and 14 % for men. Once we include part-time workers in the model, women's earnings growth due to the promotion is lower than men's (see Table B.1 in the Appendix). However, these results should be interpreted with caution, since a large increase in earnings in the model with part-time workers may also result from a change from part-time before the promotion to full-time after the promotion.

Moreover, we compare men and women who work in the same occupation, i.e. we compare a typical man with an atypical woman, or vice versa. Assuming that female-dominated occupations compensate lower wages with a better reconciliation of family and working life (Adda et al., 2017; Polachek, 1981)[22], we conclude that women who select into male-dominated are more labor market attached. In contrast, men who select into female-dominated occupations might be less career orientated. Thus, once we look at gender gaps within an occupation, we might compare a more positively selected group of women (compared to all women) to a less positively selected group of men (compared to all men).

In addition, we compare men's and women's earnings growth within the same firm. For Portugal, Card et al. (2016) show that men are more likely to select into higher paying firms. Thus, women who also work in the same (higher paying) firm might be more labor market attached than the average working woman. In contrast, men who sort into lower paying firms might reflect a negative selected group of men. Similar to occupations, estimating earnings effects within firms implies that we compare more labor market attached women (compared to all women) to less labor market attached men (compared to all men). That is, we argue again that we either compare a more career orientated woman to a typical man in a high-paying firm or a less labor market attached man to a typical woman in a low-paying firm.

Finally, we focus on persons who work in the same firm before and after being promoted. Pre-

[22]This argument, however, is highly discussed in the literature (e.g. Budig and England, 2001; Glauber, 2011, 2012; Jacobs, 1990).

vious research shows that women and men differ in their reasons to change the firm. Thus, men are more likely to change the firm for pecuniary reasons (e.g. Albrecht et al., 2018; Fitzenberger and Kunze, 2005; Loprest, 1992; Manning, 2003). Therefore, we conclude that those men, who stay in the firm might reflect a negatively selected group.
From these different selection processes, we argue that our estimated effects reflect a lower bound. Thus, the effect may be underestimated because we compare an average labor market attached group of men to a strongly positively selected group of women.
Note that we cannot observe productivity in our model, which means that we are not able to identify whether gaps in promotion and in earnings growth come from differences in productivity or discrimination.[23] Moreover, we argue that men and women may differ in their selection but we do not control on unobservable differences. A way to control for this endogeneity would be to estimate a fixed effects model. Further, it is possible to identify the causal effect of promotion on earnings and its difference between men and women in an event study setting. In this framework, we would be able to analyze how women's and men's earnings develop pre- and post-promotion. However, using fixed effects we cannot investigate the role of sorting into firms or occupations.
Lastly, we want to mention that higher earnings growth for women (in the specifications without firm fixed effects) may be the result of general gender differences in the earnings level and the role of promotions on wage growth over time. Thus, as depicted in Figure 2.3 promotions have a higher impact on female earnings growth than on men's, since men have high earnings growth even before the promotion took place, which could also be analyzed in an event study setting.

2.5.3 The role of motherhood on the gender gap in earnings growth

Further, we hypothesize that mothers' earnings increase less due to promotions because they are less likely to change the firm for monetary reasons, i.e. may have a higher preference for the firm. To test whether effects differ between women with and without children, we restrict our female sample to childless women, which we compare to all men.
The results presented in Table 2.4 are very similar to our main specification. However, the female coefficients increases slightly when we exclude mothers from the sample. According to our model, mothers might, therefore, have a higher preference for the current firm. Another explanation may be that mothers may be less productive than women without children because having children may reduce their energy or motivation (Ejrnæs and Kunze, 2013).
Again, we argue that this result may be a lower bound because women with children, who work in full-time and who get promoted, may reflect a highly labor market attached group of mothers. The relatively small share of mothers, particular in the sample (see Table 2.2), confirms this assumption.

[23] In our model we argue that differences come from job offers or productivity, however, it might be possible that women receive more job offers than men but are less successful in negotiations (e.g. Babcock and Leschever, 2003; Niederle and Vesterlund, 2007).

	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
Female	0.032***	0.042***	0.042***	0.033***	0.033***	0.014***	0.006	0.006
	(0.002)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.006)	(0.006)
Level of promotion (ref: Skilled work)								
Difficult activity		0.021***	0.021***	0.024***	0.022***	0.025***	0.001	-0.000
		(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.006)	(0.006)
Very difficult activity &		0.006***	0.006***	0.018***	0.020***	0.028***	0.002	0.002
Supervisory Power		(0.002)	(0.002)	(0.002)	(0.002)	(0.004)	(0.007)	(0.007)
Female*Level of promotion (ref: Skilled work)								
Difficult activity		-0.032***	-0.032***	-0.038***	-0.038***	-0.023***	-0.009	-0.008
		(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.007)	(0.007)
Very difficult activity &		0.019**	0.019**	0.008	0.006	0.006	-0.001	0.000
Supervisory Power		(0.007)	(0.007)	(0.006)	(0.006)	(0.007)	(0.009)	(0.009)
Constant	0.070***	0.060***	0.060***	0.188***	0.194***	0.187***	0.022	0.161**
	(0.001)	(0.001)	(0.001)	(0.005)	(0.005)	(0.006)	(0.044)	(0.053)
N	76,311	76,311	76,311	76,311	76,311	76,311	76,311	76,311
R^2	0.01	0.01	0.01	0.05	0.05	0.07	0.55	0.55
Earnings growth t_{-1}			✓	✓	✓	✓	✓	✓
Individual controls				✓	✓	✓	✓	✓
Firm specific controls					✓	✓	✓	✓
Occupation fixed effects						✓	✓	✓
Firm fixed effects							✓	✓
Year fixed effects								✓

Source: IEB 1976-2017; own calculations. DV: Relative Earnings growth = $(earnings_{after} - earnings_{before})/earnings_{before}$; Occupations: 3-digit level (KldB2010); Controls: Experience in part- and full-time (single and quadratic), Education (w/o A-levels and voc. training; Voc. Training w/o A-Levels; A-levels, w/o voc. training; A-levels + voc. training; University of appl. science; University), Month of tenure, Age, East/West Germany, Firm size. Sample: Persons who were promoted between 2012 and 2017 within the same occupation and the same firm before and after being promoted and who have worked in full-time before and after the promotion. Women without children and all men. Significance levels:* p< 0.05, ** p<0.01, *** p< 0.001. Standard errors are clustered on the individual level.

Table 2.4: Effect of promotion on (relative) earnings growth, for full-time sample, all men and childless women

2.5.4 Glass ceiling vs. Sticky Floor

Before testing whether the gender gap changes across the levels of promotions, we will first examine whether the earnings growth increases with the level of promotion. Therefore, we refer to the coefficients for the different levels of promotions. Since in row (II) to (VI) the coefficients for both "difficult activity" and "very difficult activity & Supervisory Power" are positive and significant, we can infer that earnings growth after being promoted to "skilled work" is the lowest. However, before adding occupation fixed effects to the model, the wage gain of being promoted to "very difficult activity & Supervisory Power" is smaller than after promotions to "difficult activity". Once we add occupations to the model, we observe that individuals who are promoted to highest occupational position have the largest increase in earnings. Thus, we can confirm the hypothesis if we compare individuals within the same occupation. When we add firm fixed effects to the model, however, differences between the levels of promotions disappear, which may be the result of collective agreements within firms. Thus, we cannot find differences in (relative) earnings growth between the levels of promotion within firms.[24]

From our theoretical model, we derived two counteracting hypotheses: The *Sticky Floor Hypothesis* and the *Glass Ceiling Hypothesis*. The *Sticky Floor Hypothesis*, argues that the higher women get promoted, the fewer their number of job offers. However, in our model we do not find

[24] In absolute terms, however, the earnings growth increases with the level of promotion (see Table B.2 in the Appendix).

any support for this hypothesis, since the largest gender gap appears in occupational positions with "difficult activity". Women's earnings compared to men is even the largest in positions with "very difficult activity & supervisory power".
From the descriptive results, however, it is apparent that women are less likely to be promoted to the highest occupational position. Moreover, the findings suggest that in occupational positions, where the share of women is relatively high ("difficult activity"), men's earnings growth is larger than women's. In contrast, in those positions, where the share of women is relatively low ("skilled work" and "very difficult activity & supervisory power"), women's earnings growth is larger than men's. Therefore, these results are in favor of the *Glass Ceiling Hypothesis*. However, once we add firm and year fixed effects to the model, these effects are no longer statistically significant, which again supports the role of collective agreements.
Note that the data do not differ between "very difficult activity" and "supervisory power," which differ substantially in the share of women and also the gender gap in earnings (see chapter 1). Since previous research shows that the gender gap widens, especially at the top (Arulampalam et al., 2007; Blau and Kahn, 2017; Collischon, Forthcoming), it is probable that we would observe a gender gap in the occupational position "supervisory power." As women are considerably less likely to enter these positions (e.g. Holst and Friedrich, 2017), the gender gap in positions with "supervisory power" might be overlaid by the fact that women's earnings growth is higher than men's in positions with a "very difficult activity".

2.5.5 The role of motherhood on the gender gap in earnings growth across the levels of promotions

Finally, we want to test whether the "motherhood penalty" increases with the level of promotion. Therefore, we compare the interactions between the female coefficient and the level of promotion for the sample including (Table 2.3) and excluding (Table 2.4) mothers. Interestingly, after adding individual controls to the model, the gender gap for "very difficult activity & supervisory power" is no longer significant in the specification without mothers. This finding indicates that the large earnings growth for women in the highest occupational position is driven by mothers and, therefore, highlights the role of selection: Those few mothers, who work in full-time and are promoted into the highest occupational position (7 % out of our female sample), represent a highly labor market attached group, i.e. these women may be more productive than their male counterparts and will, therefore, have higher earnings growth. Thus, we cannot confirm the *Decreasing Bargaining Hypothesis*.

2.6 Conclusion

The Gender Pay Gap is a well-established fact that has different reasons, including part-time work, firm selection, occupations and occupational positions. With this paper, we contribute to the literature by providing evidence whether promotions affect women's and men's earnings differently. To this end, we use administrative data from Germany, which offers not only

information on promotions but also on the entire employment biography. After adding firm and occupation fixed effects to the model, we do not find gender differences in earnings growth. Thus, our results confirm previous studies for the U.S. and the UK that also find no gender differences (Blau and DeVaro, 2007; Booth et al., 2003).

We argue that this result is a lower bound, since selection processes within full-time, promotions, firms and occupations differ substantially between women and men. Therefore, we compare a highly positively selected group of women to an average selected group of men.

Further, our results provide evidence for a "glass ceiling". That is, women are less likely to be promoted to the highest occupational position. However, we do not observe that women's earnings growth (compared to men's) is lower in the highest occupational position.

These results suggest that promoted women are not only more labor market attached than the average women in the labor market but also more ambitious than promoted men. However, with this model we are not able to control for individual specific effects. Thus, using a fixed effects model, or more specifically an event study framework, we could identify the causal effect of promotion. Arguing that – besides of gender, childless women do not differ in their unobservables from men – this framework also allows for estimating the causal effect of gender on earnings due to promotion.

Chapter 3

Long-term Effects of the German Parental Leave Reform on Mothers' Earnings

3.1 Introduction

Paid parental leave as it is common in many industrialized countries has been shown to be associated with higher women's employment rates on the one hand, but lower relative wages at extended durations of paid leave on the other hand (e.g. Ruhm, 1998). A synthesis from many empirical studies from various countries and institutional settings shows that there seems to be a non-monotonic relationship between the length of the leave and mothers' labor market outcomes (e.g. Olivetti and Petrongolo, 2017). Besides promoting work-family life balance, family policy often defines additional goals such as child well-being and financial security for families that might conflict with the goal of strengthening the labor market attachment and, thereby, the economic independence of mothers. Against this background, many countries are currently discussing the optimal design of parental leave policies.

Germany implemented a parental leave reform in 2007 that changed the old parental leave benefit scheme in three important ways. First, it replaced a means-tested benefit targeted at lower-income families by an earnings related transfer that is paid to all mothers. Second, while the duration of job-protection has not been changed, the maximum duration of paid leave was cut from 24 to 12 months. Depending on household income and individual prior-to-birth earnings, this changed work incentives for mothers in the first and second year after giving birth. Incentives to take a leave for one year have strongly increased for mothers with high prior-to-birth earnings. For mothers with low prior-to-birth earnings and low household income, incentives to take up employment in the second year after giving birth have increased. Third, the new parental leave scheme had a "daddy quota" of two months. This means that two out

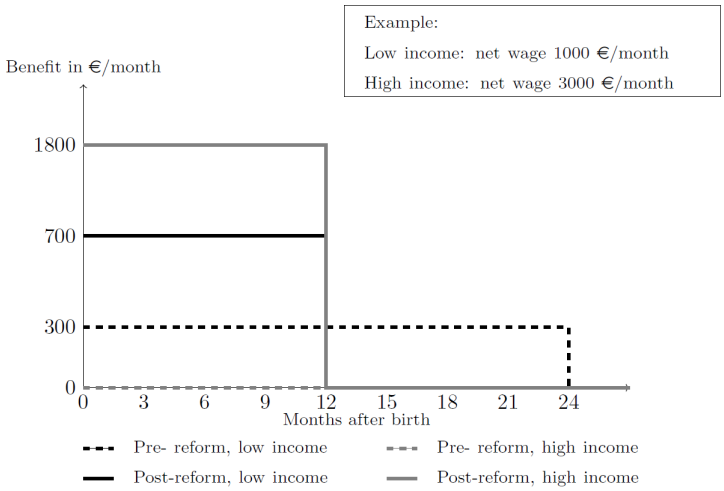
of 14 months are earmarked individually to each parent. If one parent does not take parental leave, the maximum duration of paid parental leave for the family is twelve months.
Several empirical evaluation studies have shown that this reform had the expected short-run labor supply effects for mothers: High-income mothers' labor supply decreased in the first year after giving birth, i.e. their average leave duration increased. Low-income mothers, in contrast, increased labor supply in the second year after giving birth (see. e.g. Bergemann and Riphahn, 2011, 2015; Geyer et al., 2015; Kluve and Schmitz, 2018; Kluve and Tamm, 2013; Welteke and Wrohlich, 2019).
However, much less is known on the medium- and long-run effects of the parental leave reform. A recent study by Kluve and Schmitz (2018) has shown that the parental leave reform had several positive effects, in particular for high-income mothers, in the medium-run. The authors find that after the reform, mothers have a higher probability to return to their previous employer, which in turn leads to higher job quality in the medium run.
Evaluation studies that analyzed previous reforms of maternity leave in (West) Germany from the 1970s, 1980s and 1990s has shown that extensions of paid leave and the job-protected leave have increased the employment interruptions of mothers (Schönberg and Ludsteck, 2014). These longer employment interruptions had – with one exception – no negative effects on mothers' earnings in the medium term (i.e. up to six years after giving birth).
In this paper, we broaden the focus from the short and medium-term perspective to long-term outcomes and investigate the effects of changes in the duration of mothers' employment interruptions on their earnings up to nine years after giving birth to a child. To this end, we use data from the Integrated Employment Biographies (IEB) that contain information on the total population of individuals in Germany who have an employment contract subject to social security contributions. For the identification of the causal effect of the parental leave reform of 2007 on mothers' wages we follow previous literature on short-term effects of parental leave in Germany and exploit the quasi-experiment that was set by the introduction of the parental leave benefit in 2007. In particular, we compare mothers whose first child born was in the last quarter of 2006 (control group) to mothers whose first child was born in the first quarter of 2007 (treatment group). In order to rule out seasonal differences, we add first-time mothers who gave birth to a child in the last quarter of 2005 and the first quarter of 2006 and employ a difference-in-difference analysis.
Our results confirm previous findings and show that the parental leave reform has increased employment interruptions for high-income mothers by almost 3 months on average. However, these longer employment interruptions did not lead to lower earnings in the long run. On the contrary, we confirm findings by Kluve and Schmitz (2018) who find that high-income mothers benefited from the reform. We show that two to nine years after giving birth, mothers with high prior-to-birth earnings have higher earnings than mothers in the control group. Only eight years after giving birth, however, the positive effect is not statistically significant. Therefore, we conclude that the strong positive effects of the parental leave reform on labor market outcomes of mothers in the medium run diminish in the long run. Moreover, for low-income mothers, we do not find any positive effects of the parental leave reform on earnings in the medium nor in

the long run.
In our empirical analysis, we are able to rule out that the positive effects are caused by a change in working hours, employer stability, socio-demographic characteristics of working mothers or changed fertility patterns. One potential mechanism that increases mothers' earnings in the first couple of years after giving birth could be the increased share of fathers getting involved in childcare.
From a policy perspective, our results show that granting a more generous benefit in the first year in order to provide a financial safeguard for families with young children has increased the duration of employment interruptions for certain groups of mothers without harming their long-term career perspectives. In contrast, mothers with high prior-to-birth earnings even experience positive effects on their wages. Thus, the suspected trade-off between providing a safeguard for families with a new-born child and strengthening mothers' labor market attachment and their long-term economic independence does not seem to be empirically relevant in the context of the German parental leave reform of 2007. In fact, there is suggestive evidence that this trade-off has been mitigated by simultaneously incentivizing the use of parental leave by fathers, thereby facilitating the re-entry into the labor market for mothers after their family-related employment interruptions.
However, our results also reveal that only mothers with medium or high incomes benefited from this parental leave reform. Low-income mothers potentially not only lost income due to the cut of the maximum duration period. Moreover, they did not gain higher earnings in the short, medium or long run. Also, fathers from low-income families had a lower probability to take parental leave. If family policy aims at facilitating the work-life balance also of mothers with lower earnings potential, the parental leave scheme should be reformed for example by providing higher earnings replacement rates for parents with low income.
The paper is organized as follows. In the next section we describe the institutional setting and summarize the related literature. Section 3.3 presents the empirical approach, while section 3.4 provides information on the data. We present the results of our empirical analysis in section 3.5 and section 3.6 concludes.

3.2 Institutional Background and Previous Literature

In Germany, parental leave legislation is, in particular in comparison to the United States, rather generous with respect to both, job protection and monetary benefits. First, there is maternity leave, which assures employed women a leave of six weeks before and eight weeks after giving childbirth financial benefits that replace their total net prior-to-birth earnings. After this, each parent can take parental leave from his or her job and is granted employment protection for a maximum of three years. However, not all of this maximum parental leave period is or has been paid: Up until the end of 2006, families with a new born child could draw a cash benefit amounting to 300 euro per month for a maximum period of 24 months ("Erziehungsgeld"). This benefit was means-tested at the household level and income thresholds were set to target the median of household income of families with young children. Above this income threshold,

families did not get any financial benefit after the maternity leave period expired.
In 2007, Germany implemented a major parental leave reform that had three goals. First, it was meant to increase financial stability for families with young children and providing a financial safeguard during the first year of a child's life. Second, an explicit aim stated in the law was to increase economic independence of both parents, in particular mothers', by shortening employment interruptions of mothers. Finally, gender equality goals were also explicitly stated in the law: Fathers should be encouraged to take a more active role in child care by introducing financial incentives such as a fathers' quota in the parental leave benefits scheme.
The "*Elterngeld*" that was introduced in 2007 replaced the "*Erziehungsgeld*." In contrast to this previous benefit, the new Elterngeld is not means-tested and more generous for most families. It replaces 67 percent of prior-to-birth net earnings of the parent on leave, up to a maximum of 1,800 euro per month. The minimum amount of Elterngeld awarded is 300 euro per month, which is equivalent to the monthly benefit paid under the previous Erziehungsgeld. However, it is paid for a shorter period of time (12 months if only one parent takes leave or 14 months if both parents take leave).
Figure 3.1 summarizes the changes in financial incentives for two stylized mothers who earn 1,000 euro and 3,000 euro per month, respectively. Depending on prior-to-birth earnings and household income, the reform changed financial incentives to work in a different way during the first two years after the child is born. For mothers with high prior-to-birth earnings, incentives to stay at home in the first year after the maternity leave period ended increased strongly. For mothers with no or low prior-to-birth earnings and below-median net household income, incentives to go back to work in the first year have decreased, while they have increased in the second year.



Source: Welteke and Wrohlich (2019)

Figure 3.1: Changes in financial incentives due to the 2007 parental leave reform

The parental leave benefit reform of 2007 has been evaluated in several empirical studies. For example, Kluve and Tamm (2013) exploit the quasi-experimental setting of the reform

and find that the probability that mothers return to work during the first year after giving birth to a child has declined, in particular for high-income mothers. This finding has been confirmed in later studies, e.g. by Bergemann and Riphahn (2011, 2015), Geyer et al. (2015), and Welteke and Wrohlich (2019). Kluve and Schmitz (2018) analyze mothers' employment responses not only in the first and second year after giving birth but also in the third to fifth year. Based on data from the German Microcensus, they find a large and significant increase in the employment rate of mothers with three to five year old children. Moreover, they find that the reform increased employer continuity, i.e. a higher share of mothers returned to their pre-birth employer. Moreover, Welteke and Wrohlich (2019) show that the reform changed social norms regarding the length of parental leave via social interaction effects among coworkers.[25]

Research analyzing several parental and maternity leave reforms from earlier periods (Ludsteck, 2014) has shown that extending parental leave in the 1970s, 1980s and 1990s in (West) Germany prolonged mothers' employment interruptions, however, did not affect mothers' earnings in the medium run, i.e. up to 6 years after giving birth. Only one reform that strongly extended the period of paid leave (from 6 to 22 months) has been shown to affect medium-term earnings to a small extent. Similarly, Lalive et al. (2014) have shown for Austria that reforms that have increased the maximum duration of paid leave in combination with job-protection have prolonged mothers' employment interruptions quite strongly, however did not harm mothers' earnings in the medium run. Similar results have also been found for the parental leave scheme introduced in California (e.g Baum and Ruhm, 2016), Canada (Baker and Milligan, 2008) and Australia (Broadway et al., Forthcoming). As summarized by Rossin-Slater (2018), the general conclusion from the literature is that leave entitlements up to one year can improve job continuity for women and increase their labor market attachment, however, longer leaves can negatively affect their earnings, employment and career advancement.

Against this background of previous empirical findings and the way how the 2007 parental leave reform in Germany changed incentives to work during the first and second year after childbirth, we expect the following effects on earnings: Given that the reform has ambiguous effects on the duration of employment interruption of mothers with low pre-birth earnings, later labor market outcomes of this group could be either positive or negative. On the other hand, the expected longer employment interruptions of mothers with high pre-birth earnings resulting from the parental leave reform, could potentially lead to negative effects on long-term labor market outcomes. However, since it has been shown by previous research (Kluve and Schmitz, 2018) that this reform has yielded some positive labor market effects for high-income mothers in the medium run, such as higher employer stability and a larger share of unlimited work contracts, there might also be positive effects in wages in the medium and long run.

Due to these ambiguous mechanisms, the sign and the magnitude of the long-term effects of the 2007 parental leave reform on mothers' earnings remain an empirical question that will be analyzed in the remainder of this paper.

[25] There are many further studies analyzing the effect of the 2007 parental leave reform with respect to other outcomes. For example, Cygan-Rehm (2016) and Raute (2019) analyze its effects on fertility, Huebener et al. (2019) the effects on child outcomes, Cygan-Rehm et al. (2018) look at parents' living arrangements, and Tamm (2019) evaluates the effects on father's childcare involvement.

3.3 Empirical Approach

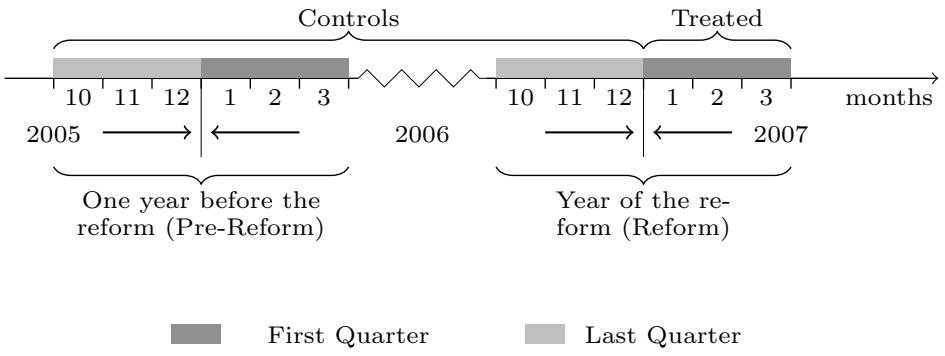
To identify the causal effects of the reform on mothers' long-run labor market outcomes, we exploit the introduction of the new parental leave benefit scheme in January 2007 as a natural experiment. Due to the timing of this reform, parents of children born in the first quarter of 2007 could not know that they would be eligible for the new benefits at the time of conception of their child (see, e.g. Kluve and Tamm, 2013). Comparing mothers with children born in the first quarter of 2007 (treatment group) to mothers with children born in the last quarter of 2006 (control group) thus identifies the intention-to-treat effect (ITT) of the reform.
Mothers with children born in winter, however, might differ in their labor market outcomes from mothers with children born in spring.[26] To control for these potential seasonal effects, we add observations from the last quarter of 2005 and the first quarter of 2006 and employ a difference-in-difference estimation strategy. Moreover, this approach allows controlling for potential seasonality in the labor demand or for seasonal bonus payments. In particular, we estimate the effect of the parental leave reform using the following equation:

$$Y_{it} = \alpha + \beta \text{FirstQuarter}_{i0} + \gamma \text{ Reform}_{i0} + \delta \text{FirstQuarter}_{i0} \cdot \text{Reform}_{i0} + \omega X_{it} + \epsilon_{it} \qquad (3.1)$$

where Y_{it} denotes the log of the daily wage of mother i in year t. The dummy variable *FirstQuarter* takes on the value 1 if the mother has given birth to her first child in the first quarter of the year 2006 or 2007 and 0 if the birth has taken place in the last quarter of 2005 or 2006. The dummy variable *Reform* takes on the value 1 if the mother gave birth to a child in the months around the implementation of the reform, i.e. in the last quarter of 2006 or in the first quarter of 2007, and 0 if the birth has taken place in the year before. Under our identifying assumptions, the coefficient δ of the interaction term of these two dummy variables is the causal effect of the parental leave reform. Figure 3.2 shows the definition of the treatment and control groups in our setting graphically.
The identification of the causal effect is only valid if the assignment of mothers into treatment and control groups is random. As already mentioned, the reform was announced in June 2006 and came into effect in January 2007 (Kluve and Tamm, 2013). This timing implies that parents whose child was born in the first three months of 2007 could not know that they would be eligible for the new benefits at the time of conception of their child. To exclude potential selection into the treatment group around the cut-off date by postponing birth[27] we exclude all mothers who have given birth to a child 14 days before and after January 1, 2007.

[26] Previous studies for the U.S. and the Czech Republic have shown that the season of birth is correlated with socio-demographic factors of the mother and the child's later outcomes (Bobak and Gjonca, 2001; Buckles and Hungerman, 2013; Clarke et al., 2019).

[27] Neugart and Ohlsson (2013) and Tamm (2013) show that some mothers, in particular employed mothers, postponed their birth after January 1st, 2007. The timing of birth around cut-off points has also been found for other reforms (Dickert-Conlin and Chandra, 1999; Gans and Leigh, 2009)



Source: Own depiction

Figure 3.2: Changes in financial incentives due to the 2007 parental leave reform

3.4 Data

For the empirical analysis we mainly use individual information generated from labour administration and social security data processing (Integrated Employment Biographies (IEB)) based on the integrated notification procedure for health, pension, and unemployment insurances. The IEB is provided by the Institute of Employment Research (IAB) and contains the total population of individuals in Germany who have either an employment contract subject to social security contributions, receive benefits in accordance with Social Code Book II or are registered with the Federal Employment Agency as a job-seeker.

From these data, we select a sub-sample of all mothers for whom we can identify the first birth of a child in the last quarter of 2005 or 2006 or the first quarter of 2006 or 2007 and who have been employed before childbirth. For these individuals, we observe their whole employment history and wages up until nine years after giving birth.

As the date of childbirth is not directly observed in the IEB data, we apply the birth identification strategy developed by Müller and Strauch (2017). This approach allows us to make assumption about the date of birth. However, this approach is based on the expected date of birth which may differ from the real date. Since we exclude births that took place two weeks before or after January 1st, it is unlikely that we confound treated and controls.

One major advantage of the IEB data is that we observe the universe of women working subject to social security. Therefore, the data offer a very large number of observations and the statuses and wages depicted exactly at each day. This allows us to use a data-consuming empirical methodology. The quasi-experimental setting needs us to use observations from a very narrow time window around the introduction of the new parental leave benefit in order to identify truly causal effects of the reform. However, one shortcoming of the IEB data is that it only contains daily earnings.[28] Hourly wages cannot be computed, since information about the hours worked

[28] As earnings in the IEB are top-censored above the contribution limit for the pension insurance, we estimate earnings above this limit. However, the censoring affects only two percent of our sample.

is not available in this data set. We, therefore, use daily earnings as the main outcome variable of interest.

Daily earnings, however, depend on the hours of work and, therefore, differ between part-time and full-time employees. Employment patterns with respect to hours of work, however, may also have changed as a result of the reform. If, for example, more women are working part-time as a result of the reform, we would find a negative effect of the reform on daily earnings. In that case, these results should not be interpreted as an effect of the parental leave reform on mothers' hourly wages but as a combined effect on working hours and (potentially) hourly wages.

In order to disentangle potential effects on daily earnings by changes in working hours and changes in hourly wages, we additionally need to analyze the long-term effects on working hours. To this end, we analyze data from the German Microcensus. The German Microcensus is a one percent random sample of the population living in Germany and includes more than 800,000 individuals in more than 350,000 households per year. We use the waves 2008 to 2016 and select mothers who gave birth to a child in the last six months of 2005 or 2006 or in the first six months of 2006 to 2007. Based on these data, we are able to identify the effect of the parental leave reform on working hours one to nine years after giving birth to a child. Further, the socio-economic variables in the Microcensus allow us to examine whether effects in earnings may come from sample selection. However, a major drawback of this data set is that is does not provide information on the past such as previous wage. Therefore, we use the level of education as a proxy for previous earnings. In particular, we define individuals with "high level of formal education" as those with a tertiary degree. In contrast, we refer to "low level of formal education" as persons without vocational training or A-levels. [29]

Since the changes in economic incentives induced by the parental leave reform differ by prior-to-birth earnings of the mother, we run separate estimations for mothers with high, and low prior-to-birth earnings in all our regressions. In this context, we define mothers with low prior-to-birth[30] earnings as those who had daily earnings of up to the 25th percentile (42.3 euro per day) and those with high prior-to birth earnings as those who had daily earnings above the 75th percentile (91.7 euro per day). As a robustness check, we will also estimate the effects for mothers with medium prior-to-birth-earnings, defined as earnings between these two thresholds.

While the IEB data allows us to observe earnings *exactly* one, two or more years before and after birth, the survey data in the Microcensus gives information only to one specific day of the year. Thus, for the Microcensus, we have to assume that the information at the date of the interview in 2008 corresponds to the employment status one year after birth, 2009 to two years after birth, and so forth. Thus, it is possible that the working hours differ between the date of the interview and the date of the corresponding year after birth. However, we do not expect this potential difference to be correlated with the treatment status.

Descriptive statistics on the dependent variables daily earnings and working hours based on

[29] Since the Microcensus is substantially smaller than the IEB, we estimate the reform effects for both groups of mothers in one single regression. In order to differentiate the causal effect for high- and low-educated, we add an interaction term of the treatment variable and the level of education to equation (3.1).

[30] In accordance with Frodermann et al. (2013), we define *prior-to-birth* as ten months before the expected date of birth.

IEB and Microcensus data can be found in Tables C.1 to C.4 in the Appendix. Table C.1 gives the descriptive statistics of daily earnings for high- and low-income mothers in treatment and control group(s) for all years starting from two years before giving birth up to nine years after giving birth based on IEB data. With two exceptions, we observe no differences in daily earnings between the treatment and the control groups for mothers with high and low prior-to-birth earnings. The first exception occurs in the first year after birth for high-income mothers: The earnings in the treatment group is around 10 euro higher than in the control groups, while the number of observation in this group is substantially smaller. This relationship indicates that mothers with high prior-to-birth earnings who worked during the first year after birth even though they were eligible for the new benefit, represent a highly labor market attached group of mothers. The second exception affects low-income mothers in the second year after birth, in which the earnings in treatment group and number of observation is higher than in the control groups. This finding, in contrast, might reflect a negative selection of working mothers pre-reform. That is, mothers who worked, even though they were eligible for the old benefit, could not afford not to work during the second year after childbirth. This descriptive results emphasize the differences in the financial incentive pre- and post-reform for high- and low-income mothers, since the *Never-Taker* lead to opposed selection effects for both income groups.
Table C.2 summarizes descriptive statistics for all relevant control variables for the same groups nine years after giving birth based on IEB data. Similarly, Tables C.3 and C.4 summarize working hours (conditional on working) and control variables, respectively, for all mothers in treatment and control groups based on the Microcensus. None of these tables indicates any difference in the control variables or the number of working hours between the treatment and control groups.

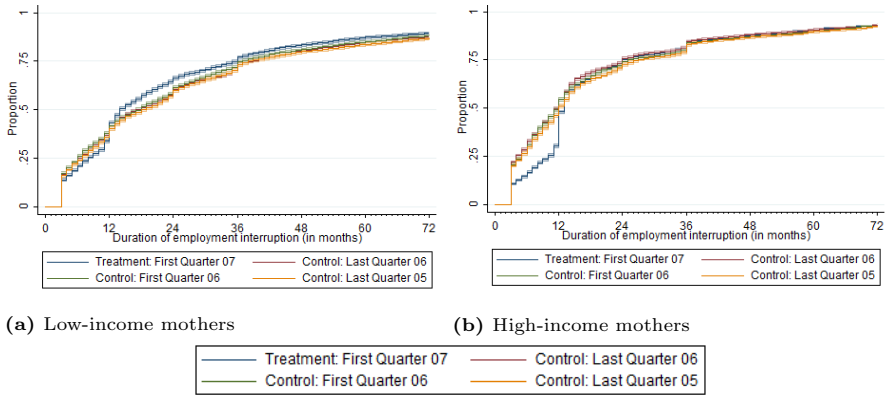
3.5 Results

In this section, we first describe the effects of the parental leave reform on the duration of mothers' employment interruptions. Following this, we present the effects on daily earnings and on average weekly working hours. Next, we show the potential changes in the socio-demographic characteristics of working mothers and changes in their probability to return to their pre-birth employer caused by the parental leave reform. Finally, we discuss the effects of changes in fertility patterns and in fathers' take-up of parental leave before presenting the results of analyses of the reform effects on earnings for several socio-economic subgroups.

3.5.1 Effects on employment interruptions

The analysis of the effect of the introduction of the new parental leave benefit on mothers' employment interruptions based on the IEB data confirms the predictions of a standard economic model of labor supply – given the changes in financial incentives – as well as the findings of previous studies. In particular, we find an increase in the duration of the employment interruptions in the first year after giving birth for high-income mothers (Figure 3.3, right panel). A

considerably larger share of high-income mothers in the treatment group chooses employment interruptions up to 12 months as compared to mothers in the control-groups. 12 months after giving childbirth, however, employment rates of high-income mothers do not differ by treatment and control groups. Results from an estimation of equation (3.1) with the duration of the employment break (measured in months) as the dependent variable show that the reform increases the employment interruption for high-income mothers by 2.8 months on average (Table 3.1, column II).



(a) Low-income mothers **(b)** High-income mothers

Source: IEB 1976-2016; own calculations.

Figure 3.3: Effects of the parental leave reform on the duration of employment interruptions

Duration of employment break (months)	Low-income mothers	High-income mothers
First quarter (vs. last quarter)	-1.540**	-0.869*
	(0.511)	(0.412)
Reform (vs. Pre-reform)	-1.467*	-2.081***
	(0.494)	(0.406)
First quarter * Reform	-1.309	2.844***
	(0.680)	(0.560)
Constant	31.436***	23.472***
	(0.368)	(0.297)
R^2	0.002	0.001
N	39,549	41,836

Source: IEB 1976-2016; own calculations. Significance levels: * p< 0.05, ** p<0.01, *** p< 0.001. Robust standard errors in parentheses.

Table 3.1: Effects of the parental leave reform on employment interruptions (in months)

The effects for low-income mothers are shown in the left panel of Figure 3.3 and in column (I) of Table 3.1: For these mothers, the probability to return to employment in the first year after giving childbirth has slightly decreased, while it has increased in the second year. However, the reform had on average no effect on the duration of employment break for mothers with low prior-to-birth earnings.

3.5.2 Effects on daily earnings

Estimation results of the earnings effects based on the difference-in-difference model show that mothers with low prior-to-birth earnings face higher earnings in the second year after giving birth (Table 3.2 and Figure 3.4).[31] Two years after giving birth, earnings of treated mothers in this group are on average 7 percent higher than for mothers in the control group. This effect might be the result of a negative-selected group of mothers pre-reform, i.e. women who were eligible for the benefit but who could not afford not to work (see table C.1 in the Appendix). However, this positive effect on earnings disappears already in the next year. In the long run, we do not find any effects on earnings resulting from the shorter employment breaks induced by the parental leave reform.

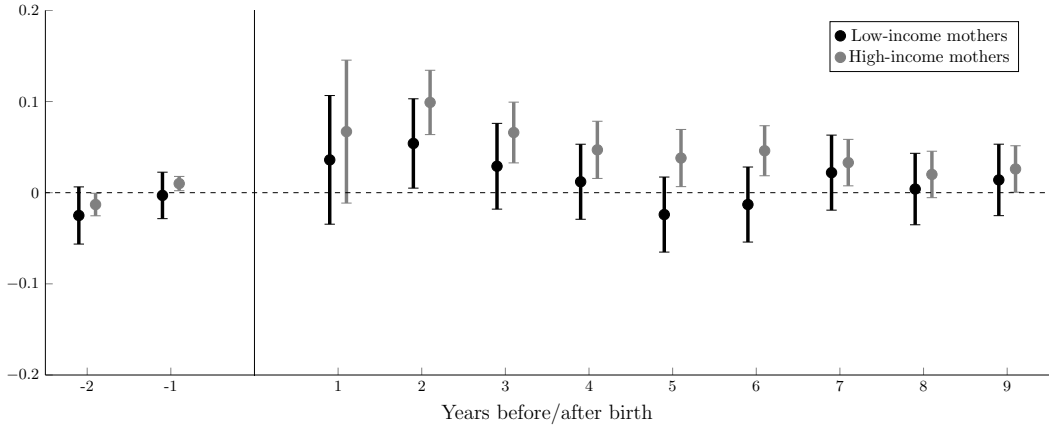
	Low-income mothers			High-income mothers		
Log earnings	Control mean†	Difference T-C	Difference T-C with controls‡	Control mean†	Difference T-C	Difference T-C with controls‡
yt-2	24.04	−0.035	−0.025	110.98	−0.006	−0.013*
		(0.021)	(0.016)		(0.008)	(0.006)
yt-1	23.84	0.006	−0.003	118.16	0.011	0.010*
		(0.016)	(0.013)		(0.006)	(0.004)
yt+1	15.08	0.016	0.036	56.13	0.091	0.067
		(0.042)	(0.036)		(0.051)	(0.041)
yt+2	15.89	0.044	0.054*	60.05	0.085***	0.099***
		(0.031)	(0.025)		(0.025)	(0.018)
yt+3	18.30	0.030	0.029	65.35	0.061**	0.066***
		(0.031)	(0.024)		(0.024)	(0.017)
yt+4	19.90	0.023	0.012	68.03	0.041	0.047**
		(0.027)	(0.021)		(0.022)	(0.016)
yt+5	21.74	−0.016	−0.024	66.56	0.040	0.038*
		(0.027)	(0.021)		(0.021)	(0.016)
yt+6	22.84	−0.006	−0.013	67.25	0.044*	0.046**
		(0.027)	(0.021)		(0.019)	(0.014)
yt+7	23.51	0.039	0.022	67.30	0.041*	0.033*
		(0.026)	(0.021)		(0.018)	(0.013)
yt+8	24.11	0.017	0.004	67.30	0.034*	0.020
		(0.026)	(0.020)		(0.018)	(0.013)
yt+9	27.81	0.025	0.014	74.03	0.040*	0.026*
		(0.026)	(0.020)		(0.018)	(0.013)

Source: IEB 1976-2016; own calculations. All specifications control for seasonal trends (pre-reform dummy), † Control mean refers to the average mean of mothers who gave birth in the last quarter of 2006, as the exponential of the log wage; Controls ‡: Pre-birth wage, age at birth, education, experience (ft & pt), rel. duration of unemployment, size of establishment, working time before birth, change of establishment, east Germany, citizenship, no. of children, region, tenure and change of employer after birth. The number of observations vary between 6,358 (y_{t+1}) and 23,093 (y_{t-1}) for low-income mothers and 8,128 (y_{t+1}) and 34,751 (y_{t-1}) for high-income mothers. Significance levels: * p< 0.05, ** p<0.01, *** p< 0.001. Robust standard errors in parentheses.

Table 3.2: Effects of the parental leave reform on daily earnings for mothers with high and low prior-to-birth earnings

For mothers with high prior-to-birth earnings, on the other hand, we find positive effects on earnings: In the second year after giving birth, the parental leave reform increases earnings for high-income mothers by 10 percent. This substantial effect diminishes in the subsequent years (6 percent in the third, 4 - 5 percent in the fourth and 3 percent in the seventh year) (Table 3.2, and Figure 3.4).

[31] The entire regression for low- and high-income mothers nine years after giving birth is shown in table C.7 in the Appendix.



Source: IEB 1976-2016; own calculations. The graph plots the causal effect of the reform with the corresponding 95% confidence intervals.

Figure 3.4: Effects of the parental leave reform on daily earnings for mothers with high and low prior-to-birth earnings

These positive effects of the parental leave reform on the earnings of mothers with high prior-to-birth earnings are in contrast to predictions of human capital theory, since for this group we find an extension of the duration of the average employment interruption by almost three months. In the next sub-sections, we will check whether these positive effects can be explained by changes in working hours, socio-demographic characteristics of working mothers (i.e. selection effects on observable characteristics) or job characteristics.

3.5.3 Effects on working hours

One explanation of the positive effects of the parental leave reform on the daily earnings of mothers with high prior-to-birth earnings could be that - as a response to the parental leave reform - they work longer weekly hours after they return to the labor market. In order to analyze whether mothers react to the parental leave reform with respect to their working hours, we estimate equation (3.1) with the weekly working hours as the dependent variable based on the German Microcensus.

Regression results based on this data set show that there is mainly no statistically significant causal effect of the parental leave reform on weekly working hours of mothers in the years after giving birth (Table 3.3). This is true for both, mothers with a high level of formal education, and for those with a low level of formal education.

Based on this result, we conclude that the parental leave reform had no effect on the working hours of mothers after re-entering the labor market. Thus, the positive effect on daily earnings for high-income mothers does not stem from an extension of their working hours but can rather be interpreted as a positive effect on their hourly wage.

	Low-educated mothers			High-educated mothers		
Weekly working hours	Control mean⋆	Difference T-C†	Difference T-C with controls † ‡	Control mean ⋆	Difference T-C	Difference T-C with controls‡
2008	24.78	6.340	5.525	29.40	1.444	1.408
P(β(Treatment) =0)**		0.765	0.837		0.418	0.600
2009	23.32	1.586	0.175	30.20	−0.265	−0.592
P(β(Treatment) =0)**		0.170	0.365		0.132	0.316
2010	23.29	1.924	3.176	29.18	1.481	1.371
P(β(Treatment) =0)**		0.489	0.653		0.335	0.382
2011	26.28	1.630	2.075	29.28	0.430	0.721
P(β(Treatment) =0)**		0.312	0.474		0.512	0.710
2012	23.66	2.805	2.948	28.64	−0.650	−1.269
P(β(Treatment) =0)**		0.844	0.406		0.731	0.255
2013	22.29	−3.967	−2.630	28.16	0.778	0.365
P(β(Treatment) =0)**		0.829	0.884		0.360	0.523
2014	20.22	1.422	2.656	27.94	0.533	0.523
P(β(Treatment) =0)**		0.976	0.881		0.842	0.971
2015	18.88	2.891	4.314	27.45	−2.306	−1.891
P(β(Treatment) =0)**		0.126	0.185		0.101	0.201
2016	24.53	−3.138	−3.630	28.56	0.150	−0.128
P(β(Treatment) =0)**		0.671	0.990		0.895	0.921

Source: RDC of the Federal Statistical Office and Statistical Offices of the Länder, Microcensus 2008-2016; own calculations. All specifications control for seasonal trends (pre-reform dummy); Treatment dummy equals 1 if the first child is born in the first half of 2007.;**: F-Test of joint significance: For low-educated P(β (Treatment) $+\beta$ (Treatment* Low-educated)) and for high-educated P(β (Treatment)) ⋆: The control mean equals the average working hours of women who gave birth to their first child in the last half of 2006. † The size of the coefficient equals the sum of the treatment effect and the interaction of the treatment and the lowest educational group. Controls ‡: Age (single and quadratic), number of children, region (East vs. West and Urban vs. Rural), nationality, marital status; The number of observations vary between 905 (2008) and 1,920 (2016). Significance levels: * p< 0.05, ** p<0.01, *** p< 0.001. Robust standard errors in parentheses.

Table 3.3: Effect of the parental leave reform on working hours

3.5.4 Changes in socio-demographic characteristics

Since we do not observe any statistically significant changes in weekly working hours of mothers that could explain the positive effects on daily earnings, we analyze whether the selection of working mothers in terms of observable socio-demographic characteristics has changed due to the parental leave reform. To this end, we run several estimations of equation (3.1) with socio-demographic characteristics such as education level, age and marital status as dependent variable. As summarized in Table 3.4, there is no statistically significant change in the composition of working mothers with respect to these characteristics resulting from the parental leave reform in any of the years 2008 to 2016, with only one minor exception. In the year 2013, we find that working mothers in the treatment group have a higher probability to be married than in the control groups. We do not find this effect, however, in any other year, and, therefore, argue that this finding is negligible.

3.5.5 Changes in employer stability

Previous research has shown that as a result of parental leave reforms, employer stability has increased. For example, studies by Baker and Milligan (2008) and Baum and Ruhm (2016) have shown that in cases where employment-protected period of leave (paid or unpaid) was introduced, employer stability has increased significantly. Kluve and Schmitz (2018) have shown that even for the German 2007 reform, where the job-protection period of 3 years has been

	Year								
Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016
High education									
Control mean	0.63	0.64	0.67	0.70	0.67	0.67	0.69	0.74	0.75
Difference T-C	0.00	−0.04	−0.07	−0.02	0.05	0.07	0.05	0.02	−0.02
Standard Error	(0.05)	(0.05)	(0.05)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.03)
Age									
Control mean	30.30	31.53	32.39	33.25	34.32	35.12	35.84	37.32	38.67
Difference T-C	−0.17	−0.57	−0.45	0.60	0.90	0.72	0.66	−0.04	0.48
Standard Error	(0.61)	(0.59)	(0.57)	(0.54)	(0.54)	(0.55)	(0.51)	(0.50)	(0.45)
Married									
Control mean	0.72	0.74	0.75	0.75	0.75	0.73	0.74	0.76	0.76
Difference T-C	−0.00	−0.07	−0.08	0.02	0.03	0.07	0.02	0.02	0.03
Standard Error	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.03)
	High-educated								
Age									
Control mean	33.55	34.52	35.27	36.04	37.10	37.96	38.10	39.22	40.46
Difference T-C	−0.44	−0.29	−0.34	0.22	−0.13	0.16	0.45	−0.02	0.54
Standard Error	(0.53)	(0.54)	(0.52)	(0.49)	(0.51)	(0.51)	(0.51)	(0.49)	(0.45)
Married									
Control mean	0.80	0.80	0.84	0.81	0.82	0.80	0.79	0.79	0.79
Difference T-C	−0.05	−0.01	−0.05	0.03	0.01	0.10*	0.02	0.02	0.05
Standard Error	(0.05)	(0.05)	(0.05)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
	Low-educated								
Age									
Control mean	26.05	27.26	27.38	28.02	29.79	30.66	31.73	33.31	34.44
Difference T-C	−0.62	−0.65	0.57	1.20	1.17	0.73	0.81	−0.20	1.15
Standard Error	(0.91)	(0.95)	(0.89)	(0.90)	(0.90)	(0.98)	(0.96)	(1.08)	(0.99)
Married									
Control mean	0.59	0.66	0.58	0.60	0.63	0.60	0.61	0.67	0.67
Difference T-C	0.02	−0.10	−0.04	0.02	0.09	0.01	0.07	0.10	−0.01
Standard Error	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.07)

Source: RDC of the Federal Statistical Office and Statistical Offices of the Länder, Microcensus 2008-2016; ⋆: The control mean equals the average working hours of women who gave birth to their first child in the last half of 2007.; Treatment dummy equals 1 if the first child is born in the first half of 2007. Significance levels: * p< 0.05, ** p<0.01, *** p< 0.001. Robust standard errors in parentheses.

Table 3.4: Effects of the parental leave reform on the socio-demographic characteristics of working mothers

left unchanged and only the duration and level of payments changed, employer stability has increased. In their analysis based on the Microcensus, they find that mothers have a higher probability to return to their pre-birth employer. Our analysis of the IEB data shows very similar results. We find that high-income mothers who return to birth in the second year after giving birth have a 2 percentage points higher probability of returning to their pre-birth employer (Table 3.5).

Probability to change the employer	Control mean	Difference T-C	Control mean	Difference T-C
y_{t+1}	0.041	−0.002	0.022	−0.005
		(0.009)		(0.006)
y_{t+2}	0.190	−0.016	0.096	−0.020**
		(0.012)		(0.007)
y_{t+3}	0.276	0.006	0.137	−0.006
		(0.008)		(0.008)
y_{t+4}	0.288	−0.003	0.151	−0.001
		(0.012)		(0.009)
y_{t+5}	0.299	−0.023	0.147	−0.005
		(0.012)		(0.008)
y_{t+6}	0.276	0.010	0.149	0.002
		(0.012)		(0.008)
y_{t+7}	0.254	0.003	0.131	−0.002
		(0.011)		(0.008)
y_{t+8}	0.244	0.002	0.113	0.003
		(0.011)		(0.007)
y_{t+9}	0.254	0.004	0.119	−0.006
		(0.011)		(0.007)

Source: IEB 1976-2016; own calculations. All specifications control for seasonal trends (pre-reform dummy), † Control mean refers to the average mean of mothers who gave birth in the last quarter of 2006, as the exponential of the log wage; Controls ‡: Pre-birth wage, age at birth, education, experience (ft & pt), rel. duration of unemployment, size of establishment, working time before birth, change of establishment, east Germany, citizenship, no. of children, region, tenure and change of employer after birth. The number of observations vary between 6,358 (y_{t+1}) and 23,093 (y_{t-1}) for low-income mothers and 8,128 (y_{t+1}) and 34,751 (y_{t-1}) for high-income mothers. Significance levels: * p< 0.05, ** p<0.01, *** p< 0.001. Robust standard errors in parentheses.

Table 3.5: Effects of the parental leave reform on the probability to change the firm after the employment interruption

Kluve and Schmitz (2018) argue that this increased employer stability is rewarded by a higher job-quality in terms of length of contract. Similarly, it could be that employers also reward higher job stability with higher wages. We, therefore, analyze the long-run earnings effects of the parental leave reform separately for mothers who return to their pre-birth employer and those who return to the labor market with a new employer. Interestingly, the earnings effects are very similar in both groups, in particular for high-income mothers (Table 3.6). Both, mothers who do or do not return to their previous employer, have on average 10 percent higher daily earnings in the second year after giving birth as a result of the parental leave reform. The results for the subsequent years are also very similar, although positive earnings effects fade out already after six years for mothers with a new employer and are still significant after nine years after giving birth for mothers returning to their pre-birth employer. From these results we conclude that the increase in job stability cannot explain the positive effects on earnings that we find for the first two to seven years after giving birth. We, therefore, conclude that the increased employer stability is not the reason for the positive earnings effects in the medium run.

	Low-income mothers			High-income mothers		
	Control mean†	Difference T-C	Difference T-C with controls‡	Control mean†	Difference T-C	Difference T-C with controls‡
Same employer						
Duration of employment break (month)	13.53	0.858*		13.61	2.418***	
		(0.426)			(0.349)	
Log earnings						
y_{t-2}	23.81	−0.010	−0.013	109.28	−0.005	−0.012
		(0.028)	(0.023)		(0.009)	(0.007)
y_{t-1}	23.32	0.003	−0.007	116.27	0.013	0.003
		(0.022)	(0.017)		(0.007)	(0.005)
y_{t+1}	14.84	0.022	0.018	61.89	0.099*	0.048
		(0.043)	(0.038)		(0.047)	(0.044)
y_{t+2}	17.53	0.067*	0.049	66.93	0.119***	0.100***
		(0.033)	(0.030)		(0.022)	(0.019)
y_{t+3}	21.51	0.056*	0.043	73.42	0.083***	0.060***
		(0.032)	(0.029)		(0.020)	(0.017)
y_{t+4}	23.36	0.050	0.024	76.02	0.045*	0.034*
		(0.029)	(0.027)		(0.019)	(0.016)
y_{t+5}	24.91	0.043	0.018	75.07	0.053**	0.044**
		(0.030)	(0.028)		(0.019)	(0.016)
y_{t+6}	25.55	0.040	0.019	74.54	0.054**	0.043**
		(0.030)	(0.028)		(0.018)	(0.015)
y_{t+7}	26.97	0.093**	0.075**	74.80	0.057***	0.038**
		(0.030)	(0.027)		(0.017)	(0.014)
y_{t+8}	28.19	0.045	0.030	76.35	0.045**	0.020
		(0.030)	(0.028)		(0.017)	(0.014)
y_{t+9}	33.38	0.021	−0.001	83.62	0.048**	0.027*
		(0.030)	(0.027)		(0.016)	(0.014)
New employer						
Duration of employment break (month)	30.68	−1.528*		26.91	0.938	
		(0.723)			(0.959)	
Log earnings						
y_{t-2}	21.82	−0.044	−0.041*	103.33	0.008	−0.009
		(0.025)	(0.020)		(0.015)	(0.013)
y_{t-1}	21.95	0.002	0.002	110.46	0.024*	0.011
		(0.020)	(0.016)		(0.011)	(0.009)
y_{t+1}	13.20	0.062	0.068	29.91	0.330*	0.109
		(0.079)	(0.077)		(0.136)	(0.116)
y_{t+2}	16.02	0.058	0.052	40.07	0.145*	0.092
		(0.047)	(0.044)		(0.061)	(0.050)
y_{t+3}	18.23	0.026	0.008	48.18	0.102	0.097*
		(0.040)	(0.038)		(0.055)	(0.046)
y_{t+4}	19.78	0.002	−0.003	50.66	0.112*	0.103**
		(0.035)	(0.033)		(0.047)	(0.040)
y_{t+5}	21.93	−0.073*	−0.070*	49.86	0.049	0.027
		(0.034)	(0.032)		(0.045)	(0.038)
y_{t+6}	23.39	−0.039	−0.043	51.74	0.083*	0.063
		(0.032)	(0.031)		(0.039)	(0.034)
y_{t+7}	24.34	−0.024	−0.027	51.71	0.039	0.032
		(0.032)	(0.030)		(0.036)	(0.031)
y_{t+8}	25.32	−0.027	−0.022	52.23	0.043	0.023
		(0.031)	(0.029)		(0.035)	(0.029)

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Table 3.6 – continued from previous page

	Low-income mothers			High-income mothers		
	Control mean†	Difference T-C	Difference T-C with controls‡	Control mean†	Difference T-C	Difference T-C with controls‡
y_{t+9}	29.41	0.017	0.025	56.71	0.058	0.034
		(0.030)	(0.029)		(0.034)	(0.029)

Source: IEB 1976-2016; own calculations. All specifications control for seasonal trends (pre-reform dummy), † Control mean refers to the average mean of mothers who gave birth in the last quarter of 2006, as the exponential of the log wage; Controls ‡: Pre-birth wage, age at birth, education, experience (ft & pt), rel. duration of unemployment, size of establishment, working time before birth, change of establishment, east Germany, citizenship, no. of children, region, tenure and change of employer after birth. The number of observations vary for women who stay with the same employer between 5,423 (y_{t+1}) and 12,346 (y_{t-1}) for low-income mothers and 7,782 (y_{t+1}) and 27,471 (y_{t-1}) for high-income mothers, and those who change the employer between 2,274 (y_{t+1}) and 15,782 (y_{t-1}) for low-income mothers and 1,343 (y_{t+1}) and 11,064 (y_{t-1}) for high-income mothers. Significance levels: * p< 0.05, ** p<0.01, *** p< 0.001. Robust standard errors in parentheses.

Table 3.6: Effects of the parental leave reform on earnings for women who stayed with the pre-birth employer and for women who changed employer

3.5.6 Fertility effects and Fathers' involvement

Positive earnings effects resulting from the parental leave reform could be the consequence of differences in the family setting caused by the reform. For example, the new parental leave scheme could have affected subsequent fertility patterns and, thereby, indirectly mothers' earnings in the medium run. Kluve and Schmitz (2018) find negative reform effects on subsequent birth for different groups of mothers but not for high-income mothers. Further, Cygan-Rehm (2016) investigated whether the reform had an effect on timing of higher-order births. She finds that high-income mothers have a higher probability of a next child within 24 months after a previous childbirth. This effect, however, fades out after the second year. Thus, there is no evidence that the positive effects on earnings result from changes in fertility patterns, i.e. that women are less likely to have higher-order birth.[32]

Another potential mechanism that could affect mothers' earnings is the role of fathers. As described in sections 3.1 and 3.2, the 2007 parental leave reform not only changed the amount and the duration of the parental leave benefit but also introduced a "daddy quota", i.e. a period of two (out of 14) months of paid parental leave earmarked for each parent. This policy has strongly changed the take-up of parental leave by fathers. Whereas less than three percent of fathers with children born before 2007 have taken parental leave, this number has increased to 15 percent immediately after the reform and has been increasing ever since (Samtleben et al., 2019). Empirical studies have shown that the share of fathers taking parental leave (while the mother has returned to the labor market) has particularly increased for fathers in couples where both spouses have a university degree (Geisler and Kreyenfeld, 2019) and in couples where the woman belongs to the highest earnings quartile (Trappe, 2013) rather than taking leave simultaneously. Moreover, there is descriptive evidence showing that in many couples, the mothers are working while the fathers are on leave (Wrohlich et al., 2012). Unfortunately,

[32]Moreover, Raute (2019) compares fertility rates pre- and post-reform and finds that the reform increased the probability to give birth to a child.

there is no micro-data set at the moment available for Germany that could be used to analyze the effect of fathers' use of parental leave on mothers' earnings.[33] However, the evidence of the studies analyzing the changes of fathers' leave taking shows that (i) fathers with high-income partners where those who reacted most strongly to the parental leave reform and that (ii) mothers use the leave of fathers to re-enter the labor market. We can speculate that the stronger child care involvement of fathers facilitates mothers' re-entry to the labor market and potentially increases their productivity. This, in turn, could be reflected in higher earnings.

3.5.7 Heterogeneity Analysis

In this section, we present the results from separate regressions for mothers living in East and West Germany and for mothers with medium income. As shown in Table 3.7, there is no difference in the effects of the parental leave reform on the duration of mothers' employment interruptions between East and West Germany. We do not find any effect on the employment interruption of mothers in the lowest quartile of pre-birth earnings in either part of the country, however statistically significant increases in the duration of the employment interruption of mothers with high pre-birth earnings.

	West Germany		**East Germany**	
Duration of employment break (months)	Low-income mothers	High-income mothers	Low-income mothers	High-income mothers
First quarter (vs. last quarter)	−1.612*	−1.013*	−1.680*	−0.320
	(0.645)	(0.447)	(0.782)	(0.908)
Reform (vs. Pre-reform)	−1.733**	−2.138***	−1.347	−1.846*
	(0.619)	(0.441)	(0.768)	(0.848)
First quarter * Reform	−1.033	2.914***	−1.430	2.717*
	(0.849)	(0.607)	(1.048)	(1.233)
Constant	33.540***	24.387***	26.617***	15.898***
	(0.465)	(0.323)	(0.563)	(0.630)
R^2	0.002	0.001	0.003	0.003
N	28,020	37,327	11,529	4,509

Source: IEB 1976-2016; own calculations. Significance levels: * p< 0.05, ** p<0.01, *** p< 0.001. Robust standard errors in parentheses.

Table 3.7: Effects of the parental leave reform of the duration of employment break in West and East Germany

The positive effects on earnings that we find for the full sample, however, are only driven by high-income mothers living in West Germany (Table 3.8 and Figures C.1 and C.2 in the Appendix). For this sample, we find very similar effects as for the whole sample, i.e. strong positive effects in the second year after giving birth that are diminishing but still significant up until nine years after giving birth (except for eight years after giving birth). In contrast, for high-income mothers living in East Germany, we only find positive earnings effects in the second year after giving birth.

[33] Although the Socio-Economic Panel (SOEP) provides the relevant information, the number of observations in this data set is too small to estimate precise effects.

	Low-income mothers			High-income mothers		
Log earnings	Control mean†	Difference T-C	Difference T-C with controls‡	Control mean†	Difference T-C	Difference T-C with controls‡
West Germany						
y_{t-2}	24.04	−0.035	−0.042*	110.98	−0.006	−0.015*
		(0.021)	(0.019)		(0.008)	(0.006)
y_{t-1}	23.84	0.006	0.004	118.16	0.011	0.007
		(0.016)	(0.015)		(0.006)	(0.004)
y_{t+1}	15.08	0.016	0.027	56.13	0.091	0.032
		(0.042)	(0.040)		(0.051)	(0.046)
y_{t+2}	15.89	0.044	0.045	60.05	0.085***	0.089***
		(0.031)	(0.030)		(0.025)	(0.021)
y_{t+3}	18.30	0.030	0.034	65.34	0.061**	0.067**
		(0.031)	(0.030)		(0.024)	(0.020)
y_{t+4}	19.90	0.023	0.017	68.03	0.041	0.045*
		(0.027)	(0.026)		(0.022)	(0.018)
y_{t+5}	21.74	−0.016	−0.017	66.56	0.040	0.041*
		(0.027)	(0.026)		(0.021)	(0.018)
y_{t+6}	22.84	−0.006	−0.008	67.25	0.044*	0.050**
		(0.027)	(0.025)		(0.019)	(0.016)
y_{t+7}	23.51	0.039	0.029	67.30	0.041*	0.038*
		(0.026)	(0.025)		(0.018)	(0.015)
y_{t+8}	24.11	0.017	0.020	68.24	0.034	0.028
		(0.026)	(0.025)		(0.018)	(0.015)
y_{t+9}	27.81	0.025	0.027	74.03	0.040*	0.029*
		(0.026)	(0.025)		(0.018)	(0.015)
East Germany						
y_{t-2}	18.05	−0.013	−0.013	89.16	0.016	−0.007
		(0.039)	(0.031)		(0.021)	(0.018)
y_{t-1}	17.77	0.011	−0.002	96.94	0.028	0.023*
		(0.032)	(0.025)		(0.016)	(0.011)
y_{t+1}	11.73	0.014	−0.003	63.27	−0.007	−0.030
		(0.089)	(0.083)		(0.103)	(0.099)
y_{t+2}	17.71	0.085	0.089	78.52	0.098**	0.093***
		(0.060)	(0.055)		(0.030)	(0.027)
y_{t+3}	20.87	0.091	0.089	85.40	0.041	0.029
		(0.050)	(0.047)		(0.023)	(0.019)
y_{t+4}	23.66	0.046	0.048	86.86	0.029	0.016
		(0.048)	(0.045)		(0.025)	(0.022)
y_{t+5}	25.77	−0.027	−0.033	86.00	0.032	0.018
		(0.047)	(0.044)		(0.026)	(0.023)
y_{t+6}	26.72	0.046	0.043	85.67	0.046	0.029
		(0.046)	(0.043)		(0.026)	(0.023)
y_{t+7}	28.93	0.039	0.046	86.14	0.039	0.029
		(0.044)	(0.041)		(0.026)	(0.023)
y_{t+8}	31.90	−0.020	−0.019	89.20	0.021	0.008
		(0.042)	(0.040)		(0.025)	(0.022)

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Table 3.8 – continued from previous page

	Low-income mothers			High-income mothers		
Log earnings	Control mean†	Difference T-C	Difference T-C with controls‡	Control mean†	Difference T-C	Difference T-C with controls‡
y_{t+9}	38.78	−0.013	−0.014	97.38	0.033	0.024
		(0.040)	(0.038)		(0.026)	(0.022)

Source: IEB 1976-2016; own calculations. All specifications control for seasonal trends (pre-reform dummy), † Control mean refers to the average mean of mothers who gave birth in the last quarter of 2006, as the exponential of the log wage; ‡ Controls: Pre-birth wage, age at birth, education, experience (ft & pt), rel. duration of unemployment, size of establishment, working time before birth, change of establishment, citizenship, no. of children, region, tenure and change of employer after birth. The number of observations vary for West Germany between 6,447 (y_{t+1}) and 18,565 (y_{t-1}) for low-income mothers and 7,700 (y_{t+1}) and 27,343 (y_{t-2}) for high-income mothers, and East Germany between 1,418 (y_{t+1}) and 5,809 (y_{t-1}) for low-income mothers and 1,268 (y_{t+1}) and 5,895 (y_{t-2}) for high-income mothers. Significance levels: * p< 0.05, ** p<0.01, *** p< 0.001. Robust standard errors in parentheses.

Table 3.8: Effects of the parental leave reform on earnings in West and East Germany

Finally, in Table 3.9 we present the results of estimations of the earnings effects of mothers with medium pre-birth earnings, i.e. with daily earnings above 42.3 euro (25th percentile) and below 91.7 euro (75th percentile).[34] We have left out these mothers in the main specification, since the change in financial incentives induced by the parental leave reform are not so unambiguous as for the high- and low-income mothers. However, since they form the largest group of mothers, it is relevant to analyze in what way the parental leave reform affected their post-birth earnings. As Table 3.9 shows, we find strong positive effects on earnings in the first and second year after giving birth that are smaller but still significant in the two subsequent years and fade out after four years. So, the pattern that we find for this group is similar to the effects for high-income mothers, however, less pronounced. Moreover, the very large positive effect in the first year after giving birth (earnings are higher by 15 percent in this period for mothers in the control group), is probably due to selection effects (see Table C.6 in the Appendix).

3.6 Discussion and Conclusion

The German parental leave reform of 2007, which increased the generosity of the financial benefits for mothers with medium and high pre-birth earnings but cut the maximum duration period, has prolonged employment interruptions of high-income mothers by three months on average. Our estimation results, however, show that these longer employment interruptions did not have a negative effect on mothers' long-term earnings perspectives. Nine years after giving birth, we do not find negative effects on mothers' daily earnings. In contrast, we even find positive effects, which diminish over time: In the short run, mothers with high pre-birth earnings earn ten percent more as a result from the new parental leave scheme. In the medium run, i.e. three to six years after giving birth, they still earn between 4 to 5 percent and in the

[34]The reform effects on the duration of the parental leave for medium-income mothers are shown in Figure C.3 in the Appendix. The selection mechanism are similar to those of high-income mothers, i.e. mothers, who work in the first year after childbirth, although they were eligible for the benefit, represent a highly labor market attached group of women.

	Medium-income mothers		
	Control mean†	Difference T-C	Difference T-C with controls‡
Duration of employment break (month)	25.00	1.038*	
		(0.412)	
Log earnings			
y_{t-2}	60.66	−0.010	−0.014*
		(0.008)	(0.006)
y_{t-1}	64.68	0.000	−0.002
		(0.006)	(0.005)
y_{t+1}	24.27	0.208***	0.148***
		(0.039)	(0.032)
y_{t+2}	24.15	0.121***	0.108***
		(0.021)	(0.016)
y_{t+3}	30.84	0.063**	0.052***
		(0.020)	(0.014)
y_{t+4}	32.32	0.050**	0.036**
		(0.017)	(0.013)
y_{t+5}	32.69	0.023	0.015
		(0.017)	(0.012)
y_{t+6}	33.24	0.033*	0.018
		(0.016)	(0.012)
y_{t+7}	33.66	0.001	0.001
		(0.015)	(0.011)
y_{t+8}	34.63	−0.003	0.003
		(0.014)	(0.011)
y_{t+9}	38.82	−0.001	0.002
		(0.014)	(0.011)

Source: IEB 1976-2016; own calculations. All specifications control for seasonal trends (pre-reform dummy), † Control mean refers to the average mean of mothers who gave birth in the last quarter of 2006, as the exponential of the log wage; Controls ‡: Pre-birth wage, age at birth, education, experience (ft & pt), rel. duration of unemployment, size of establishment, working time before birth, change of establishment, east Germany, citizenship, no. of children, region, tenure and change of employer after birth. The number of observations vary between 15,392 (y_{t+1}) and 56,969 (y_{t-2}). Significance levels: * p< 0.05, ** p<0.01, *** p< 0.001. Robust standard errors in parentheses.

Table 3.9: Effect of the parental leave reform on daily earnings for mothers with medium prior-to-birth earnings

long run, i.e. seven to nine years after childbirth, 3 percent more than the control group. This is also true, albeit to a lesser extent, for mothers with medium pre-birth earnings. In our empirical analysis, we investigate several potential mechanisms that could cause the positive effects on mothers' earnings. We are able to show that these positive effects are not driven by (i) changes in working hours, (ii) changes in observable socio-demographic characteristics of working mothers or (iii) changes in employer stability. Actually, employer stability has increased as a result of the parental leave reform. However, positive earnings effects several years after giving birth are found for both groups of mothers, those who return to their pre-birth employer and those who start working with a new employer after the birth-related employment interruption.

One alternative mechanism that could explain the positive effect on mothers' earnings is the stronger child care involvement of fathers that has been caused by the "daddy quota" that was introduced as part of the 2007 parental leave reform. This policy measure has been shown to have increased fathers' parental leave taking, in particular among fathers with highly educated and high earnings spouses. Thus, it could be that the increased child care involvement of fathers facilitates mothers' re-entry into the labor market and increases their productivity, which in turn could increase their earnings. Up to now, however, it is not possible to directly analyze the potential effect of fathers' parental leave taking on mothers' earnings due to lack of adequate data.

From a policy perspective, we interpret our empirical findings as good news: Granting a more generous benefit in the first year in order to provide a financial safeguard for families with young children has lead to longer employment interruptions for certain groups of mothers without harming their long-term career perspectives. Actually, we can speculate that the "daddy quota" element of the parental leave reform might have diminished the potentially negative effect of longer paid leave durations for the group of high-income mothers and even lead to a positive effect on the earnings of this group.

However, from a social policy point of view, it has to be stressed that for mothers with low prior-to-birth earnings, we did not find positive labor market effects. Thus, not only did this group experience cuts in their benefit entitlements, but these mothers did also not benefit in terms of medium- or long-term labor market outcomes. This result is particularly relevant against the background of other recent family policy reforms such as the expansion in subsidized child care that have been shown to also benefit primarily mothers with medium or high socio-economic characteristics (Müller and Wrohlich, 2020). If family policy wants to target low-income families, the parental leave benefit scheme should be reformed, for example by increasing the earnings replacement rate and, thereby, the financial benefit for parents with below-median earnings. This could directly increase the household income of these families in the first year after giving birth and incentivize fathers in this group to stronger engage in parental leave taking. This, in turn, could facilitate the re-entry into the labor market also for mothers with low prior-to-birth earnings and potentially increase their labor market outcomes in the years after the employment interruption.

From a Gender Pay Gap perspective, the parental leave reform increases the lifetime earnings of mothers with high and medium prior-to-birth earnings, and might, therefore, also decrease

the Gender Lifetime Earnings Gap as well as the Gender Pension Gap. Since the reform did not decrease the duration of employment interruption of low-income mothers nor increase their earnings, we expect that the reform had no effect on their lifetime earnings. Hence, these imbalanced reform effects on earnings between mothers with high and medium prior-to-birth earnings on the one hand, and low-income mothers on the other, seem to have increased the earnings gap between these groups.

Chapter 4

Looking for the Missing Rich: Tracing the Top Tail of the Wealth Distribution

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Appendix A

Appendix to Chapter 1

Classification	Tasks
non-routine analytic	researching, analyzing, evaluating and planning, making plans/ constructions, designing, sketching, working out rules/ prescriptions, and using interpreting rules
non-routine interactive	negotiating, lobbying, coordinating, organizing, teaching or training, selling, buying, advising customers, advertising, entertaining or presenting, and employing or managing personnel
routine cognitive	calculating, bookkeeping, correcting texts/ data, and measuring length/ weight/ temperature
routine manual	operating or controlling machines and equipping machines
non-routine manual	repairing or renovating houses/ apartments/ machines/ vehicles, restoring art/ monuments, and serving or accommodating

Source: Spitz-Oener (2006)

Table A.1: Activities within tasks

Code	Classification title
111	Occupations in farming
112	Occupations in animal husbandry
113	Occupations in horsekeeping
114	Occupations in fishing
115	Occupations in animal care
116	Occupations in vini- and viticulture
117	Occupations in forestry, hunting and landscape preservation
121	Occupations in gardening
122	Occupations in floristry
211	Occupations in underground and surface mining and blasting engineering
212	Conditioning and processing of natural stone and minerals, production of building materials
213	Occupations in industrial glass-making and -processing
214	Occupations in industrial ceramic-making and -processing
221	Occupations in plastic- and rubber-making and -processing
222	Occupations in colour coating and varnishing
223	Occupations in wood-working and -processing
231	Technical occupations in paper-making and -processing and packaging
232	Occupations in technical media design
233	Occupations in photography and photographic technology
234	Occupations in printing technology, print finishing, and book binding
241	Occupations in metal-making
242	Occupations in metalworking
243	Occupations in treatment of metal surfaces
244	Occupations in metal constructing and welding
245	Occupations in precision mechanics and tool making
251	Occupations in machine-building and -operating
252	Technical occupations in the automotive, aeronautic, aerospace and ship building industries
261	Occupations in mechatronics, automation and control technology
262	Technical occupations in energy technologies
263	Occupations in electrical engineering
271	Occupations in technical research and development
272	Draftspersons, technical designers, and model makers
273	Technical occupations in production planning and scheduling
281	Occupations in textile making
282	Occupations in the production of clothing and other textile products
283	Occupations in leather- and fur-making and -processing
291	Occupations in beverage production

Continued on next page

Table A.2 – continued from previous page

Code	Classification title
292	Occupations in the production of foodstuffs, confectionery and tobacco products
293	Cooking occupations
311	Occupations in construction scheduling and supervision, and architecture
312	Occupations in surveying and cartography
321	Occupations in building construction
322	Occupations in civil engineering
331	Floor layers
332	Painters and varnishers, plasterers, occupations in the waterproofing of buildings, preservation of structures and wooden building components
333	Occupations in the interior construction and dry walling, insulation, carpentry, glazing, roller shutter and jalousie installation
341	Occupations in building services engineering
342	Occupations in plumping, sanitation, heating, ventilating, and air conditioning
343	Occupations in building services and waste disposal
411	Occupations in mathematics and statistics
412	Occupations in biology
413	Occupations in chemistry
414	Occupations in physics
421	Occupations in geology, geography and meteorology
422	Occupations in environmental protection engineering
423	Occupations in environmental protection management and environmental protection consulting
431	Occupations in computer science
432	Occupations in IT-system-analysis, IT-application-consulting and IT-sales
433	Occupations in IT-network engineering, IT-coordination, IT-administration and IT-organization
434	Occupations in software development and programming
511	Technical occupations in railway, aircraft and ship operation
512	Occupations in the inspection and maintenance of traffic infrastructure
513	Occupations in warehousing and logistics, in postal and other delivery services, and in cargo handling
514	Service occupations in passenger traffic
515	Occupations in traffic surveillance and control
516	Management assistants in transport and logistics
521	Driver of vehicles in road traffic
522	Drivers of vehicles in railway traffic

Continued on next page

Table A.2 – continued from previous page

Code	Classification title
523	Aircraft pilots
524	Ship's officers and masters
525	Drivers and operators of construction and transportation vehicles and equipment
531	Occupations in physical security, personal protection, fire protection and workplace safety
532	Occupations in police and criminal investigation, jurisdiction and the penal institution
533	Occupations in occupational health and safety administration, public health authority, and disinfection
541	Occupations in cleaning services
611	Occupations in purchasing and sales
612	Trading occupations
613	Occupations in real estate and facility management
621	Sales occupations in retail trade (without product specialization)
622	Sales occupations (retail trade) selling clothing, electronic devices, furniture, motor vehicles and other durables
623	Sales occupations (retail) selling foodstuffs
624	Sales occupations (retail) selling drugstore products, pharmaceuticals, medical supplies and healthcare goods
625	Sales occupations (retail) selling books, art, antiques, musical instruments, recordings or sheet music
631	Occupations in tourism and the sports (and fitness) industry
632	Occupations in hotels
633	Gastronomy occupations
634	Occupations in event organization and management
711	Managing directors and executive board members
712	Legislators and senior officials of special interest organizations
713	Occupations in business organization and strategy
714	Office clerks and secretaries
715	Occupations in human resources management and personnel service
721	Occupations in insurance and financial services
722	Occupations in accounting, controlling and auditing
723	Occupations in tax consultancy
731	Occupations in legal services, jurisdiction, and other officers of the court
732	Occupations in public administration
733	Occupations in media, documentation and information services
811	Doctors' receptionists and assistants
812	Laboratory occupations in medicine
813	Occupations in nursing, emergency medical services and obstetrics
814	Occupations in human medicine and dentistry

Continued on next page

Table A.2 – continued from previous page

Code	Classification title
815	Occupations in veterinary medicine and non-medical animal health practitioners
816	Occupations in psychology and non-medical psychotherapy
817	Occupations in non-medical therapy and alternative medicine
818	Occupations in pharmacy
821	Occupations in geriatric care
822	Occupations providing nutritional advice or health counselling, and occupations in wellness
823	Occupations in body care
824	Occupations in funeral services
825	Technical occupations in medicine, orthopaedic and rehabilitation
831	Occupations in education and social work, and pedagogic specialists in social care work
832	Occupations in housekeeping and consumer counselling
833	Occupations in theology and church community work
841	Teachers in schools of general education
842	Teachers for occupation-specific subjects at vocational schools and in-company instructors in vocational training
843	Teachers and researcher at universities and colleges
844	Teachers at educational institutions other than schools (except driving, flying and sports instructors)
845	Driving, flying and sports instructors at educational institutions other than schools
911	Occupations in philology
912	Occupations in the humanities
913	Occupations in the social sciences
914	Occupations in economics
921	Occupations in advertising and marketing
922	Occupations in public relations
923	Occupations in publishing and media management
924	Occupations in editorial work and journalism
931	Occupations in product and industrial design
932	Occupations in interior design, visual marketing, and interior decoration
933	Occupations in artisan craftwork and fine arts
934	Artisans designing ceramics and glassware
935	Artisans working with metal
936	Occupations in musical instrument making
941	Musicians, singers and conductors
942	Actors, dancers, athletes and related occupations
943	Presenters and entertainers

Continued on next page

Table A.2 – continued from previous page

Code	Classification title
944	Occupations in theatre, film and television productions
945	Occupations in event technology, cinematography, and sound engineering
946	Occupations in stage, costume and prop design
947	Technical and management occupations in museums and exhibitions
011*	Commissioned officers
012*	Senior non-commissioned officers and higher
013*	Junior non-commissioned officers
014*	Armed forces personnel in other ranks

Source: Bundesagentur für Arbeit (2011) and Matthes et al. (2015);
Note: Occupations with * are not included in the analysis as they do not offer task information
Occupational sectors: S1: Production, S2: Person-related services, S3: Business administration and business-related services, S4: IT and science related services, S5: Other economic services

Table A.2: Occupations according to the German Classification of Occupation 2010

	(I)	(II)
Age	0.022	0.025
	(0.017)	(0.024)
Age^2	−0.000	−0.000
	(0.005)	(0.001)
Tenure	0.020	0.016
	(0.001)	(0.002)
$Tenure^2$	−0.000	−0.000
	(0.000)	(0.000)
Permanent contract	0.103	0.107
	(0.001)	(0.002)
Former GDR	−0.149	−0.165
	(0.001)	(0.001)
Leadership Position	0.275	0.261
	(0.002)	(0.002)
Size of Establishment (ref: 50-499 employees)		
1-9 employees	−0.222	−0.191
	(0.002)	(0.002)
10-49 employees	−0.107	−0.102
	(0.001)	(0.001)
>500 employees	0.075	0.084
	(0.001)	(0.001)
Education (ref: No A-Level. VT)		
No A-Level. No VT	−0.088	−0.096
	(0.002)	(0.002)
A-Level. No VT	0.017	0.117
	(0.003)	(0.004)
A-Level. VT	0.103	0.112
	(0.002)	(0.002)
Polytechnical degree	0.183	0.210
	(0.002)	(0.003)
University degree	0.353	0.337
	(0.001)	(0.001)
N	595,333	437,858
R^2	0.615	0.605

Source: RDC of the Federal Statistical Office and Statistical Offices of the Länder, SES, 2014, own calculations.; *Note*: Not shown: Constant, occupational fixed effects and female-occupational fixed effects.; (I): Entire sample (min. working hours 9 hs/week), (II): Full-time sample (min. working hours 35 hs/week); Standard errors presented in parentheses; All coefficients are statistically significant.

Table A.3: Results: First step

Appendix B

Appendix to Chapter 2

	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
Female	0.026	-0.018	-0.018	-0.127***	-0.126***	-0.019**	0.031	0.027
	(0.015)	(0.025)	(0.025)	(0.029)	(0.029)	(0.025)	(0.030)	(0.030)
Level of promotion (ref: Skilled work)								
Difficult activity		-0.323***	-0.323***	-0.204***	-0.219***	-0.197***	-0.156***	-0.156***
		(0.028)	(0.028)	(0.028)	(0.028)	(0.033)	(0.034)	(0.034)
Very difficult activity &		-0.648***	-0.648***	-0.424***	-0.384***	-0.241***	-0.122	-0.121
Supervisory Power		(0.031)	(0.031)	(0.037)	(0.038)	(0.044)	(0.066)	(0.066)
Female*Level of promotion (ref: Skilled work)								
Difficult activity		-0.148***	-0.148***	-0.049	-0.054	-0.035	-0.042	-0.038
		(0.033)	(0.033)	(0.034)	(0.033)	(0.033)	(0.035)	(0.035)
Very difficult activity &		0.099*	0.099*	0.121*	0.094*	0.006	-0.059	-0.055
Supervisory Power		(0.046)	(0.046)	(0.047)	(0.047)	(0.049)	(0.044)	(0.044)
Constant	0.548***	0.808***	0.808***	0.750***	0.788***	0.772***	1.539	1.983
	(0.012)	(0.023)	(0.023)	(0.054)	(0.055)	(0.056)	(1.137)	(1.126)
N	142,848	142,848	142,848	142,848	142,848	142,848	142,848	142,848
R^2	0.00	0.01	0.01	0.02	0.02	0.04	0.87	0.87
Earnings growth t_{-1}			✓	✓	✓	✓	✓	✓
Individual controls				✓	✓	✓	✓	✓
Firm specific controls					✓	✓	✓	✓
Occupation fixed effects						✓	✓	✓
Firm fixed effects							✓	✓
Year fixed effects								✓

Source: IEB 1976-2017; own calculations. DV: Relative Earnings growth = $(earnings_{after} earnings_{before})/earnings_{before}$; Occupations: 3-digit level (KldB2010); Controls: Experience in part- and full-time (single and quadratic), Education (w/o A-levels and voc. training; Voc. Training w/o A-Levels; A-levels, w/o voc. training; A-levels + voc. training; University of appl. science; University), Month of tenure, Age, East/West Germany, Firm size, Share of women(male, mixed and female occupations). Sample: Persons who were promoted between 2012 and 2017 within the same occupation and the same firm before and after being promoted and who have worked in full-time before and after the promotion. Women without children and all men. Significance levels:* p< 0.05, ** p<0.01, *** p< 0.001. Standard errors are clustered on the individual level.

Table B.1: Effect of promotion on (relative) earnings growth, for the total sample (including part-time worker)

	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
Female	1.291***	0.802***	0.802***	0.741***	0.748***	0.124	-0.062	-0.084
	(0.157)	(0.182)	(0.182)	(0.200)	(0.201)	(0.235)	(0.424)	(0.424)
Level of promotion (ref: Skilled work)								
Difficult activity		2.137***	2.137***	2.163***	2.122***	2.559***	1.962**	1.857**
		(0.150)	(0.150)	(0.157)	(0.160)	(0.201)	(0.611)	(0.611)
Very difficult activity &		2.253***	2.253***	2.649***	2.686***	3.371***	2.623***	2.638***
Supervisory Power		(0.286)	(0.286)	(0.305)	(0.305)	(0.397)	(0.795)	(0.797)
Female*Level of promotion (ref: Skilled work)								
Difficult activity		-1.175***	-1.175***	-1.806***	-1.820***	-1.300***	-0.945	-0.856
		(0.254)	(0.254)	(0.253)	(0.253)	(0.278)	(0.563)	(0.562)
Very difficult activity &		4.753***	4.753***	3.532***	3.484***	2.562***	2.115*	2.168*
Supervisory Power		(0.578)	(0.578)	(0.574)	(0.576)	(0.618)	(1.040)	(1.036)
Constant	6.202***	4.746***	4.746***	14.103***	14.247***	13.347***	0.944	13.204*
	(0.014)	(0.027)	(0.027)	(0.459)	(0.467)	(0.483)	(4.364)	(6.112)
N	84,308	84,308	84,308	84,308	84,308	84,308	84,308	84,308
R^2	0.00	0.01	0.01	0.02	0.02	0.03	0.31	0.32
Earnings growth t_{-1}			✓	✓	✓	✓	✓	✓
Individual controls				✓	✓	✓	✓	✓
Firm specific controls					✓	✓	✓	✓
Occupation fixed effects						✓	✓	✓
Firm fixed effects							✓	✓
Year fixed effects								✓

Source: IEB 1976-2017; own calculations. DV: Absolute Earnings growth = $earnings_{after} - earnings_{before}$; Occupations: 3-digit level (KldB2010); Controls: Experience in part- and full-time (single and quadratic), Education (w/o A-levels and voc. training; Voc. Training w/o A-Levels; A-levels, w/o voc. training; A-levels + voc. training; University of appl. science; University), Month of tenure, Age, East/West Germany, Firm size, Share of women(male, mixed and female occupations). Sample: Persons who were promoted between 2012 and 2017 within the same occupation and the same firm before and after being promoted and who have worked in full-time before and after the promotion. Women without children and all men. Significance levels:* p< 0.05, ** p<0.01, *** p< 0.001. Standard errors are clustered on the individual level.

Table B.2: Effect of promotion on absolute earnings growth, for the full-time sample

	Total		**Women**		**Men**	
	Mean	SD	Mean	SD	Mean	SD
			Main Variables			
Earnings pre-promotion	62.70	53.33	46.69	42.09	77.26	58.10
Earnings post-promotion	73.38	52.14	57.86	42.03	87.50	56.28
Relative earnings growth	1.04	10.86	0.97	6.67	1.11	13.58
Absolute earnings growth	10.86	25.31	11.17	20.83	10.24	28.78
Level of promotion						
Skilled work	0.61	0.49	0.67	0.47	0.56	0.50
Difficult activity	0.27	0.44	0.26	0.44	0.28	0.45
Very difficult activity & Supervisory Power	0.12	0.32	0.07	0.26	0.16	0.37
			Individual Characteristics			
Age	36.53	10.39	37.58	10.44	35.57	10.26
Work experience (ft)	89.45	94.29	61.60	70.83	114.77	105.21
Work experience (pt)	28.52	47.47	44.48	59.53	14.02	25.26
Tenure (months)	57.78	75.64	50.33	64.70	64.54	83.80
Share of unemployment experience	0.05	0.09	0.05	0.10	0.05	0.09
Education						
No A-level, No VT	0.09	0.28	0.07	0.26	0.10	0.30
No A-Level, VT	0.23	0.42	0.21	0.40	0.26	0.44
A-Level, No VT	0.05	0.23	0.05	0.22	0.06	0.23
A-Level, VT	0.47	0.50	0.53	0.50	0.43	0.49
Polytechnical degree	0.02	0.13	0.02	0.14	0.02	0.12
University	0.13	0.34	0.13	0.33	0.14	0.35
			Firm Characteristics			
East vs. West Germany	0.20	0.40	0.20	0.40	0.19	0.39
Size of the Establishment	1775.26	6153.77	991.83	4382.69	2488.67	7334.47
Observations	262,512		125,020		137,492	

Source: IEB, 1976-2017, own calculations.

Table B.3: Summary Statistics, including part-time worker

Earnings growth	β	se	β	se
Female	0.003	(0.005)	0.006	(0.006)
Level of promotion				
Difficult activity	−0.002	(0.005)	−0.001	(0.006)
Very difficult activity & Supervisory Power	0.000	(0.006)	0.002	(0.007)
Female*Level of promotion				
Difficult activity	−0.010	(0.006)	−0.008	(0.007)
Very difficult activity & Supervisory Power	0.009	(0.008)	0.000	(0.009)
Previous earnings growth	0.000	(0.000)	0.000	(0.000)
Full-time experience	−0.001***	(0.000)	−0.001***	(0.000)
Full-time experience squared	0.000***	(0.000)	0.000***	(0.000)
Part-time experience	0.000	(0.000)	0.000*	(0.000)
Part-time experience squared	0.000*	(0.000)	0.000*	(0.000)
Unemployment work experience	0.009	(0.017)	0.005	(0.019)
Educational level (ref: No A-Levels/ No VT)				
No A-Levels/ VT	0.002*	(0.004)	0.003	(0.004)
A-Levels/No VT	0.011	(0.008)	0.009	(0.008)
A-Levels/ VT	0.003	(0.004)	0.004	(0.004)
University of Applied Science	0.004	(0.007)	−0.002	(0.007)
University Degree	0.002	(0.005)	0.003	(0.005)
Tenure	0.000***	(0.000)	0.000***	(0.000)
Age at promotion	−0.001***	(0.000)	−0.001***	(0.000)
East Germany	0.034**	(0.011)	0.036	(0.011)
Firm size	0.000	(0.000)	0.000	(0.000)
R-squared	0.548		0.553	
N	84,308		76,311	

Source: IEB 1976-2016; *Note*: Not shown: Constant, occupational fixed effects and firm fixed effects.; (I): Full-time workers, (II): Full-time working men and childless women; Significance levels: * p< 0.05, ** p<0.01, *** p< 0.001. Standard errors are clustered at the individual level.

Table B.4: Effect of promotion on (relative) earnings growth, for the full-time sample, full regression

Appendix C

Appendix to Chapter 3

		Birth quarter				
Daily earnings in		1st 2007	4th 2006	1st 2006	4th 2005	N
		High-income mothers				
t-2	Mean Log(y)	4.66	4.68	4.66	4.68	39,513
	SD	(0.38)	(0.36)	(0.38)	(0.36)	
	Mean y	105.95	107.51	106.03	107.70	
	N	10,152	9390	10,159	9812	
t-1	Mean Log(y)	4.73	4.74	4.72	4.74	40,075
	SD	(0.29)	(0.29)	(0.29)	(0.28)	
	Mean y	113.62	114.60	111.73	114.50	
	N	10,494	9676	10,447	10,133	
t+1	Mean Log(y)	4.18	4.01	4.06	4.02	9293
	SD	(1.10)	(1.04)	(1.05)	(1.04)	
	Mean y	65.35	54.97	57.92	55.86	
	N	1438	2646	2629	2580	
t+2	Mean Log(y)	4.17	4.10	4.04	4.08	24,573
	SD	(0.82)	(0.88)	(0.89)	(0.87)	
	Mean y	64.47	60.24	56.64	59.20	
	N	6414	5983	6258	5918	
t+3	Mean Log(y)	4.22	4.20	4.12	4.18	24,256
	SD	(0.77)	(0.79)	(0.84)	(0.80)	
	Mean y	67.78	66.83	61.41	65.11	
	N	6461	5808	6154	5833	
t+4	Mean Log(y)	4.26	4.23	4.19	4.21	25,274
	SD	(0.73)	(0.74)	(0.76)	(0.76)	
	Mean y	70.88	68.82	65.82	67.10	
	N	6618	6043	6329	6284	
t+5	Mean Log(y)	4.23	4.21	4.16	4.19	27,044
	SD	(0.74)	(0.75)	(0.80)	(0.78)	
	Mean y	68.97	67.57	64.17	65.77	
	N	7082	6524	6810	6628	
t+6	Mean Log(y)	4.23	4.22	4.16	4.20	29,301
	SD	(0.71)	(0.75)	(0.76)	(0.73)	
	Mean y	68.58	67.72	64.18	66.69	
	N	7602	7045	7489	7165	
t+7	Mean Log(y)	4.23	4.21	4.16	4.18	31,392
	SD	(0.70)	(0.73)	(0.75)	(0.73)	
	Mean y	68.80	67.67	63.77	65.59	
	N	8065	7568	8061	7698	

Continued on next page

		Birth quarter				
Daily earnings in		1st 2007	4th 2006	1st 2006	4th 2005	N
t+8	Mean Log(y)	4.25	4.23	4.18	4.19	32,336
	SD	(0.69)	(0.70)	(0.72)	(0.73)	
	Mean y	70.29	68.76	65.04	65.84	
	N	8306	7754	8306	7970	
t+9	Mean Log(y)	4.35	4.32	4.20	4.21	32,616
	SD	(0.68)	(0.71)	(0.71)	(0.73)	
	Mean y	77.59	74.91	66.85	67.30	
	N	8252	7684	8508	8172	
		Low-income mothers				
t-2	Mean Log(y)	3.09	3.12	3.14	3.14	26,013
	SD	(0.73)	(0.71)	(0.71)	(0.73)	
	Mean y	22.03	22.73	23.05	23.14	
	N	6717	6828	6213	6255	
t-1	Mean Log(y)	3.10	3.11	3.11	3.13	31,328
	SD	(0.65)	(0.64)	(0.64)	(0.64)	
	Mean y	22.18	22.53	22.41	22.86	
	N	8078	8177	7489	7584	
t+1	Mean Log(y)	2.73	2.66	2.72	2.68	7895
	SD	(0.89)	(0.84)	(0.83)	(0.81)	
	Mean y	15.29	14.34	15.11	14.62	
	N	1741	2203	1944	2007	
t+2	Mean Log(y)	2.91	2.83	2.82	2.80	16,014
	SD	(0.84)	(0.85)	(0.85)	(0.88)	
	Mean y	18.42	16.92	16.83	16.48	
	N	4611	4018	3729	3656	
t+3	Mean Log(y)	3.00	2.99	2.97	3.00	18,642
	SD	(0.85)	(0.87)	(0.86)	(0.87)	
	Mean y	20.17	19.96	19.44	20.07	
	N	5219	4651	4507	4265	
t+4	Mean Log(y)	3.11	3.07	3.07	3.05	21,520
	SD	(0.82)	(0.85)	(0.84)	(0.85)	
	Mean y	22.43	21.55	21.50	21.21	
	N	5817	5559	5067	5077	
t+5	Mean Log(y)	3.16	3.15	3.12	3.09	22,297
	SD	(0.82)	(0.84)	(0.84)	(0.87)	
	Mean y	23.57	23.33	22.60	22.06	
	N	6031	5795	5260	5211	
t+6	Mean Log(y)	3.20	3.19	3.17	3.16	23,074
	SD	(0.83)	(0.83)	(0.85)	(0.87)	
	Mean y	24.56	24.38	23.78	23.64	
	N	6140	5962	5520	5452	
t+7	Mean Log(y)	3.25	3.24	3.19	3.21	23,589
	SD	(0.82)	(0.83)	(0.85)	(0.85)	
	Mean y	25.83	25.52	24.32	24.85	
	N	6225	6105	5623	5636	
t+8	Mean Log(y)	3.29	3.28	3.25	3.25	23,904
	SD	(0.83)	(0.83)	(0.84)	(0.85)	
	Mean y	26.76	26.61	25.86	25.88	

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		Birth quarter				
Daily earnings in		1st 2007	4th 2006	1st 2006	4th 2005	N
	N	6287	6150	5720	5747	
t+9	Mean Log(y)	3.45	3.44	3.31	3.31	24,041
	SD	(0.81)	(0.81)	(0.84)	(0.84)	
	Mean y	31.50	31.13	27.27	27.50	
	N	6268	6149	5811	5813	

Source: IEB 1976-2016; own calculations.

Table C.1: Descriptive Statistics on Daily Earnings of Mothers

		Birth quarter			
Variables		1st 2007	4th 2006	1st 2006	4th 2005
		High-income mothers			
Log(Daily Earnings 10 months prior-to-birth)	Mean	4.78	4.77	4.78	4.78
	SD	(0.21)	(0.20)	(0.20)	(0.20)
Non-German	Mean	0.09	0.08	0.08	0.08
	SD	(0.28)	(0.27)	(0.27)	(0.27)
Full-time work experience (months)	Mean	90.45	89.67	90.07	88.53
	SD	(57.77)	(57.17)	(56.60)	(55.42)
Part-time work experience (months)	Mean	35.60	33.69	35.74	33.57
	SD	(46.70)	(45.11)	(46.57)	(45.27)
Unemployment work experience (Share of total work life)	Mean	0.01	0.01	0.01	0.01
	SD	(0.03)	(0.04)	(0.04)	(0.04)
Age at birth	Mean	31.97	31.89	31.81	31.81
	SD	(3.49)	(3.54)	(3.58)	(3.52)
Change of employer after birth	Mean	0.28	0.28	0.27	0.29
	SD	(0.45)	(0.45)	(0.44)	(0.45)
Employment ten months prior-to-birth					
Full-time	Mean	0.77	0.76	0.76	0.77
	SD	(0.42)	(0.42)	(0.43)	(0.42)
Part-time	Mean	0.23	0.24	0.24	0.23
	SD	(0.42)	(0.42)	(0.43)	(0.42)
Marginal Employment	Mean	0.00	0.00	0.00	0.00
	SD	(0.01)	(0.01)	(0.00)	(0.01)
Location of the establishment (before birth)					
West Germany	Mean	0.89	0.90	0.89	0.89
	SD	(0.32)	(0.31)	(0.31)	(0.31)
East Germany	Mean	0.11	0.10	0.11	0.11
	SD	(0.32)	(0.31)	(0.31)	(0.31)
Educational level					
No A-Levels/ No VT	Mean	0.03	0.02	0.02	0.02
	SD	(0.14)	(0.12)	(0.13)	(0.12)
No A-Levels/ VT	Mean	0.38	0.38	0.42	0.40
	SD	(0.49)	(0.49)	(0.49)	(0.49)
A-Levels/ No VT	Mean	0.01	0.01	0.01	0.01
	SD	(0.12)	(0.12)	(0.11)	(0.11)
A-Levels/ VT	Mean	0.27	0.27	0.26	0.27
	SD	(0.44)	(0.44)	(0.44)	(0.44)

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		Birth quarter			
Variables		1st 2007	4th 2006	1st 2006	4th 2005
University of Applied Science	Mean	0.08	0.08	0.08	0.09
	SD	(0.28)	(0.28)	(0.27)	(0.28)
University Degree	Mean	0.22	0.24	0.22	0.22
	SD	(0.42)	(0.42)	(0.41)	(0.42)
Tenure (months, 10 months prior-to-birth)	Mean	73.95	70.05	73.83	69.89
	SD	(50.28)	(49.68)	(50.99)	(50.27)
Number of children					
1	Mean	0.55	0.57	0.56	0.58
	SD	(0.50)	(0.50)	(0.50)	(0.49)
2	Mean	0.40	0.38	0.39	0.38
	SD	(0.49)	(0.49)	(0.49)	(0.49)
3	Mean	0.05	0.05	0.04	0.04
	SD	(0.21)	(0.21)	(0.20)	(0.20)
4	Mean	0.00	0.00	0.00	0.00
	SD	(0.07)	(0.05)	(0.06)	(0.06)
5	Mean	0.00	0.00	0.00	0.00
	SD	(0.01)	(0.02)	(0.02)	(0.00)
Observations		8,252	7,684	8,508	8,172
		Low-income mothers			
Log(Daily Earnings 10 months prior-to-birth)	Mean	3.30	3.11	3.30	3.08
	SD	(0.60)	(0.60)	(0.64)	(0.60)
Non-German	Mean	0.18	0.18	0.18	0.17
	SD	(0.38)	(0.38)	(0.38)	(0.38)
Full-time work experience (months)	Mean	19.15	19.67	19.82	18.78
	SD	(27.63)	(29.67)	(29.79)	(28.69)
Part-time work experience (months)	Mean	27.31	26.14	28.30	27.21
	SD	(33.89)	(32.69)	(33.67)	(33.47)
Unemployment work experience (Share of total work life)	Mean	0.04	0.04	0.04	0.04
	SD	(0.09)	(0.09)	(0.09)	(0.09)
Age at birth	Mean	26.17	26.14	26.22	25.85
	SD	(5.16)	(5.20)	(5.30)	(5.28)
Change of employer after birth	Mean	0.55	0.56	0.55	0.54
	SD	(0.50)	(0.50)	(0.50)	(0.50)
Employment ten months prior-to-birth					
Full-time	Mean	0.16	0.15	0.17	0.16
	SD	(0.37)	(0.36)	(0.37)	(0.37)
Part-time	Mean	0.56	0.56	0.54	0.53
	SD	(0.50)	(0.50)	(0.50)	(0.50)
Marginal Employment	Mean	0.28	0.29	0.29	0.31
	SD	(0.45)	(0.46)	(0.45)	(0.46)
Location of the establishment (before birth)					
West Germany	Mean	0.68	0.69	0.68	0.67
	SD	(0.47)	(0.46)	(0.47)	(0.47)
East Germany	Mean	0.32	0.31	0.32	0.33
	SD	(0.47)	(0.46)	(0.47)	(0.47)
Educational level					
No A-Levels/ No VT	Mean	0.09	0.10	0.10	0.10
	SD	(0.29)	(0.31)	(0.30)	(0.30)
No A-Levels/ VT	Mean	0.30	0.31	0.29	0.29
	SD	(0.46)	(0.46)	(0.45)	(0.45)
A-Levels/ No VT	Mean	0.02	0.01	0.01	0.01
	SD	(0.13)	(0.12)	(0.12)	(0.13)
A-Levels/ VT	Mean	0.15	0.15	0.15	0.15
	SD	(0.36)	(0.36)	(0.35)	(0.34)
University of Applied Science	Mean	0.01	0.01	0.01	0.01
	SD	(0.10)	(0.11)	(0.10)	(0.11)

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		Birth quarter			
Variables		1st 2007	4th 2006	1st 2006	4th 2005
University Degree	Mean	0.02	0.02	0.02	0.02
	SD	(0.14)	(0.14)	(0.14)	(0.15)
No Information	Mean	0.41	0.39	0.41	0.41
	SD	(0.49)	(0.49)	(0.49)	(0.49)
Tenure (months, 10 months prior-to-birth)	Mean	33.58	31.57	34.16	34.16
	SD	(30.33)	(30.25)	(30.24)	(30.63)
Number of children					
1	Mean	0.66	0.67	0.66	0.66
	SD	(0.47)	(0.47)	(0.47)	(0.48)
2	Mean	0.29	0.29	0.29	0.29
	SD	(0.45)	(0.46)	(0.45)	(0.45)
3	Mean	0.04	0.04	0.05	0.05
	SD	(0.20)	(0.19)	(0.21)	(0.21)
4	Mean	0.00	0.00	0.00	0.00
	SD	(0.05)	(0.05)	(0.06)	(0.07)
5	Mean	0.00	0.00	0.00	0.00
	SD	(0.00)	(0.01)	(0.02)	(0.02)
Observations		6,228	6,149	5,811	5,813

Source: IEB 1976-2016; own calculations.

Table C.2: Descriptive Statistics on Control Variables, Nine years after giving birth

		Birth quarter				
Working hours in		1st 2007	4th 2006	1st 2006	4th 2005	N
High-income mothers						
2008	Mean	29.61	29.40	28.56	29.79	743
	SD	(12.96)	(12.17)	(11.76)	(12.17)	
	N	181	202	185	175	
2009	Mean	30.33	30.20	28.54	28.15	753
	SD	(11.41)	(11.80)	(11.46)	(12.30)	
	N	179	205	192	177	
2010	Mean	28.99	29.18	27.88	29.56	845
	SD	(11.78)	(11.06)	(11.36)	(12.07)	
	N	203	231	206	205	
2011	Mean	28.22	29.28	27.52	29.01	1008
	SD	(11.92)	(11.29)	(11.88)	(11.84)	
	N	269	246	254	239	
2012	Mean	27.72	28.64	28.11	28.38	947
	SD	(11.22)	(12.05)	(12.91)	(12.17)	
	N	249	234	224	240	
2013	Mean	28.44	28.16	27.46	27.96	980
	SD	(11.59)	(11.15)	(12.32)	(11.25)	
	N	261	245	241	233	
2014	Mean	28.30	27.94	28.11	28.29	1246
	SD	(11.53)	(11.21)	(12.00)	(11.06)	
	N	330	302	320	294	
2015	Mean	27.42	27.45	28.85	26.57	1306
	SD	(11.68)	(10.75)	(12.05)	(11.10)	
	N	350	331	304	321	
2016	Mean	28.98	28.56	28.63	28.35	1634
	SD	(12.27)	(11.73)	(11.59)	(11.29)	
	N	396	408	400	430	
Low-income mothers						
2008	Mean	31.11	28.68	28.67	24.78	162
	SD	(11.94)	(12.75)	(12.99)	(12.82)	
	N	38	41	39	44	
2009	Mean	24.43	23.32	24.30	24.78	191
	SD	(12.73)	(12.93)	(12.56)	(11.81)	
	N	47	47	46	51	
2010	Mean	23.88	23.29	22.76	24.10	219
	SD	(13.82)	(13.36)	(12.46)	(13.29)	
	N	57	48	55	59	
2011	Mean	27.35	26.28	24.21	24.77	214
	SD	(13.24)	(13.47)	(14.64)	(12.90)	
	N	51	50	61	52	
2012	Mean	23.40	23.66	21.78	23.54	226
	SD	(12.84)	(12.92)	(12.04)	(14.02)	
	N	57	59	64	46	
2013	Mean	20.65	22.29	21.92	19.59	234
	SD	(12.25)	(13.10)	(12.79)	11.25)	
	N	43	72	60	59	

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		Birth quarter				
Working hours in		1st 2007	4th 2006	1st 2006	4th 2005	N
2014	Mean	21.35	20.22	20.74	21.05	254
	SD	(12.33)	(11.89)	(11.37)	(11.89)	
	N	54	78	62	60	
2015	Mean	23.27	18.88	21.60	20.10	257
	SD	(15.38)	(11.81)	(10.88)	(11.05)	
	N	52	72	63	70	
2016	Mean	21.88	24.53	21.44	20.95	286
	SD	(12.11)	(23.46)	(13.00)	(13.62)	
	N	59	75	66	86	

Source: RDC of the Federal Statistical Office and Statistical Offices of the Länder, Microcensus 2008-2016, own calculations.

Table C.3: Descriptive Statistics on Mothers' Working Hours (conditional on working)

			Birth half-year			
Variables			1st 2007	4th 2006	1st 2006	4th 2005
			High-income mothers			
2008	Age	Mean	33.23	34.25	34.55	34.94
		SD	(3.44)	(4.07)	(4.34)	(4.02)
	Married	Mean	0.76	0.80	0.79	0.78
		SD	(0.43)	(0.40)	(0.41)	(0.41)
	Single Mother	Mean	0.05	0.07	0.08	0.07
		SD	(0.22)	(0.25)	(0.27)	(0.25)
	German	Mean	0.93	0.93	0.94	0.93
		SD	(0.25)	(0.26)	(0.25)	(0.25)
	Foreigner, European	Mean	0.02	0.04	0.03	0.04
		SD	(0.15)	(0.21)	(0.16)	(0.20)
	Foreigner, Non-European	Mean	0.04	0.03	0.04	0.03
		SD	(0.21)	(0.17)	(0.19)	(0.17)
	Partner's age	Mean	36.09	37.00	36.85	37.96
		SD	(4.53)	(5.32)	(5.35)	(6.09)
	Net income	Mean	1355.64	1208.16	1419.46	1439.35
		SD	(1037.32)	(925.26)	(991.49)	(1348.31)
	Net household income	Mean	3936.94	3667.98	3952.53	4046.96
		SD	(2384.09)	(2081.73)	(2017.38)	(2502.27)
	Fulltime	Mean	0.49	0.46	0.42	0.38
		SD	(0.50)	(0.50)	(0.49)	(0.49)
	Observations		181	202	185	175
2009	Age	Mean	33.85	35.11	34.55	35.60
		SD	(3.59)	(4.16)	(4.04)	(4.17)
	Married	Mean	0.75	0.80	0.84	0.81
		SD	(0.43)	(0.40)	(0.37)	(0.39)
	Single Mother	Mean	0.04	0.10	0.06	0.08
		SD	(0.21)	(0.30)	(0.23)	(0.28)
	German	Mean	0.93	0.91	0.92	0.92
		SD	(0.26)	(0.29)	(0.28)	(0.27)
	Foreigner, European	Mean	0.02	0.06	0.04	0.06
		SD	(0.13)	(0.24)	(0.20)	(0.23)
	Foreigner, Non-European	Mean	0.06	0.03	0.04	0.02
		SD	(0.23)	(0.18)	(0.20)	(0.15)
	Partner's age	Mean	36.67	38.24	38.06	38.60
		SD	(4.46)	(5.98)	(5.48)	(4.88)
	Net income	Mean	1636.57	1437.24	1504.10	1584.43

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			Birth half-year			
Variables			1st 2007	4th 2006	1st 2006	4th 2005
		SD	(11,137.79)	(1056.65)	(1110.33)	(1603.86)
	Net household income	Mean	4138.89	3777.27	4183.53	4351.90
		SD	(2072.82)	(2129.47)	(2312.92)	(2683.81)
	Fulltime	Mean	0.40	0.49	0.40	0.39
		SD	(0.49)	(0.50)	(0.49)	(0.49)
	Observations		179	205	192	177
2016	Age	Mean	40.11	40.57	40.80	41.78
		SD	(4.66)	(4.76)	(4.97)	(4.97)
	Married	Mean	0.76	0.79	0.74	0.82
		SD	(0.43)	(0.41)	(0.55)	(0.39)
	Single Mother	Mean	0.18	0.18	0.22	0.13
		SD	(0.39)	(0.18)	(0.41)	(0.34)
	German	Mean	0.94	0.91	0.90	0.92
		SD	(0.24)	(0.28)	(0.30)	(0.28)
	Foreigner, European	Mean	0.03	0.05	0.05	0.06
		SD	(0.16)	(0.22)	(0.22)	(0.23)
	Foreigner, Non-European	Mean	0.04	0.03	0.05	0.03
		SD	(0.18)	(0.18)	(0.22)	(0.16)
	Partner's age	Mean	43.18	43.35	43.98	44.53
		SD	(6.30)	(5.76)	(5.93)	(4.88)
	Net income	Mean	2026.98	2002.37	2138.54	1854.03
		SD	(1559.57)	(1555.72)	(2037.86)	(1195.73)
	Net household income	Mean	4773.78	4922.81	4804.37	5003.35
		SD	(2868.12)	(2982.95)	(3018.83)	(2871.30)
	Full-time	Mean	0.35	0.36	0.34	0.31
		SD	(0.48)	(0.48)	(0.47)	(0.46)
	Observations		396	408	400	430
			Low-income mothers			
2008	Age	Mean	25.34	28.51	27.36	27.45
		SD	(5.38)	(7.31)	(6.03)	(6.03)
	Married	Mean	0.55	0.63	0.56	0.57
		SD	(0.50)	(0.49)	(0.50)	(0.50)
	Single Mother	Mean	0.18	0.29	0.21	0.30
		SD	(0.39)	(0.46)	(0.41)	(0.46)
	German	Mean	0.87	0.80	0.74	0.84
		SD	(0.34)	(0.40)	(0.44)	(0.37)
	Foreigner, European	Mean	0.03	0.00	0.08	0.05
		SD	(0.16)	(0.00)	(0.27)	(0.21)
	Foreigner, Non-European	Mean	0.11	0.20	0.18	0.11
		SD	(0.31)	(0.40)	(0.39)	(0.32)
	Partner's age	Mean	30.87	34.34	30.77	32.58
		SD	(6.83)	(8.60)	(6.55)	(6.34)
	Net income	Mean	645.95	677.78	690.54	792.68
		SD	(559.87)	(314.69)	(451.71)	(342.11)
	Net household income	Mean	1795.94	1982.81	1763.89	1964.47
		SD	(1061.30)	(820.17)	(574.66)	(1224.84)
	Full-time	Mean	0.61	0.41	0.54	0.50
		SD	(0.50)	(0.50)	(0.50)	(0.51)

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			Birth half-year			
Variables			1st 2007	4th 2006	1st 2006	4th 2005
	Observations		38	41	39	44
2009	Age	Mean	26.70	28.25	29.93	28.67
		SD	(5.63)	(6.40)	(5.99)	(5.86)
	Married	Mean	0.53	0.72	0.53	0.61
		SD	(0.50)	(0.45)	(0.50)	(0.49)
	Single Mother	Mean	0.26	0.26	0.17	0.35
		SD	(0.44)	(0.44)	(0.38)	(0.48)
	German	Mean	0.81	0.81	0.74	0.75
		SD	(0.40)	(0.40)	(0.44)	(0.44)
	Foreigner, European	Mean	0.06	0.02	0.11	0.04
		SD	(0.25)	(0.15)	(0.31)	(0.20)
	Foreigner, Non-European	Mean	0.13	0.17	0.15	0.22
		SD	(0.34)	(0.38)	(0.36)	(0.42)
	Partner's age	Mean	31.49	34.49	34.00	33.06
		SD	(8.51)	(7.06)	(7.32)	(4.80)
	Net income	Mean	645.56	663.33	679.38	864.67
		SD	(416.60)	(379.73)	(361.35)	(506.94)
	Net household income	Mean	1980.00	1982.14	1861.11	1894.05
		SD	(2074.04)	(873.93)	(704.99)	(975.07)
	Full-time	Mean	0.34	0.30	0.37	0.33
		SD	(0.48)	(0.46)	(0.49)	(0.48)
	Observations		47	47	46	51
2016	Age	Mean	35.59	34.43	36.33	36.16
		SD	(6.53)	(5.99)	(6.70)	(6.19)
	Married	Mean	0.61	0.71	0.71	0.65
		SD	(0.49)	(0.46)	(0.46)	(0.48)
	Single Mother	Mean	0.31	0.28	0.27	0.31
		SD	(0.46)	(0.45)	(0.45)	(0.46)
	German	Mean	0.73	0.69	0.73	0.73
		SD	(0.45)	(0.46)	(0.45)	(0.45)
	Foreigner, European	Mean	0.10	0.19	0.09	0.15
		SD	(0.30)	(0.39)	(0.29)	(0.36)
	Foreigner, Non-European	Mean	0.17	0.12	0.18	0.12
		SD	(0.38)	(0.33)	(0.39)	(0.32)
	Partner's age	Mean	40.00	39.84	41.02	39.84
		SD	(11.39)	(7.56)	(6.11)	(7.56)
	Net income	Mean	962.07	1032.00	1014.23	877.65
		SD	(546.04)	(532.61)	(604.35)	(546.04)
	Net household income	Mean	2353.51	2606.08	2665.39	2536.47
		SD	(991.12)	(1429.32)	(1118.24)	(1045.47)
	Full-time	Mean	0.22	0.28	0.27	0.26
		SD	(0.42)	(0.45)	(0.49)	(0.44)
	Observations		59	75	66	86

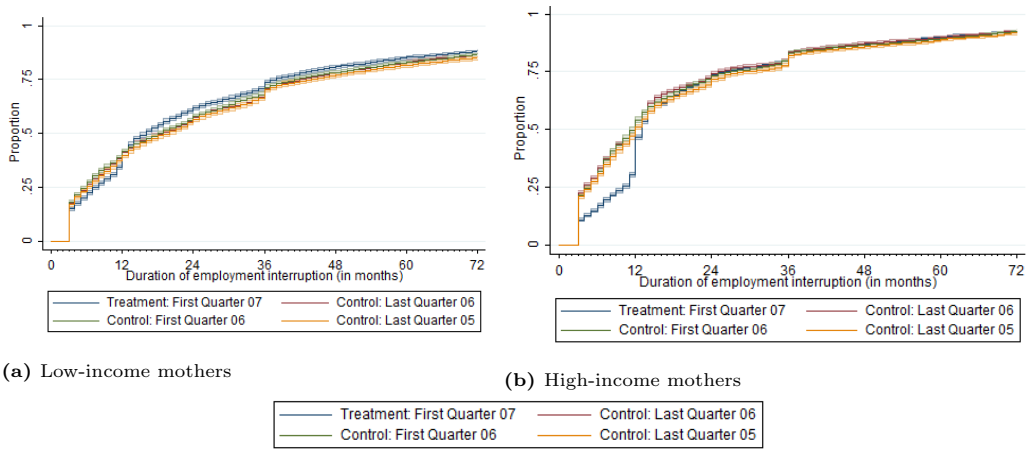
Source: RDC of the Federal Statistical Office and Statistical Offices of the Länder, Microcensus 2008-2016, own calculations.

Table C.4: Descriptive Statistics on Control Variables for selective years (Microcensus)

Working hours	2008	2009	2010	2011	2012	2013	2014	2015	2016
	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se
no VT (vs. University)	−2.90	−8.40*	−8.08*	−3.73	−8.58**	−4.71	−8.85***	−10.65***	−4.04
	(3.70)	(3.27)	(3.41)	(3.50)	(3.20)	(2.97)	(2.64)	(2.55)	(2.81)
Birth 1st half (vs. 2nd half)	−1.12	0.60	−1.37	−1.45	−0.21	−0.45	−0.61	1.94*	0.23
	(1.26)	(1.21)	(1.15)	(1.04)	(1.10)	(1.00)	(0.86)	(0.88)	(0.74)
no VT * Birth 1st half (vs. 2nd half)	−0.95	0.16	0.59	0.46	2.47	−1.68	0.24	2.48	−0.43
	(2.95)	(2.65)	(2.56)	(2.75)	(2.63)	(2.33)	(2.16)	(2.01)	(2.27)
Birth 06/07 (vs. 05/06)	−0.73	1.83	−0.37	−0.33	0.07	0.29	−0.49	0.75	0.05
	(1.29)	(1.22)	(1.09)	(1.00)	(1.04)	(0.95)	(0.83)	(0.80)	(0.78)
no VT* Birth 06/07 (vs. 05/06)	2.73	3.89	2.25	−0.44	1.72	−0.41	1.02	2.59	−3.34
	(2.95)	(2.65)	(2.56)	(2.75)	(2.63)	(2.33)	(2.16)	(2.01)	(2.27)
Treatment	1.41	−0.59	1.37	0.72	−1.27	0.37	0.52	−1.89	−0.13
	(1.78)	(1.70)	(1.58)	(1.45)	(1.49)	(1.40)	(1.20)	(1.20)	(1.10)
no VT * Treatment	4.12	0.77	1.81	2.07	4.22	−3.00	2.13	6.21*	−3.50
	(4.16)	(3.72)	(3.72)	(3.91)	(3.56)	(3.41)	(3.10)	(3.25)	(3.19)
Age	0.17	−1.95*	−1.03	0.44	0.82	0.41	−0.37	−0.82	−0.95
	(0.82)	(0.79)	(0.83)	(0.74)	(0.74)	(0.63)	(0.59)	(0.68)	(0.65)
Age squared	−0.00	0.03*	0.01	−0.01	−0.01	−0.01	0.00	0.01	0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Number of Children (ref: 1 child)									
2	0.91	−0.27	−1.11	−2.73***	−5.36***	−4.17***	−3.62***	−2.66***	−3.83***
	(1.27)	(0.93)	(0.76)	(0.73)	(0.73)	(0.71)	(0.62)	(0.64)	(0.62)
3	0.12	−1.69	0.03	−2.23	−5.46***	−6.69**	−7.01***	−5.95***	−6.33***
	(8.18)	(4.44)	(3.25)	(1.88)	(2.04)	(1.40)	(1.15)	(1.04)	(0.89)
4							−6.67	−1.53	−9.73***
							(7.42)	(3.15)	(2.04)
East Germany	4.06***	5.32***	5.63***	5.49***	6.69***	8.48***	7.49***	6.11***	6.56***
	(0.94)	(0.89)	(0.88)	(0.76)	(0.78)	(0.76)	(0.65)	(0.70)	(0.64)
Nationality (ref: German)									
Non German, EU-Citizen	−1.68	−6.19**	2.34	−2.40	2.27	0.92	2.87*	−0.65	0.11
	(2.34)	(2.06)	(1.99)	(1.56)	(1.96)	(1.86)	(1.49)	(1.50)	(1.31)
Non German, Non-EU-Citizen	−3.71*	−1.53	−3.83*	−3.43*	−3.23*	−1.70	1.39	−1.74	0.40
	(2.04)	(1.65)	(1.65)	(1.68)	(1.39)	(1.43)	(1.31)	(1.35)	(1.48)
Marital status (ref: single)									
married	−2.44*	−1.38	−1.42	−1.40	−2.24*	−1.56	−2.51***	−2.28**	−0.25
	(1.03)	(1.00)	(0.92)	(0.87)	(0.87)	(0.86)	(0.71)	(0.77)	(0.70)
divorced	−12.62***	1.31	2.36	1.37	−1.87	−1.56	−2.39	1.10	2.73*
	(3.80)	(2.39)	(2.49)	(1.92)	(1.44)	(1.46)	(1.32)	(1.44)	(1.11)
Public sector	0.66	0.81	1.12	0.39	−0.10	−0.22	1.00	1.27*	0.10
	(0.90)	(0.84)	(0.78)	(0.72)	(0.73)	(0.67)	(0.58)	(0.58)	(0.53)
Region (ref: City)									
Urban Region	−0.73	−2.26*	−0.54	−1.82*	−2.47**	0.03	−0.45	−0.15	−0.53
	(0.94)	(0.88)	(0.80)	(0.76)	(0.78)	(0.79)	(0.67)	(0.67)	(0.62)
Rural region	1.05	−0.65	0.47	−0.42	−1.62	−1.36	−1.07	0.37	−0.55
	(1.35)	(1.24)	(1.19)	(1.14)	(0.97)	(0.83)	(0.70)	(0.73)	(0.69)
Constant	28.96*	62.08***	48.33***	25.23	19.66	22.53	38.62***	44.02***	50.99***
	(13.32)	(13.22)	(14.40)	(13.22)	(13.13)	(11.74)	(11.04)	(13.04)	(12.77)
R-squared	0.06	0.11	0.10	0.10	0.17	0.18	0.19	0.16	0.14
N	905	944	1064	1222	1173	1214	1500	1563	1920

Source: RDC of the Federal Statistical Office and Statistical Offices of the Länder, Microcensus 2008-2016; own calculations. Treatment dummy equals 1 if the first child is born in the first half of 2007. VT: Vocational Training. Significance levels: * p< 0.05, ** p<0.01, *** p< 0.001. Robust standard errors in parentheses.

Table C.5: Effects of the parental leave reform on working hours

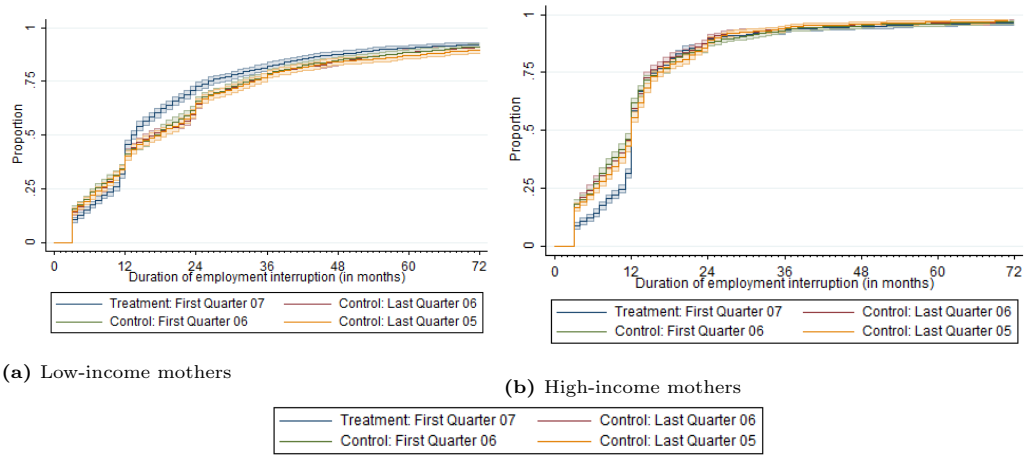


(a) Low-income mothers

(b) High-income mothers

Source: IEB 1976-2016; own calculations.

Figure C.1: Effects of the parental leave reform on the duration of employment interruptions in West Germany



(a) Low-income mothers

(b) High-income mothers

Source: IEB 1976-2016; own calculations.

Figure C.2: Effects of the parental leave reform on the duration of employment interruptions in East Germany

		Birth quarter				
Daily earnings in		1st 2007	4th 2006	1st 2006	4th 2005	N
		Medium-income mothers				
t-2	Mean Log(y)	4.04	4.05	4.05	4.06	76,363
	SD	(0.50)	(0.50)	(0.49)	(0.49)	
	Mean y	56.83	57.40	57.40	57.97	
	N	18,625	19,679	18,500	19,559	
t-1	Mean Log(y)	4.11	4.12	4.12	4.13	79,345
	SD	(0.40)	(0.41)	(0.40)	(0.39)	
	Mean y	60.95	61.56	61.56	62.18	
	N	19,341	20,423	19,253	20,328	

Continued on next page

		Birth quarter				
Daily earnings in		1st 2007	4th 2006	1st 2006	4th 2005	N
t+1	Mean Log(y)	3.94	3.21	3.19	3.20	15,413
	SD	(1.14)	(0.99)	(1.03)	(1.03)	
	Mean y	51.42	24.78	24.29	24.53	
	N	2240	4579	4181	4413	
t+2	Mean Log(y)	3.41	3.26	3.27	3.30	41,458
	SD	(0.89)	(0.92)	(0.94)	(0.95)	
	Mean y	30.27	26.05	26.31	27.11	
	N	10,720	10,674	9838	10,226	
t+3	Mean Log(y)	3.52	3.55	3.43	3.52	45,165
	SD	(0.85)	(0.87)	(0.89)	(0.88)	
	Mean y	33.78	34.81	30.88	33.78	
	N	11,692	11,311	11,144	11,018	
t+4	Mean Log(y)	3.60	3.57	3.55	3.57	50,707
	SD	(0.80)	(0.81)	(0.83)	(0.83)	
	Mean y	36.60	35.52	34.81	35.52	
	N	12,505	13,150	12,076	12,976	
t+5	Mean Log(y)	3.59	3.58	3.55	3.56	52,471
	SD	(0.80)	(0.81)	(0.84)	(0.84)	
	Mean y	36.23	35.87	34.81	35.16	
	N	13,015	13,558	12,596	13,302	
t+6	Mean Log(y)	3.60	3.59	3.56	3.59	55,528
	SD	(0.79)	(0.80)	(0.82)	(0.81)	
	Mean y	36.60	36.23	35.16	36.23	
	N	13,673	14,358	13,475	14,022	
t+7	Mean Log(y)	3.62	3.60	3.57	3.57	59,201
	SD	(0.77)	(0.78)	(0.80)	(0.80)	
	Mean y	37.34	36.60	35.52	35.52	
	N	14,400	15,334	14,248	15,219	
t+8	Mean Log(y)	3.64	3.63	3.60	3.40	60,593
	SD	(0.77)	(0.77)	(0.79)	(0.80)	
	Mean y	38.09	37.71	36.60	29.96	
	N	14,796	15,753	14,510	15,534	
t+9	Mean Log(y)	3.75	3.74	3.64	3.63	61,355
	SD	(0.75)	(0.76)	(0.77)	(0.78)	
	Mean y	42.52	42.10	38.09	37.71	
	N	14,788	15,680	14,878	16,009	

Source: IEB 1976-2016; own calculations.

Table C.6: Descriptive Statistics on Daily Earnings of Mothers, Medium-income mothers

Log(Daily Earnings)	β	se	β	se
FirstQuarter	−0.01	(0.02)	−0.01	(0.01)
Reform	0.13***	(0.01)	0.11***	(0.01)
FirstQuarter × Reform	0.01	(0.02)	0.03*	(0.01)
Previous wage	0.11***	(0.02)	0.93***	(0.02)
Foreign	−0.09***	(0.02)	0.15***	(0.01)
Full-time experience	0.00***	(0.00)	−0.00***	(0.00)
Full-time experience squared	0.00***	(0.00)	0.00***	(0.00)
Part-time experience	0.00	(0.00)	0.00	(0.00)
Part-time experience squared	0.00	(0.00)	−0.00	(0.00)
Unemployment work experience	−0.48***	(0.06)	−0.11	(0.10)
Age at birth	0.00*	(0.00)	0.02***	(0.00)
Change of employer after birth	−0.10***	(0.01)	−0.20***	(0.01)
Employment pre-birth (ref: Full-time)				
Part-time	0.08***	(0.03)	0.18***	(0.01)
Marginal Employment	−0.05	(0.03)	0.04	(0.14)
East Germany	0.37***	(0.01)	0.36***	(0.01)
Educational level (ref: No A-Levels/ No VT)				
No A-Levels/ VT	0.04*	(0.02)	−0.07**	(0.03)
A-Levels/No VT	0.15**	(0.04)	0.00	(0.04)
A-Levels/ VT	0.10***	(0.02)	−0.06*	(0.03)
University of Applied Science	0.19***	(0.05)	−0.03	(0.03)
University Degree	0.44***	(0.04)	0.02	(0.03)
No Information	0.21***	(0.02)	0.15	(0.13)
Tenure	−0.00**	(0.00)	−0.00***	(0.00)
Firm size (ref: < 50)				
50-100	0.31***	(0.03)	0.33***	(0.01)
101-200	0.32***	(0.03)	0.39***	(0.01)
201-500	0.38***	(0.03)	0.43***	(0.01)
>500	0.50***	(0.03)	0.47***	(0.01)
Missing	−0.03	(0.02)	0.05*	(0.03)
Constant	2.63***	(0.08)	−0.85***	(0.09)
R-squared	0.13		0.33	
N	23,931		32,5865	

Source: IEB 1976-2016; Besides firm size all variables refer to the employment spell 10 months prior to birth. Significance levels: * p< 0.05, ** p<0.01, *** p< 0.001. Robust standard errors in parentheses.

Table C.7: Effects of the parental leave reform on daily earnings, nine years after birth

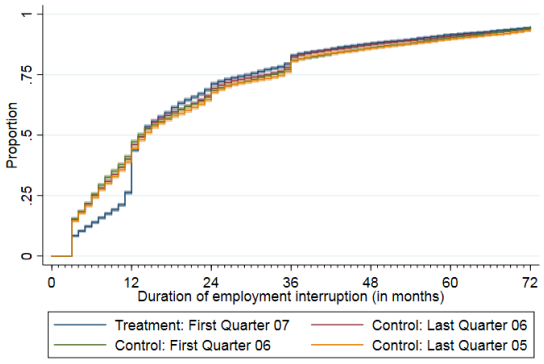


Figure C.3: Effects of the parental leave reform on the duration of employment interruptions for Medium-income mothers

Appendix D

Appendix to Chapter 4

Summary

This dissertation consists of four independent chapters. In the first two chapters, I investigate gender differences in pay between men and women within occupations and occupational positions. In particular, the chapter analyzes whether occupational characteristics and promotions are linked with the Gender Pay Gap. The third chapter deals with the long-run earnings of mothers after the parental leave reform that was implemented in 2007. Since the reform changed the incentives to work during the first two years after giving birth differently for women with low and high prior-to-birth incomes, the chapter analyzes the earnings effect for both groups separately. The last chapter examines whether the integration of national rich lists compared to international list can improve the estimation of top tail of the wealth distribution.

Chapter 1 is concerned with question why some occupations have large Gender Pay Gaps while others have only small gaps. Using data from the Structural Earnings Study merged with occupational task information provided by the Federal Labor Office, this chapter aims at uncovering the relationship between occupational characteristics and the Gender Pay Gap. To do so, I apply a two-step approach, where the first step uses individual characteristics to estimate the adjusted occupation-specific Gender Pay Gaps. In the second step, occupational characteristics are regressed on these gaps. I find that wage differences between men and women are lower in occupations with linear earnings and in occupations with a large share of public firms. Moreover, I observe that an increasing share of persons with supervisory power is linked to larger wage differences between men and women, which indicates the presence of a "glass ceiling". Finally, the Gender Pay Gap is lower in occupations with non-routine tasks. Moreover, the findings suggest that the more that employees can be substituted with other employees, the lower is the Gender Pay Gap. Hence, this study extends previous findings on the relationship between the Gender Pay Gap and occupational characteristics on a more general level.

Chapter 2 focuses on the Gender Pay Gap within occupational positions. Although occupational positions can explain an important part of the differences in pay between men and women, a considerable Gender Pay Gap exists even within the same occupational position. In this chapter, we aim at understanding the reasons for the gap within occupational positions and, therefore, investigate whether promotions lead to the same effect on earnings growth for men and women. Using administrative data, we are the first to investigate potential gender gaps in earnings increase due to a promotion in Germany. Moreover, we are the first to analyze differences in

the gender gap across promotions into different occupational positions. Our results emphasize that women's earnings growth are larger than men's after being promoted to the same position. We find that this effect is mainly due to selection, since we compare a highly positively selected group of women to an average group of men. Once, we add firm fixed effects, however, gender differences disappear, which highlights the role of collective agreements.

In chapter 3 we analyze the impact of the German Parental Leave Reform of 2007 on mothers' long-term earnings. This reform introduced a new earnings-related benefit that is more generous than the previous means-tested benefit but granted for a shorter period of time. Thus, it changed financial incentives to work during the first two year after childbirth depending on prior-to-birth earnings. Additionally, a "daddy quota" of two months was introduced. To identify the causal effect of this policy, we use a difference-in-difference approach that compares labor market outcomes of mothers who gave birth just before and right after the reform and net out seasonal effects by including the year before. Using the total population of the Integrated Employment Biographies (IEB), we confirm previous findings and show that the average duration of employment interruptions increases for high-income mothers. This effect, however, does not translate into lower earnings after re-entering the labor market. We even find a positive effect on earnings for mothers with high prior-to-birth earnings that diminish in the long run. These effects cannot be explained by changes in working hours, observed characteristics of working mothers, or fertility patterns. Descriptive evidence suggests that the stronger involvement of fathers, incentivized by the reform, could have facilitated mothers' re-entry to the labor market and thereby increased earnings. For mothers with low prior-to-birth earnings, however, we do not find any beneficial labor market effects of this parental leave reform.

In chapter 4 we analyze the top tail of the wealth distribution in France, Germany and Spain using the first and second waves of the Household Finance and Consumption Survey (HFCS). Since top wealth is likely to be underrepresented in household surveys, we integrate big fortunes from rich lists, estimate a Pareto distribution, and impute the missing rich. In addition to the *Forbes* list, we rely on national rich lists, since they represent a broader base of the big fortunes in those countries. As a result, the top one percent wealth share increases notably for the three selected countries after imputing the top wealth. We find that national rich lists can improve the estimation of the Pareto coefficient in particular when the list of national USD billionaires is short.

German Summary

Diese Dissertation besteht aus vier unabhängigen Kapiteln. In den ersten beiden Kapiteln untersuche ich die Gender Pay Gaps zwischen Männern und Frauen innerhalb von Berufen und beruflichen Positionen. Insbesondere gehen die Kapitel dabei der Frage nach, ob Berufsmerkmale und berufliche Aufstiege mit dem Gender Pay Gap verbunden sind. Das dritte Kapitel befasst sich damit, wie sich die Löhne von Müttern nach der Einführung des Elterngeldes langfristig verändert haben. Da sich die Anreize zu arbeiten beziehungsweise nicht zu arbeiten in den beiden ersten Jahren nach der Geburt für Frauen, die niedrige und hohe Einkommen vor der Geburt des Kindes hatten, unterschiedlich verändert haben, werden in diesem Kapitel die Lohneffekte für beide Gruppen getrennt untersucht. Das letzte Kapitel untersucht, ob die Verwendung nationaler Reichenlisten im Vergleich zu der internationalen Forbes-Liste die Schätzung des Vermögensanteils der Superreichen am Gesamtvermögen verbessern kann.

Kapitel 1 befasst sich mit der Frage, warum einige Berufe große geschlechtsspezifische Lohnunterschiede, andere hingen nur kleine Lücken aufweisen. Auf Basis der Daten der Verdienststrukturerhebung, die mit einem Datensatz über die berufsspezifischen Tasks, der auf Informationen der Bundesagentur für Arbeit beruht, zusammengespielt werden, soll in diesem Kapitel der Zusammenhang zwischen den Berufsmerkmalen und dem Gender Pay Gap untersucht werden. Dazu wird ein zweistufiger Ansatz verwendet, wobei im ersten Schritt basierend auf den individuellen Charakteristika die bereinigten berufsspezifischen Gender Pay Gaps geschätzt werden. Im zweiten Schritt werden die Berufsmerkmale auf diese geschlechtsspezifischen Lohnlücken regressiert. Die Ergebnisse zeigen, dass die Lohnunterschiede zwischen Männern und Frauen in Berufen mit linearer Entlohnung und in Berufen mit einem hohen Anteil an öffentlichen Unternehmen geringer sind. Außerdem kann beobachtet werden, dass ein zunehmender Anteil von Personen in Führungspositionen mit größeren Lohnunterschieden zwischen Männern und Frauen einhergeht, was auf das Phänomen einer "gläsernen Decke" hinweist. Zudem ist das geschlechtsspezifische Lohngefälle in Berufen mit nicht routinemäßigen Tasks geringer. Außerdem legen die Ergebnisse nahe, dass das geschlechtsspezifische Lohngefälle umso geringer ist, je mehr Arbeitnehmer*Innen durch andere Arbeitnehmer*Innen ersetzt werden können. Die vorliegende Studie erweitert daher den bisherigen Erkenntnisstand, da sie einen allgemeinen Zusammenhang zwischen dem Gender Pay Gap und den Berufsmerkmalen herstellt.

Kapitel 2 konzentriert sich auf den Gender Pay Gap innerhalb beruflicher Positionen. Neben

der Tatsache, dass Männer und Frauen in unterschiedlichen beruflichen Positionen arbeiten, die einen großen Teil des Lohnunterschieds zwischen Männern und Frauen erklären kann, besteht auch innerhalb derselben beruflichen Position ein beträchtlicher Gender Pay Gap. In diesem Kapitel wollen wir die Gründe für die Lohnlücke innerhalb beruflicher Positionen verstehen und in diesem Zusammenhang untersuchen, ob berufliche Aufstiege bei Männern und Frauen zu den gleichen Lohnanstiegen führen. Auf Basis administrativer Daten untersuchen wir die potenziellen Unterschiede zwischen Männern und Frauen im Lohnanstieg nach beruflichen Aufstiegen in Deutschland. Darüber hinaus analysieren wir, ob sich die Lücke im Verdienstanstieg zwischen Männern und Frauen für die unterschiedlichen Ebenen der Aufstiege unterscheiden. Unsere Ergebnisse zeigen, dass die Lohnanstiege von Frauen nach einem beruflichen Aufstieg innerhalb der gleichen Position größer sind als die von Männern. Allerding legen die Ergebnisse nahe, dass dieser Effekt hauptsächlich auf Selektion zurückzuführen ist, da wir eine sehr positiv selektierte Gruppe von Frauen mit einer durchschnittlichen Gruppe von Männern vergleichen. Sobald wir jedoch betriebs-fixe Effekte in das Modell mit aufnehmen, verschwinden die Unterschiede zwischen den Geschlechtern, was die Bedeutung von Tarifverträgen unterstreicht.

In Kapitel 3 analysieren wir die Auswirkungen der 2007 durchgeführten Elterngeldreform. Mit dieser Reform wurde die bisherige bedarfsorientierte Transferleistung (Erziehungsgeld) durch das Elterngeld, dessen Höhe vom Lohn vor Geburt des Kindes abhängt, ersetzt. Somit steigt die Höhe der Leistung an, während sich die Bezugsdauer aber verkürzt. Damit haben sich die finanziellen Anreize in den ersten zwei Jahren nach der Geburt zu arbeiten oder nicht zu arbeiten in Abhängigkeit der Höhe des Einkommens vor der Geburt unterschiedlich verändert. Zusätzlich wurden die (zwei) sogenannten "Vätermonate" eingeführt. Um den kausalen Effekt dieser Reform zu identifizieren, verwenden wir einen Differenzen-in-Differenzen-Ansatz, der die Löhne von Müttern, die unmittelbar vor und unmittelbar nach der Reform entbunden haben, vergleicht und dabei saisonale Effekte durch das Einbeziehen des Vorjahres herausrechnet. Anhand der Grundgesamtheit der Integrierten Erwerbsbiographien (IEB) bestätigen wir die bisherigen Ergebnisse und zeigen, dass die durchschnittliche Dauer der Erwerbsunterbrechungen bei Müttern mit hohem Einkommen zunimmt. Dieser Effekt schlägt sich jedoch nicht in niedrigeren Löhnen nach dem Wiedereinstieg in den Arbeitsmarkt nieder. Bei Müttern, die vor Geburt hohe Löhne hatten, finden wir sogar positive Lohneffekte, die in der langen Frist kleiner werden. Diese Effekte lassen sich nicht durch Änderungen in der Arbeitszeit, in den individuellen Merkmalen der berufstätigen Mütter oder in den Fertilitätsmustern erklären. Mittels deskriptiver Evidenz gehen wir davon aus, dass die durch die Reform bedingt stärkere Einbindung der Väter, den Wiedereinstieg der Mütter in den Arbeitsmarkt erleichtert und damit deren Löhne erhöht haben könnte. Für Mütter, die vor der Geburt geringe Löhne hatten, finden wir jedoch keine positiven Arbeitsmarkteffekte dieser Elternzeitreform.

In Kapitel 4 analysieren wir das obere Ende der Vermögensverteilung in Frankreich, Deutschland und Spanien mit Hilfe der ersten und zweiten Welle des Household Finance and Consumption Survey (HFCS). Da das Vermögen der Superreichen in den Haushaltsbefragungen wahrscheinlich unterrepräsentiert ist, verknüpfen wir die Survey-Daten zusätzlich mit den Vermögen-

sangaben aus Reichenlisten. Darauf aufbauend schätzen wir eine Pareto-Verteilung und imputieren die fehlenden Reichen. Zusätzlich zu der *Forbes*-Liste stützen wir uns auf nationale Reichenlisten, da diese eine größere Basis der Topvermögenden in diesen Ländern darstellen. Folglich steigt der Vermögensanteil des obersten 1 % für die drei ausgewählten Länder nach der Imputation der Topvermögen deutlich an. Unsere Ergebnisse zeigen, dass die nationalen Reichenlisten die Schätzung des Pareto-Koeffizienten insbesondere dann verbessern können, wenn die *Forbes*-Liste nur wenige Milliardäre aus dem jeweiligen Land enthält.

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Declaration

Erklärung gem. §4 Abs. 2 der Promotionsordnung

Hiermit erkläre ich, dass ich mich noch keinem Promotionsverfahren unterzogen oder um Zulassung zu einem solchen beworben habe, und die Dissertation in der gleichen oder einer anderen Fassung bzw. Überarbeitung einer anderen Fakultät, einem Prüfungsausschuss oder einem Fachvertreter an einer anderen Hochschule nicht bereits zur Überprüfung vorgelegen hat.

Berlin, Januar 2020

Aline Zucco

Erklärung gem. §10 Abs. 3 der Promotionsordnung

Hiermit erkläre ich, dass ich für die Dissertation folgende Hilfsmittel und Hilfen verwendet habe: Stata und Microsoft Excel.

Berlin, Januar 2020

Aline Zucco