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Wage Inequality Consequences of Expanding Public Childcare

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This paper assesses the impact of a large expansion of public childcare in Germany on wage inequality. Exploiting regional variation in childcare supply over the 1990s, I show that in regions with stronger increases in childcare, wage inequality among women increased less strongly compared to regions with smaller increases. This is primarily driven by the lower half of the wage distribution and qualitatively similar for full- and part-time workers. Larger expansions in childcare, however, do not contribute to a further closing of the gender wage gap.

Keywords: wage inequality, childcare, gender wage gap

JEL: J13, J16, J31, J82

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1 Introduction

A large body of literature documents the impact of changes in labor market institutions on inequality of wages (Fortin and Lemieux 1997). Common examples for such institutions are labor unions or minimum wage regulations. Most of the existing studies focuses on the male part of the workforce since women face a different set of constraints when making decisions on human capital acquisition and labor supply. Almost all constraints women face additionally to men are—directly or indirectly—related to the costs of having children. The impact that children have on female careers is large, long-lasting and well-documented, ranging from direct earnings losses due to maternity leave breaks or part-time work (Angelov, Johansson, and Lindahl 2016; Adda, Dustmann, and Stevens 2017; Kleven, Landais, and Søgaard 2019) to reductions in fertility (Doepke and Kindermann 2019). Consequently, policies that change women's calculus with respect to work and fertility choices play a role as institutions that shape the labor market as well. In this paper, I therefore evaluate which impact a large expansion of publicly provided childcare in Germany had on wage inequality. I analyze both the dispersion of wages among women but also at the gender wage gap as a measure for wage inequality between women and men.

Over the course of the past decades most developed countries have seen striking increases in female labor force participation (Olivetti and Petrongolo 2016). One enabling factor in increasing female labor supply was the expansion of publicly provided childcare which made reconciling market and household work easier. While a direct effect of childcare on wage inequality (such as observed for union membership or minimum wages) is unlikely, this paper's hypothesis is that the easier availability of childcare, which promoted increases in female labor supply, led to changes in the composition of the female workforce such that in turn inequality in wages was affected as well.

Germany provides a very well suited setting to assess the impact of childcare on wage inequality. Before the expansion of childcare, female labor force participation was relatively low and likely selective. One of the major family policies was parental leave. By granting job protection and benefit payments during leave—both was extended multiple times until 1993—it set incentives for prolonged labor market absence of women after childbirth. When in 1996 Germany introduced the legal right to a slot in public childcare for children of kindergarten age (usually starting at age three until the start of primary school at age five or six), this marked a shift in policy towards promoting labor supply of women, especially mothers, by lowering the opportunity costs of work. This shift happened at a time when the length of parental leave taking had started to decrease, indicating a general shift to more positive attitudes towards working mothers and thus making it more likely that women indeed utilized the additional childcare. Further, the 1990s are a period during which the participation of women in the labor market substantially increased—to a large degree due to work in part time—and wage inequality (among both genders) increased as well. To connect these

observations, I analyze how the development of wages and wage inequality as well as changes in workforce composition differ between regions with differential increases in public childcare supply. I further decompose the changes in wage inequality within female workers and between genders to show the impact of workforce composition. For most analyses, I distinguish between full- and part-time working women to highlight similarities and differences between both groups.

I use administrative data on wages and characteristics of workers along with data on county-level childcare supply to provide the following main findings on the development of wage inequality between 1986 and 2010. First, while wage inequality among women overall increases, stronger regional increases in childcare are associated with smaller increases in wage inequality. In 1986, counties that increase their childcare supply more strongly show the larger levels of wage inequality—until 2010 this relationship has reversed, i.e. counties which experienced the largest increases in childcare supply now tend to exhibit the lowest levels of wage inequality. This is primarily driven by workers from the lower end of the wage distribution. In 1986, an (at this time future) increase in childcare at the county-level by one standard deviation (or 13.36 additional slots per 100 children) is associated with a p50–p15 log wage gap that is larger by 21 percent of a standard deviation. In 2010, however, the same increase in childcare is associated with a p50–p15 wage gap that is smaller by 8.5 percent of a standard deviation. Second, along with inequality the composition of the female workforce changes as well. In regions with larger increases in childcare supply more women select into part-time work, female workers are more often from the middle of the education distribution and work in more stable jobs. Third, connecting wage inequality and workforce composition, I use the DiNardo, Fortin, and Lemieux (1996, henceforth abbreviated as DFL) decomposition to show that stronger regional increases in childcare are associated with larger fractions of the increase in inequality being explained by compositional changes in the workforce. This is primarily driven by the lower end of the wage distribution. Among these compositional changes, those that are related to changes in the participation decision appear to be more relevant than changes in the choices of women who already work. Lastly, I move from a within-gender perspective to comparing women and men. The gender wage gap decreased over the observation period. However, in regions with stronger increases in childcare supply smaller fractions of this decrease can be explained by changes in the workforce composition, i.e. an inverse relationship between inequality and workforce composition compared to within-gender inequality. Together with the findings for within-female inequality, this suggests that an increasing supply of public childcare affected primarily the participation decisions of women with lower earnings potential. Compared with the initial lower end of the female wage distribution, those who provided additional labor were a more positive selection such that inequality among women increased less. At the same time, when comparing with male workers, they were negatively selected such that they only made a small contribution to the reduction of the gender

wage gap. For part-time workers, the findings are broadly similar with the relationship between larger increases in childcare and smaller increases in inequality being stronger.

This paper builds on and contributes to several strands of the literature. There is a number of studies analyzing the development of wage inequality in Germany that focus on male workers. Dustmann, Ludsteck, and Schönberg (2009) focus on the roles of composition, declining unionization and polarization between occupations, whereas Card, Heining, and Kline (2013) highlight sorting between workers and firms. Dauth, Findeisen, Moretti, et al. (2022) extend studying worker-firm sorting to assess spatial wage inequality. Dustmann, Lindner, et al. (2022) and Bossler and Schank (2023) analyze the effects of the German minimum wage. While West Germany often is often the sole focus of studies, Brüll and Gathmann (2020) analyze wage inequality in East Germany. With respect to inequality between women and men Antonczyk, Fitzenberger, and Sommerfeld (2010) assess gender wage inequality in Germany focusing on workforce composition and unionization. They and especially the results of Biewen, Fitzenberger, and Lazzer (2018) put emphasis on personal characteristics such as education or experience in explaining rising inequality. Bruns (2019), building on Card, Cardoso, and Kline (2016), analyzes the growing role of firms for wage setting (among other factors due to the decline in collective bargaining coverage) and the gender inequality contribution of sorting of workers to firms. Drechsel-Grau et al. (2022) combine social security and tax data to calculate inequality series on income of both genders. In comparison to most existing work, this paper focuses on female workers. It is the first to relate wage inequality to a family policy, namely an expansion in public childcare. In addition, it provides the first results on wage inequality among part-time working women who—both during the 1990s and 2000s as well as today—account for a large part of the female workforce. My findings on the gender wage gap highlight the role of selection into work for women (Olivetti and Petrongolo 2008; Mulligan and Rubinstein 2008) and connects that to a policy change.

Moreover, I contribute to the literature evaluating the consequences of expansions in the supply of public care for children of kindergarten age. Existing international evidence paints a positive to mixed picture of the employment effects of childcare (see, among others, Baker, Gruber, and Milligan 2008, Cascio 2009 and Havnes and Mogstad 2011; Olivetti and Petrongolo 2017 and Albanesi, Olivetti, and Petrongolo 2022 give overviews of the literature)[1] where substitution from informal to public childcare appears to weaken the link. Bauernschuster and Schlotter (2015) provide an important finding on which this paper builds as they analyze the expansion of childcare slots in Germany in the 1990s at the micro-level. They conclude that it led to marked increases in maternal

[1] An additional literature analyzes the supply effects of childcare for younger children, i.e. below the age of three. In Germany, care expansions for younger children started much later (children of age one have the legal right to a childcare slot since 2013). For quasi-experimental and microsimulation results from the German context see Geyer, Haan, and Wrohlich (2015), K.-U. Müller and Wrohlich (2020), and Busse and Gathmann (2020) as well as the references they provide on findings from other countries.

labor supply, both on the intensive and the extensive margin. I extend these findings by looking at the entire wage distribution and address the question how additional women joining the workforce as well as changing behavior of those who were already part of it led to compositional changes and, in turn, affected wage inequality.

The remainder of this paper is organized as follows. Section 2 describes the data I use, Section 3 gives an introduction to the German labor market during the 1990s and 2000s and describes the changes in family policy, especially the expansion of childcare supply. Section 4 explains which effects of additional childcare options on wage inequality can be expected under which circumstances. Section 5 shows how wages and wage inequality evolve over time. Section 6 relates these developments to changes in workforce composition and decomposes them, separately for full- and part-time working women and by regions with lower or higher increases in their childcare supply. Section 7 decomposes the decrease in the gender wage gap by regional increases in childcare supply. Section 8 concludes.

2 Data

This paper uses individual-level, administrative data on workers and combines them with information on the availability and utilization of childcare facilities at the regional level. This section describes the datasets.

2.1 Individual-level Labor Market Data

As most work on wage inequality in Germany this paper relies on the *Sample of Integrated Employment Biographies* (SIAB, Frodermann, Schmucker, et al. 2021; Frodermann, Graf, et al. 2021) provided by the *Institute for Employment Research* (IAB) as its main source of data on workers and their characteristics. The SIAB is a two-percent-sample from the German social security records containing information on workers who are subject to social security contributions for the period from 1975 to 2019.

Data Preparation As the data is sourced from notifications by employers to the federal employment agency which do not explicitly consider the data needs for research purposes, some limitations apply. They are discussed in the following.

Censored wages above the social security threshold Earnings are only subject to social security contributions up to an upper limit. If earnings exceed this limit, the associated daily wages are right-censored such that they need to be imputed based on individual-level characteristics.[2] All results reported in the following are based on these imputed daily wages.

[2] Section B in the Appendix provides are description.

Compared to work that focuses on men, censored wages are a much less severe concern for the results in this paper which puts its emphasis on women. Card, Heining, and Kline (2013) report a share of around 2 to 3 percent of censored wages for women, whereas around 10 percent of male wages are censored. In this paper's sample up to 3 percent of female wages are censored on average (see Table 1), in some regions up to 4 percent (see Table 3).

Workers in part-time work Most existing studies on wage inequality restrict their samples to those working full time. As their primary focus are male workers, this restriction applies only to very small fractions of the data. For this paper, I choose to keep all workers, both in full- and in part-time work, in the sample. Dropping women in part-time work would reduce the sample size substantially as during the 1990s and early 2000s between around 25 to 40 percent of women worked part time. As part-time work among women is a choice that is likely related to circumstances such as the presence of children and the availability of childcare, focusing only on those in full-time work would reduce the overall representativeness of the analysis. To allow for different effects for full- and part-time workers, the analysis treats them separately.

Note that the indicator for part-time work in the SIAB data has limitations. In 2011 the notification procedure to record workers in part-time has changed. Fitzenberger and Seidlitz (2020) argue that for the period prior to 2011 the share of actual part-time workers was larger than the one identified in the SIAB. They also propose a correction which, however, can only be used for workers who are part of the sample in 2012 (i.e. in a year where their part-time status is recorded correctly). As the probability to observe a person in 2012 decreases with greater distance in time and this paper focuses on a period starting in the mid 1980s, this correction cannot be applied. In practice, this means that while the full-time sample can include women in part-time work and thus some bias cannot be fully ruled out, the sample of part-time working women only includes those who actually work in part-time. There is no indication that the amount of false part-time reports changed substantially over time prior to 2011. Fitzenberger and Seidlitz (2020) compare observed and corrected wage percentiles between 2000 and 2010 finding differences in levels, though no different trends. As this paper primarily focuses on changes in inequality a bias that some full-time workers in fact work in part-time is unlikely to have a large impact on its results.

Another shortcoming of the SIAB data is that there is no information on working hours beyond the part-time indicator. When measuring how inequality changes over time this poses the threat that changes in inequality among part-time workers are driven by changes in intensive margin labor supply, such that the missing information on hours constitutes an omitted variable bias. Since this concern cannot be addressed directly with the SIAB, I use survey data from the German Socio-Economic Panel (SOEP) to assess working hours of full- and part-time workers. Figure A.1 in the Appendix plots contracted working hours of women in full- and part-time for the sample period

between 1986 and 2010. Working hours of full-time workers vary little, both over time and within each year. Part-time workers show a larger spread in hours which is likely to explain some fraction of cross-sectional wage disparity. Over time, however, the variation in working hours does not show substantial changes. Wanger (2020) also documents only small changes in mean working hours of women in part-time and additionally points out that hours changes for part-time workers are often driven by workers in marginal employment, i.e. a group that this study drops from the sample (see below). It is thus unlikely as well that changes in working hours drive changes in inequality.

Break in the notification procedure for workers in marginal employment As of April 1999, employers are required to submit employment notifications for workers in marginal employment which leads to an influx of additional workers into the sample (Frodermann, Schmucker, et al. 2021). Even though workers in marginal employment can be identified based on their wages before the reporting change, they have to be dropped to ensure a sample that is consistent over time.

Workers in East Germany Family policy in the German Democratic Republic (GDR) put an emphasis on the wide-spread availability of childcare to promote maternal labor supply. The expansion of childcare the western part of Germany experienced thus does not have an analog in the East. Family policies in the GDR are further associated with generally different attitudes towards female employment such that East and West Germany are hardly comparable.[3] Therefore, I only keep workers in West Germany (excluding Berlin) in the sample.

Sample Characteristics The final dataset is a panel of West German workers in regular employment who are between 21 and 60 years old. Workers in vocational training, marginal employment, interns and others in less common employment relationships are dropped. The data covers the period from 1986 until 2010. I chose 1986 as starting point as this is the first year for which data on childcare is available (see below). I extend the observation period beyond the last data point for childcare (2002) until 2010 to be able to capture long-run effects. These are a likely possibility because during most of the increases in childcare supply in the mid 1990s slots had to be rationed (see Bauernschuster and Schlotter 2015, and Section 3). Widespread use of public childcare thus cannot be expected to immediately have in impact. Both for mothers who intended to utilize it as well as for all women, it takes time to adapt decision making on having children and labor supply. The duration of parental leave, for instance, is typically decided on before the birth of the child, such that this decision needs to take into account the childcare supply around three years before the

[3] Becker, Mergele, and Woessmann (2020) argue that marked differences in gender norms between the eastern and western parts of Germany even predate the creation of the GDR. Boelmann, Raute, and Schönberg (2022) exploit these differences to provide evidence on the relationship between gender norms and the labor supply of mothers.

Table 1: Summary statistics for women in 1986 and 2010.

	1986		2010	
	Mean	SD	Mean	SD
Log daily wage	4.13	0.49	4.25	0.57
Share censored wage	0.02	0.12	0.03	0.16
Age	37.84	11.21	42.26	10.23
Share part-time	0.26	0.44	0.40	0.49
Education				
Share no vocational degree	0.24	0.43	0.08	0.28
Share vocational degree	0.71	0.46	0.77	0.42
Share university degree	0.04	0.19	0.14	0.34
Years in employment	7.79	3.58	15.89	8.79
Years in current job	5.70	4.00	7.31	7.03
Observations	132,550		164,493	

Notes: Summary statistics for women in regular employment, age 21–60 in the years 1986 and 2010. The log of daily wages is given in Euro, inflation adjusted to 2015 as base year. *Source:* Own calculations using the SIAB data described in this section.

child can enter kindergarten. Extending the analysis to years beyond 2010 is not possible because of the break in the reporting of part-time work in 2011.

Table 1 provides summary statistics of the SIAB data in 1986 and 2010. Throughout the paper, monetary values are expressed in Euro, inflation adjusted to the base year 2015; wages always refer to log imputed wages. The table points out some of the changes the female workforce underwent over time. The share of women who work in part-time strongly increased (from 26 to 40 percent). Education levels increased as well. In 2010, only on third of the initial 24 percent of women without a vocational degree remains, the share of women with vocational education increases from 71 to 77 percent and the share of women who own a high school degree more than triples (from 4 to 14 percent).

2.2 County-level Data on Childcare

Since the SIAB data do not allow to observe individual take-up of childcare, I use regional differences in the supply of care for children of kindergarten age as a proxy for individual exposure, comparable with an intention-to-treat approach in a policy analysis setting. The main explanatory variable is the county-level change in the ratio of kindergarten slots to the number of children between age three and five. It is constructed by combining data from the regional database of the German Youth Institute (Bertram, Bayer, and Bauereiss 1993) and the German Federal Statistical Office (Statistisches Bundesamt 2023c; Statistisches Bundesamt 2023b). I describe the change in childcare supply in more detail in the next section.

3 Institutional Background

This sections starts with giving a broad overview of the main changes in the German labor market between the 1980s and the 2010s to, then, narrow its focus to policy changes affecting especially female workers. Its last part provides a description of this paper's object of investigation, the expansion of public childcare in the mid 1990s.

Trends in the German Labor Market Over the 1990s and early 2000s, the German economy and the labor market faced several difficulties until a recovery in the later 2000s. The oil price shocks at the beginning of and economic turmoil during the 1980s led to high unemployment rates that persisted over the following decade. The German reunification and the associated costs put additional pressure on the economy. Starting in the mid of the 1990s, we observe marked increases in wage inequality, both for men and for women (Dustmann, Ludsteck, and Schönberg 2009). An explanation that is often put forward argues that trade exposure—especially with Eastern Europe following the fall of the Iron Curtain—and increased competition had negative economic impacts (following Autor, Dorn, and Hanson 2013). Dauth, Findeisen, and Suedekum (2014) instead argue, that in Germany job losses due to trade exposure were caused in some industries while new jobs in other industries offset these negative impacts. Goldschmidt and Schmieder (2017) highlight the contribution of domestically outsourcing certain occupations to wage inequality. Starting in 2003 Germany implemented a set of labor market reforms intended to foster flexibility of employment (coined "Hartz IV"). In the following, the economy recovered and unemployment decreased which, however, was not necessarily an effect of these reforms. Dustmann, Fitzenberger, et al. (2014) point instead to the decline in unionization and the share of workers covered by collective bargaining agreements starting in the mid 1990s. By allowing for more decentralized wage setting, this contributed to lower wages, mostly at the lower end of the distribution, which in turn increased competitiveness and contributed to the overall recovery of the German economy.

Female Workers and Changes in Family Policy Against the backdrop of these broad trends, the female part of the workforce experienced additional changes. Most notable is the increasing number of women who entered the workforce, though a substantial fraction of them chose to work in part-time (see also the descriptive statistics in Table 1 as well as Section 6.1).

As women take on the main responsibility for raising children and household work (still today but even more so in the 1990s), family policies can play an especially important role for female labor supply. Before the expansion of childcare in the mid of the 1990s, parental leave was the arguably most important family policy. Starting in 1979, Germany first introduced six months of job protected maternity leave during which maternity benefits were paid. Multiple reforms extended the duration of both job protection and benefits as well as they introduced eligibility for men, among whom

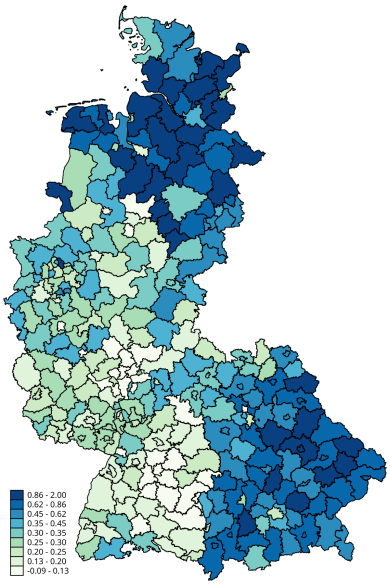
the take-up is, however, small. Between 1993 and 2006, parental leave was in terms of duration most generous offering 36 months of job protection and up to 24 months of benefit payments. The incentives this policy set were ambiguous as, on the one hand, it promotes employer continuity which can be career improving, but, on the other hand, it encourages longer labor market breaks after childbirth that can be harmful for maternal careers through losses of human capital. As benefits were paid as lump sums until 2006, their theoretical effect of delaying the re-entry to the labor market is of relatively greater importance for lower earning mothers. Schönberg and Ludsteck (2014) find overall small effects of this policy on maternal labor market outcomes which Findeisen et al. (2023) attribute to the effect of job protection. An additional reform in 2007 tied the level of benefit payments to mothers' pre-birth earnings from which the higher earning mothers gained relatively more.[4]

Contrary to the incentive to take longer post-childbirth labor market breaks the average duration of maternity leave starts to decline for children born since 1994 (see Figure A.3 in the Appendix) suggesting that the preferences of mothers started shifting towards an increased willingness to participate in the labor market, even in the presence of small children. The increase in childcare supply, thus, happened in a environment where mothers generally appear to be willing to make use of it.

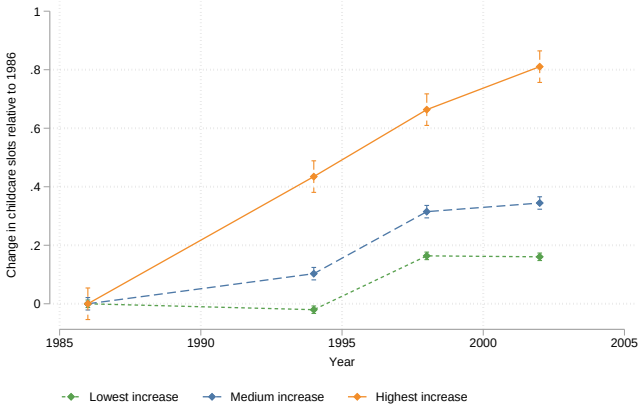
Expansion of Childcare A further work incentive for mothers was set by the expansion of childcare that this paper uses as its main variation of interest. Starting as of 1996[5], children from the age of three to school entry (which can be between age five and seven, depending on the federal state and the parents' decisions) had the legal right to a place in kindergarten. This right entitled children and their parents only to half-day care; full-day childcare options were sparse at that time. As Bauernschuster and Schlotter (2015) point out, the supply with childcare could not meet the demand, such that initially rationing measures had to be implemented. Importantly for this paper, childcare supply was expanded by different extents and at different speed at the regional level. The map in Figure 1a plots the county-level relative increase in the number of available slots in public childcare for children of kindergarten age per 100 children of age three to five between 1986 and 2002, normalized to zero in 1986. It shows that the largest increases were concentrated in Bavaria in the south and Lower Saxony and Schleswig-Holstein in the north. In these regions, the number of available childcare slots on average doubled, in some counties it even tripled. The smallest increases, in some counties slight decreases, can be found in Baden-Württemberg and Hesse. Especially the difference between Bavaria and Baden-Württemberg stands out as in both regions conservative

[4] Bergemann and Riphahn (2023) and Kluve and Schmitz (2018) assess the labor market consequences of these reforms, Raute (2019) shows that fertility increased for higher earning women.

[5] The relevant reform changed the social security legislation in the *SGB VIII, Achtes Buch Sozialgesetzbuch*.



(A) Geographical distribution of increase in childcare supply between 1986 and 2002, normalized by 1986 values.



(B) Increase in childcare supply between 1986 and 2002, normalized by values in 1986 and grouped by counties with low, medium and high increases.

FIGURE 1: Increase in childcare supply for children of kindergarten age between 1986 and 2002.

Notes: The right-hand figure documents the increase in childcare supply relative to levels in 1986 along with 95-percent confidence bands. Absolute levels are plotted in Figure A.2 in the Appendix. Childcare supply is measured at the county-level as the number of slots in public childcare for children of kindergarten age per 100 children aged three to five. The left-hand figure shows the geographical distribution at the county-level of the increases in childcare supply. *Source:* Own representation using the county-level data described in Section 2.2.

gender norms are more prevalent. This suggests that regional differences in gender norms are unlikely to be a main driver of this paper's findings.

This expansion of childcare had significant effects on maternal labor supply. Bauernschuster and Schlotter (2015) estimate that childcare attendance of the youngest child increases mothers' labor supply. Their participation increases by around 37 percentage points; labor supply on the intensive margin by around 14 hours per week. Their findings at the micro-level underline the substantial effect of childcare provision on mothers' labor market choices upon which this paper builds.

Identifying Variation Most analyses in this paper use aggregated county-level changes in childcare supply and relate them to changes in workforce composition and wage inequality. I group the 324 West German counties[6] into terciles with 108 counties each. The variable to build the terciles is the increase at the county-level in the number of childcare slots available to children of kindergarten age between 1986 and 2002. It differentiates between three groups of counties, henceforth referred

[6] *Landkreise*, referring to the NUTS-3-level.

to as *regions*, with low, medium and high increases in their childcare supply. Figure 1b illustrates the relative increase in childcare supply by region. In the low- and medium-increase regions the increase over time amounts to 16, respectively 34 percentage points. The largest increases happen between 1994 and 1998. Between 1986 and 1994, childcare supply in the low-increase regions even decreases slightly while it increases by 10 percentage points in the medium-increase regions. The high-increase regions show a steady increase over the entire period of observation, in 2002 it amounts to around 81 percentage points relative to 1986 levels. Note that the regions did not start at equal levels of childcare. Figure A.2 in the Appendix plots the absolute increases in the number of childcare slots by region. It indicates that larger increases are associated with lower initial levels, while in 2002 all regions reached similar levels. The stronger increase in childcare in some regions is thus rather a catch-up process than an overtaking of other regions.

Apart from these observable initial differences between the regions, there can be unobservable ones. For instance, women's preferences regarding labor supply can differ as well as gender norms of women, their families or of employers. To take them into account, this paper primarily aims to explain changes in workforce composition and inequality by changes in childcare supply. As long as regional differences are constant over time, this removes them similar to fixed effects. Partitioning the sample into three regions allows for a sufficiently large number of observations in each region to provide robust graphical results and to calculate DFL weights while ensuring common support between baseline and target year. To provide a further validation of the results that are obtained across regions, I provide additional results at the county-level in Section 5.2.

4 Potential Effects of Childcare on Wage Inequality

Easier and more widespread access to childcare options can generally be expected to lower women's opportunity costs of working, especially for mothers. How this in turn impacts wage inequality is, ex ante, ambiguous. It rather depends on which group of women reacts in which ways. To give a background for the later analysis, this section provides an overview how women's labor supply can be affected by increased childcare options and the related effects on wage inequality.

The following considerations make some assumptions. First, women can be ranked by their earnings potential. This applies to those who work and those who do not work. Second, larger supply with public childcare decreases the price of childcare. Here, price refers to the monetary costs of childcare as well as the non-monetary opportunity costs of organizing care for a child. The latter can include that public and informal care by relatives can easier be combined or that childcare is more conveniently to access, for instance due to being located closer to the home or the workplace. Third, I assume sufficient labor demand, i.e. that increasing female labor supply translates into employment, and rule out general equilibrium effects such that more labor supply

by women due to childcare does not lead to changes in wages. Fourth and finally, women increase their labor supply if their net benefits of working (more)—holding other factors constant, they are given by the (potential) earnings net of childcare costs—are positive.

Mothers with young children are the likeliest beneficiaries of an increased availability of childcare. For them, two channels can be distinguished. The first one emphasizes labor supply on the extensive margin. With lower childcare prices, more mothers have positive net benefits of working such that labor force participation increases. Mothers either revert a non-participation decision or they decrease the duration of a post-childbirth labor market interruption. If childcare costs are similar for all mothers, this will not affect mothers with sufficiently high earnings potential as they had positive net benefits of working already before the childcare expansion. Instead, such a mechanism will rather expand the workforce towards those mothers with lower earnings potential. Their increased participation will then increase inequality.

The second channel focuses on increased flexibility. This is especially relevant if some level of informal care, for instance by relatives, is already present, because during the observation period public childcare only covered half of the day.[7] As before, an expansion of public care lowers the price of childcare in general but, in addition, also increases the flexibility of mothers as, in total, more care is available and easier to plan. Additional flexibility can impact mothers by allowing them easier commuting, such that they have a broader choice of employers, by being less depended on the family-friendliness of an employer or by giving them additional time. These aspects ease the constraints they face when making labor supply decisions. This can lead to an increase in participation in the labor market, but also to additional working hours of mothers who already participate. It, further, can lead to fewer downgrades in terms of hours, occupation or employer when making a participation decision after childbirth. Increasing flexibility decreases the opportunity costs of working such that it more likely affects women with lower earnings potential. As, however, the availability of informal care is unlikely to strongly depend on earnings potential, the effect of additional public care is not necessarily restricted to them. It can also extend upwards in the distribution as well as to those women who are already part of the labor market. Nevertheless, the effect is likely to decrease in strength in earnings potential since better earning women have more opportunities to organize and pay for childcare, even in absence of public care provision.

Both channels are not mutually exclusive. Given the results by Bauernschuster and Schlotter (2015) who find labor supply effects of the German childcare expansion on the extensive and intensive margin, it is plausible to expect a combination of both.

Turning away from mothers, an expansion of childcare can, more indirectly, also benefit women before they have children. For them, not the direct but the expected opportunity costs of working

[7] Informal care likely plays a substantial role since a market for private childcare was almost nonexistent in the early and mid 1990s (see Bauernschuster and Schlotter 2015).

decrease.[8] With increasing prospects of a career that can be sustained in the long run, investments into education are more likely to pay off such that the probability of young women pursuing higher degrees and selecting into higher-paying occupations increases as well. After women have entered the labor market, better long-run career prospects can affect employer choice, effort put into work or on-the-job training. Under the assumption that concerns regarding the costs of having children are more relevant for women with lower intrinsic career preference, i.e. have a lower earnings potential, they can be expected to have the larger gains from childcare. Therefore, this indirect channel rather decreases wage inequality among women by facilitating upgrades at the lower end of the (potential) wage distribution.

5 The Evolution of Wages and Wage Inequality

This section shows how wages and wage inequality develop over time. It considers both the general trends as well as it differentiates by the change in childcare supply.

5.1 Trends in Full- and Part-time Wages

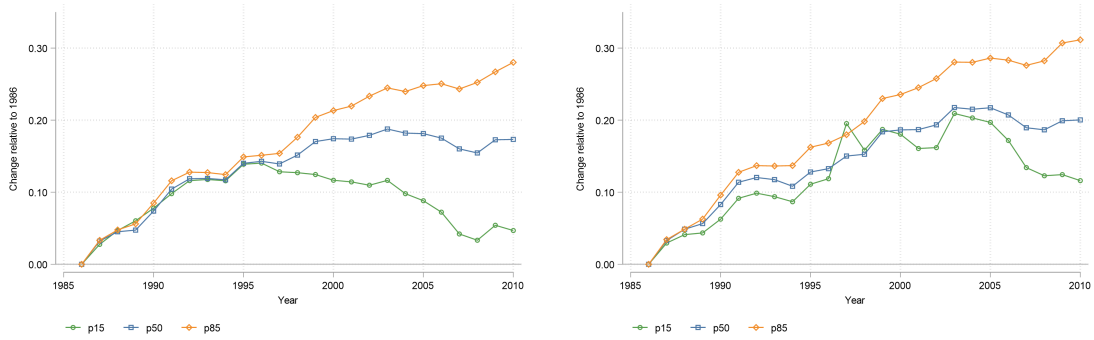
Having shown the changes in workforce composition, in this section I collect results on the evolution of wage inequality. First, I focus on women and show the development of wages and wage inequality and how this is related to childcare and workforce composition. Then, I extend the perspective to the gender wage gap.

This section, first, shows how wages develop over time, both for all female workers in West Germany as well as separately by regions with low, medium and high increases in their childcare supply.

Figure 2 starts by plotting the development of the 15th, 50th and 85th log wage percentiles. The changes for full-time working women in the left-hand panel are similar to the findings in others studies, qualitatively they also follow the trends for male workers (see Dustmann, Ludsteck, and Schönberg 2009; Biewen, Fitzenberger, and Lazzer 2018). Until 1997, the three wage percentiles grew in an almost parallel fashion by around 14 percent. Since 1998 the percentiles diverge. Wages in the 85th percentile continue to grow strongly (by another 12.7 percent to 28 percent in 2010), while the growth of median wages is only modest (additional 3.4 to overall 17.4 percent) and wages in the 15th percentile even have decreased since by 8.2 percent to a total growth of 4.6 percent.

Wages of part-time working women (plotted in the right-hand panel) show a different trajectory. Between 1986 and 2010, they increased stronger than those of full-time workers by 11.6 (p15), 20.1 (p50)

[8] This rests on the assumption that these women expect to have children at some point in the future. Given that for the cohorts who are of childbearing age during the 1990s the share of those who eventually become mothers is close to or above 80 percent (Statistisches Bundesamt 2019), this is likely to be the case.



(A) Full-time workers

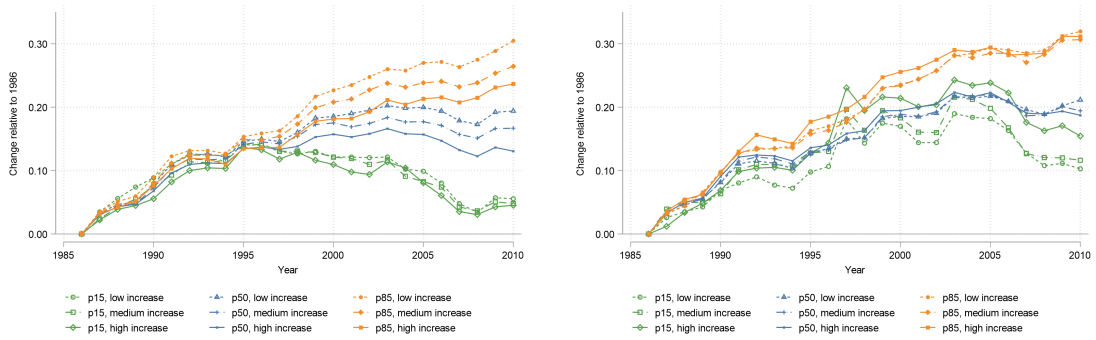
(B) Part-time workers

FIGURE 2: Development of the 15th, 50th and 85th log wage percentiles of women, 1986–2010.

Notes: The figure plots changes in percentiles of log daily wages between 1986 and 2010. All values are normalized to 0 in 1986. Panel A focuses on female full-time workers, Panel B on female part-time workers. The 15th percentile is plotted in green, the 50th in blue and the 85th in orange. *Source:* Own estimations using the SIAB data described in Section 2.1.

and 31.1 percent (p85). In contrast to full-time wages, the percentiles start to diverge earlier, around the end of the 1980s. After some flattening between 1991 and 1994, wages continue to grow until 2003. Between 1993 and 1999, especially the 15th wage percentile stands out with high growth rates. After 2003, only the high wages continue to increase. Median part-time wages, however, remain mostly constant after 2003 and wages in the 15th percentile—which in some years before 2003 increased even stronger than those in the 50th percentile—start to decrease. The longer growth of part-time wages, which is for all percentiles larger than for full-time workers, together with the increased number of women working in part-time, points out that the additional part-time labor supply was met by a sufficient demand for work, providing an additional incentive for women to join the labor market. This finding is, further, consistent with the hypothesis that more mothers, who otherwise would have stayed out of the labor market and who are better selected compared to the preexisting part-time workforce, take up part-time work.

Turning to an analysis that relates the development of wages and childcare, Figure 3 plots the development of the 15th, 50th and 85th wage percentile separately for regions with high, medium and low increases in their childcare supply. The development of full-time wages (plotted in the left-hand panel) is qualitatively similar across all regions and follows the trajectory observed in the full sample (see Figure 2), i.e. wage growth across percentiles starts to develop in different ways around 1998. There are almost no regional differences for low wages in the 15th percentile. For the 50th and 85th percentile, regional differences are small until 1997 when regional wage growth starts to diverge. The regions exhibit a clear pattern that increases in wages and childcare are inversely related. Both median and high wages increase stronger where childcare supply increases were the



(A) Full-time workers

(B) Part-time workers

FIGURE 3: Development of the 15th, 50th and 85th log wage percentiles of women by change in childcare supply, 1986–2010.

Notes: The figure plots changes in percentiles of log daily wages between 1986 and 2010. All values are normalized to 0 in 1986. Panel A focuses on full-time workers, Panel B on part-time workers. Both panels differentiate between regions with low (plotted as short dashed lines), medium (longer dashed lines) and high (solid lines), increases in childcare supply. The 15th percentile is plotted in green, the 50th in blue and the 85th in orange. *Source:* Own estimations using the SIAB data described in Section 2.1.

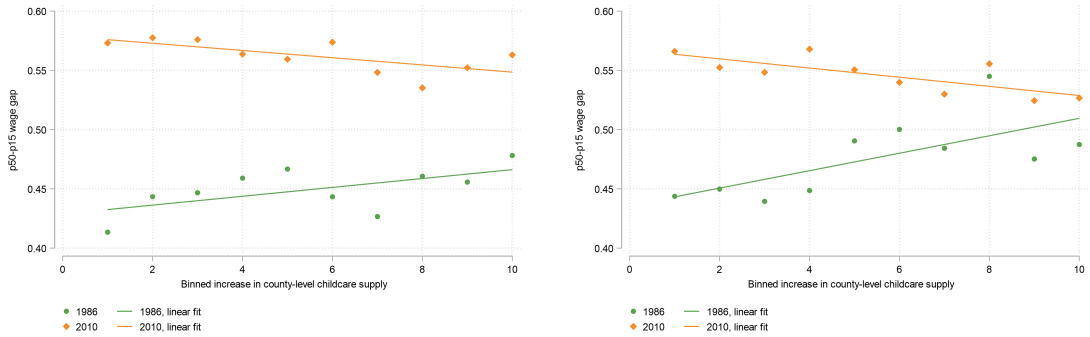
smallest, while those regions with the largest changes in childcare supply show the lowest wage gains. In 2010, the wage growth of the 85th percentile ranges between 30.5 and 23.6 percent; for median wages between 19.4 and 13.1 percent.

Wages of part-time working women (plotted in the right-hand panel) follow a different profile with respect to their association with childcare. In the upper and middle part of the wage distribution, the 85th and the 50th percentile show slightly larger increases between the early 1990s and 2005 in those regions with greater changes in childcare. After 2005 all regions develop almost similarly. Wage growth until 2010 is similar across regions, for the median between around 19 and 21 percent, for the 85th percentile between 31 and 32 percent. What stands out more, is the lower part of the wage distribution. The trajectory of the 15th wage percentile is, in general, less smooth compared to the median and the 85th percentile which is suggestive of a greater degree of heterogeneity in the underlying part of the female workforce. Despite the more uneven trajectory, a pattern that in regions with larger childcare increases wage gains are larger between 1990 and 2005 is clearly observable for the 15th percentile. Between 1996 and 2006, the increase in low wages in regions with higher childcare increases even exceeds that of median wages. Until 2010, low wages in high-increase regions grew by 15.4 percent; in low-increase regions by 10.3 percent. The finding of relatively large

growth for low-wage part-time workers from the full sample is amplified in regions with stronger increases in childcare supply.[9]

5.2 The Development of Wage Inequality

Having shown that wages of both full- and part-time working women develop differentially with respect to the regional change in childcare supply, this section turns to inequality in wages. Here, I depart from sorting counties into three regions. Instead, I show graphical results over ten bins of counties and regression results directly at the county-level. Figure 4 shows binned scatter plots for the relationship between the regional increase in childcare supply and the size of the p50–p15 gap in log wages. On the x-axis there are ten bins of counties by their increase in childcare supply as illustrated in Figure 1. The outcome on the y-axis is the size of the p50–p15 log wage gap. The relationship between both variables is plotted for the years 1986 (in green) and 2010 (in orange). Since the increase in childcare supply is a time-constant measure, each bin contains the same counties in each year. Those in the first bin increase their childcare supply between 1986 and 2002 by on average 6.5 slots per 100 children, while for counties in the tenth bin the increase is on average 54 additional slots.



(A) Full-time workers

(B) Part-time workers

FIGURE 4: p50–p15 wage gap of women in 1986 and 2010 by binned regional increase in childcare supply.

Notes: The figure plots the p50–p15 gap in log daily wages of women by binned regional increase in childcare supply. The relationship in 1986 is plotted in green, results for the year 2010 are plotted in orange. Each bin contains 32–33 counties where those in the first bin increase their childcare supply by on average 6.5 additional slots per 100 children and those in the tenth bin by on average 54 additional slots. Figure A.4 in the Appendix plots the analog for the p85–p15 wage gap. *Source:* Own estimations using the SIAB data described in Section 2.1.

[9] Both for women in full- and part-time work, the ranking of regions with respect to their change in childcare supply is mostly constant over time during the 2000s. This allows to conclude that the choice of 2010 as last year to analyze is unlikely to impact the results.

The left-hand panel of Figure 4 plots results for full-time working women. Over time, the relationship between the increase in childcare supply and lower-tail wage inequality clearly changed. In 1986, those counties where the (at this time future) increases in childcare are larger, show slightly larger wage gaps. This relationship reverses over time. In all bins, the wage gaps increase and those bins with the smallest increases in childcare exhibit the largest increases of the p50–p15 wage gap such that the relationship between care supply and inequality is negative in 2010. For part-time workers (plotted in the right-hand panel of Figure 4) the relationship between childcare supply increases and inequality is qualitatively similar, though markedly more pronounced. This holds both for the positive relationship in 1986 and for the negative one in 2010. While inequality on the lower end of the wage distributions reacts to changes in childcare, no such relationship can be found for the upper end, i.e. the p85–p50 wage gap. Results for overall inequality, measured by the p85–p15 wage gap, show a similar but less strong pattern as the p50–p15 gap (plotted in Figure A.4 in the Appendix). Figure A.5 in the Appendix checks the relationship between childcare supply increases and wage inequality for male workers in full-time. It shows that for all three percentile gaps, wage inequality is smaller in counties that experience larger increases in childcare supply. Apart from an overall increase in levels, there is no change over time, i.e. while childcare supply is expanded. This indicates there is no relationship between both measures for men.

Table 2: County-level relationship between increase in childcare supply and wage inequality (in standard deviations), 1986 and 2010.

	Full-time workers			Part-time workers		
	1986	2010	$\Delta_{2010\text{-}1986}$	1986	2010	$\Delta_{2010\text{-}1986}$
p85–p15	0.202***	−0.032	−0.234	−0.070	−0.126***	−0.056
p85–p50	0.057	0.060	0.003	−0.089**	−0.046	0.043
p50–p15	0.210***	−0.085*	−0.295	0.130**	−0.119***	−0.249

The table reports the relationship between the increase in childcare supply and percentile wage gaps for female workers in 1986 and 2010. The values for each year indicate by which fraction of a standard deviation the percentile gap would change if the increase in childcare supply was stronger by one standard deviation (additional 13.36 slots per 100 children). The columns marked with Δ indicate the change from 1986 to 2010. All results are obtained from linear regressions on the county level, weighted with each county's observation share. Analog results for male workers in full-time are given in Table A.1 in the Appendix. */**/*** indicate significance at the 10/5/1 percent levels. *Source:* Own estimations using the SIAB data described in Section 2.1.

As a next step, I quantify the graphical findings. Table 2 reports the county-level relationships between different log wage gaps and childcare increases in terms of standard deviations. The results are obtained from regressing each respective log wage gap on the absolute increase in childcare supply in the years 1986 (columns 2 and 5) and 2010 (columns 3 and 6). The regression results are converted to effects for an increase in childcare by one standard deviation, i.e. by 13.36 additional slots per 100 children (the mean increase is 28.3 slots per 100 children). Columns 4 and 7 report the

difference between the years. As before, increase in childcare supply is a time-constant measure. The aim of this task is thus to assess whether and how the relationship between inequality within counties and childcare supply changed over time.

For full-time working women in 1986, a larger increase in childcare slots is associated with a significantly larger p85–p15 log wage gap. Precisely, for an increase in childcare by one standard deviation, the p85–p15 wage gap increases by around 20 percent of a standard deviation. In 2010, a similar increase in childcare is associated with a decrease in the p85–p15 wage gap by around 3 percent of a standard deviation. For the p50–p15 wage gap, the effect is more pronounced; in 1986 I observe an increase by 21 percent of a standard deviation, but for 2010 a decrease by 8.5 percent of a standard deviation. Both values are statistically significant. There is virtually no change in inequality in the upper end of the wage distribution (measured by the p85–p50 wage gap).

For part-time workers, the finding that larger increases in inequality are associated with a decrease in wage inequality is confirmed. As for full-time workers, this is driven by inequality in the lower end of the wage distribution. Consistent with Figure 3 which documents that the differences in wage percentiles between regions are smaller for part-time workers than for full-time workers, effects of childcare documented in Table 2 are smaller as well. Larger increases in childcare by one standard deviation are related to a slightly smaller p85–p15 wage gap in 1986 (by 7 percent of a standard deviation); until 2010 this has numerically almost doubled to a significantly negative effect of 13 percent. Results for the p85–p50 wage gap are again comparatively small. For lower wages, a positive association of a 13 percent larger p50–p15 wage gap per standard deviation increase in childcare in 1986 decreases to −12 percent of a standard deviation in 2010.

In summary, this section shows that larger increases in childcare supply at the county-level are related to smaller increases in wage inequality among women between 1986 and 2010. This result is primarily driven by the lower part of the wage distribution. It is further consistent across different levels of aggregation; either bins of around 30 counties or in regressions where the single county is the smallest entity. This suggests that other results that are aggregated over three regions, each consisting of around 100 counties, do not suffer from biases by the broader level of aggregation. As the results are based on regional differences in changes (in inequality), they are, further, not driven by time-constant differences between regions, for instance by wage- or education-levels (see also Table 3).

Robustness There might be the concern that the observed lower wage inequality is not directly related to childcare but is rather driven by other factors. One possibility is that childcare and wage inequality are unrelated and that the latter is reduced by good regional economic conditions which increase labor demand. If this was the case, male and female workers would likely be affected in a similar way. Table A.1 in the Appendix therefore reports results analog to Table 2, but for men

working in full-time. Consistent with the graphical evidence in Figure A.5, it shows that there is no relationship between the increase in childcare supply and changes in inequality over time for male workers.

A second possibility is that favorable economic conditions contribute to less strong increases in wage inequality, but also to higher local tax revenues that enable the expansion of public childcare. Table A.2 in the Appendix tests this hypothesis by again repeating the estimations from Table 2, but with controlling for the county-level change in the log of per-capital GDP. This additional variable turns out to have no significant impact on wage inequality in almost all estimations, and importantly, it does not lead to relevant changes in the measured relationship between childcare and wage inequality. Both tests together show that a bias in this section's results through economic conditions or other changes that would affect men and women in a similar way is unlikely.

6 Explaining the Impact of Childcare on Wage Inequality

The impact of childcare on wage inequality primarily operates through changes in the composition of the female workforce. This section describes the compositional changes and relates them to changes in the supply with childcare at the regional level. Women in regions with larger childcare expansions show stronger increases in part-time work, they are more often in the middle of the education distribution and have accumulated longer tenure in their current job. With this background I decompose the changes in wage inequality to assess the contribution of different aspects of workforce composition.

6.1 Changes in Workforce Composition

Table 3 lists summary statistics by region for the baseline year 1986 and for 2010. It highlights that the regions do not enter the observation period with similar characteristics. Regions where childcare supply increased stronger have the lower wage levels, both in 1986 and 2010. They also have slightly higher shares of part-time working women; these differences become more pronounced until 2010. Education levels are mostly similar across regions. Experience measures are smaller in regions with higher childcare increases.

Part-time Work The most prominent change in the composition of the female workforce is the increase in part-time work. Between 1986 and 2010 the share of women who are recorded as working in part-time in the SIAB data rose from 26 to 40 percent.[10] This trend is observable in all

[10] The German Federal Statistical Office (Statistisches Bundesamt 2023a) records an increase from 29 to 46 percent during this time period which gives an impression of the amount of underreporting in the SIAB data. Contrary to the dataset used in this paper, the data from the Statistical Office additionally include workers above the age of 60

Table 3: Summary statistics for women by regional increase in childcare supply, years 1986 and 2010.

	1986			2010		
	Low	Medium	High	Low	Medium	High
Log daily wage	4.17	4.12	4.03	4.30	4.24	4.13
Share censored wage	0.02	0.01	0.01	0.04	0.02	0.01
Age	37.93	37.91	37.46	42.14	42.31	42.44
Share part-time	0.25	0.26	0.27	0.38	0.40	0.44
Education						
Share no vocational degree	0.24	0.23	0.26	0.09	0.08	0.08
Share vocational degree	0.71	0.71	0.70	0.75	0.77	0.82
Share university degree	0.04	0.04	0.03	0.16	0.13	0.10
Years in employment	7.84	7.76	7.70	15.84	15.8	16.14
Years in current job	5.72	5.71	5.64	7.25	7.26	7.55
Observations	61,654	46,904	23,299	74,126	58,639	31,692

Notes: Summary statistics (means) for women in regular employment, age 21–60 in the years 1986 and 2010. The table differentiates between regions with low, medium and high increases in childcare supply as described in Section 3. The log of daily wages is given in Euro, inflation adjusted to 2015 as base year. *Source:* Own calculations using the SIAB data described in Section 2.1.

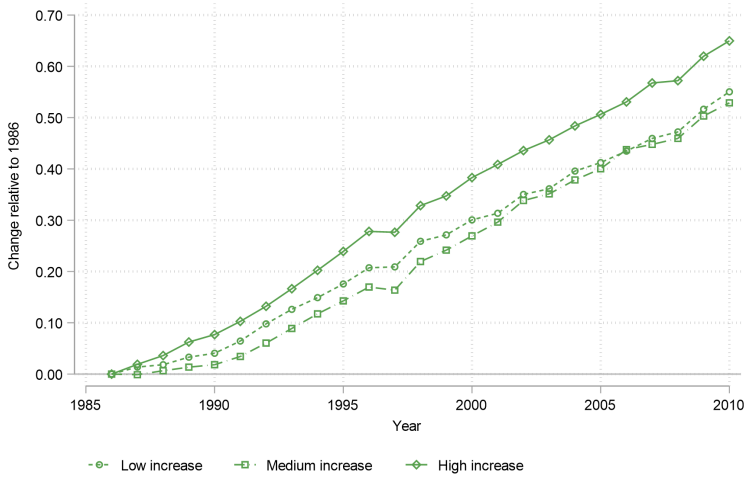
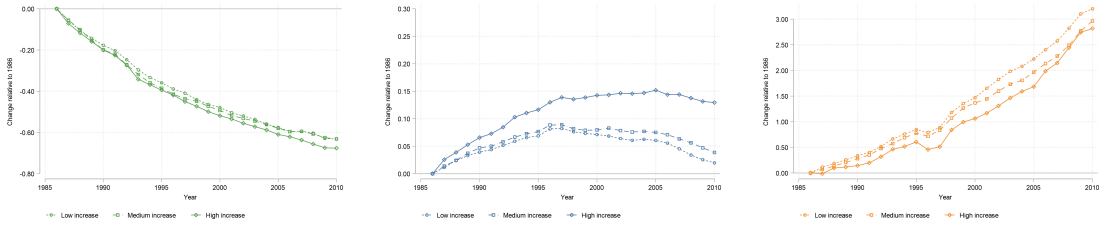


Figure 5: Change in part-time work relative to 1986 by year and development of childcare supply.

Notes: Changes in part-time work of the female workforce over time by development of childcare supply. Plots indicate changes relative to 1986. Observations are grouped by the position of a region in the distribution of the change in childcare supply between 1986 and 2002. The tercile of regions with the largest increases is plotted as a solid line, the second tercile as a long-dashed line, and the tercile of regions with the smallest increases as a short-dashed line. *Source:* Own estimations using the SIAB data described in Section 2.1.



(A) Below vocational education (B) Vocational education (C) University or equivalent education

FIGURE 6: Changes in education of female full-time workers relative to 1986 by year and development of childcare supply.

Notes: Changes in the education levels of the female full-time workforce over time by development of childcare supply. Plots indicate changes relative to 1986. Observations are grouped by the position of a region in the distribution of the change in childcare supply between 1986 and 2002. The tercile of regions with the largest increases is plotted as a solid line, the second tercile as a long-dashed line, and the tercile of regions with the smallest increases as a short-dashed line. Results for part-time workers are plotted in Figure C.2 in the Appendix. *Source:* Own estimations based on the SIAB data described in Section 2.1.

regions, although Figure 5 shows that there are clear differences in how strong it is. Regions with large increases in childcare supply have the initial slightly higher share of part-time workers (27 vs. 25 percent on average) but also show the strongest increase by 63 percent to 44 percent on average. The change in the other regions with low or medium sized increases in childcare supply is around ten percentage points smaller and less distinct from another at between 52 to 54 percent.

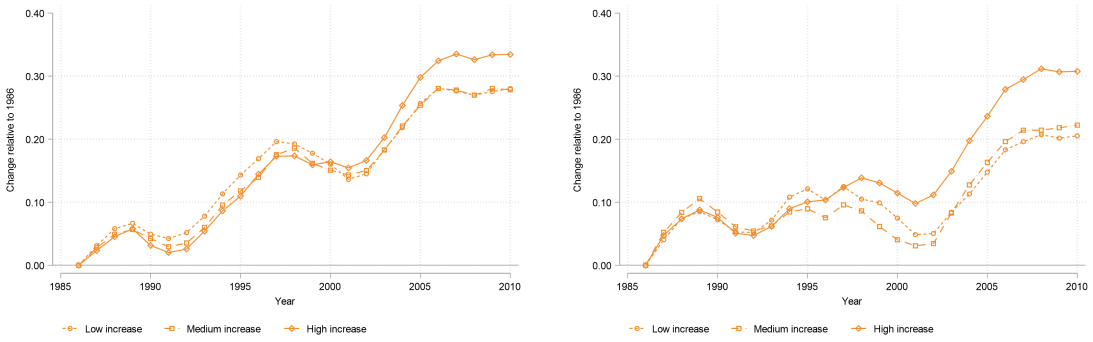
Education Workforce composition with regard to education improved. This is mostly driven by the a substantial decrease in the share of workers with low education levels (from 23 to 8 percent) and an increase in the share of workers with university-level education (from 4 to 14 percent). Nevertheless, most workers—between around 71 and 77 percent—own a vocational degree. In general, the development of the educational composition is similar for full- and part-time workers. For the latter, the decrease in less than vocational respectively the increase in vocational education is stronger while university-level education increases to a smaller degree.[11]

Differentiating by regional increases in childcare supply yields qualitatively similar trends but with noticeable differences. Figure 6 plots the change in the education levels of full-time workers relative to 1986 for regions with low, medium and high increases in childcare supply. The extent of the regional changes are ordered such that those regions with the smallest childcare increases show the smallest changes in below vocational and vocational education, whereas where childcare increased the strongest the reduction in below vocational respectively the increase in vocational education is

as well as those in marginal employment. These are both groups for whom the part-time share is relatively large. Taking this into account implies that underreporting by the SIAB is even smaller than suggested by the numbers given here.

[11] See also Figure C.1 in the Appendix.

the strongest. As the initial education levels across the regions show only little differences, this led to substantial changes in the education composition. The difference between low and high-increase regions almost continuously widens over time, in 2010 it amounts to −4 percentage points for below vocational, 11 percentage points for vocational and −39 percentage points for university education. For vocational education, it stands out that the slight decrease since the late 1990s observed in the full sample is almost entirely driven by regions with only low or medium increases in childcare supply. Such an ordering can as well be found for university education. Here, however, greater expansions of childcare coincide with the lowest increases in the share of highly educated women who participate in the labor market. Results for women who work in part-time show similar trends.[12] For them, the overall increase in vocational education is stronger, though the differences between the regions are smaller. In sum, this findings indicate a greater degree of upgrading from the bottom to the middle of the education distribution in regions with larger childcare expansions. In comparison, in the other regions a relatively larger fraction of the female workforce can be found in the tails of the education distributions, especially the upper one.



(A) Full-time workers

(B) Part-time workers

FIGURE 7: Change in tenure in the current job relative to 1986 by year and development of childcare supply.

Notes: Changes in years spent in the current job of the female workforce over time by development of childcare supply. Plots indicate changes relative to 1986. Observations are grouped by the position of a region in the distribution of the change in childcare supply between 1986 and 2002. The tercile of regions with the largest increases is plotted as a solid line, the second tercile as a long-dashed line, and the tercile of regions with the smallest increases as a short-dashed line. Results for total work experience, tenure in the current firm and tenure in the current job that do not differentiate by childcare are plotted in Figure C.6 in the Appendix. *Source:* Own estimations using the SIAB data described in Section 2.1.

Tenure and Work Experience Work experience of women increases between 1986 and 2010.[13] This is, to some degree, mechanically related to age. As Table 1 shows, average age increases over time. Table 3 points out that in 1986 age decreases slightly in the regional increase in childcare supply

[12] See Figure C.2 in the Appendix.

[13] Figure C.6 in the Appendix plots the development in absolute terms for full- and part-time workers.

whereas in 2010 it increases. This matches expectations of an effect of childcare, as it provides women with the opportunity to easier continue work after childbirth and parental leave. Instead of total experience, this section focuses on tenure in the current job which is the more informative measure for current wages as it accounts for the time to accumulate firm and job-specific human capital. The descriptives in Table 3 show a relationship that larger increases in childcare are associated with shorter tenure in the current job in 1986 but with longer tenure in 2010. The graphical representation of the changes in tenure over time in Figure 7 confirm this. In regions with high increases in childcare supply, both full- and part-time working women show larger increases in their tenure in the current job. For full-time workers, the high-increase regions start to diverge from the others in the early 2000s, in 2010 the increase in tenure is larger by 5.4 percentage points. The trend of part-time workers is similar but for them the high increase regions diverge already since the late 1990s. Their increase until 2010 is by 10.2 percentage points larger compared to regions with low-level increases in childcare.

Selection into Occupations and Associated Skills Both women who work in full- and in part-time upgrade in terms of occupations. Consistent with the findings for education, they less often work in occupations requiring low levels of qualification but more often work in occupations that demand medium to high qualification levels. There are some differences in levels, though no differential trends between regions with different increases in childcare supply.[14]

More significant differences emerge when looking at the required skills within occupations. The skill measure is derived from the fifth digit in the occupation classification KldB 2010 (Bundesagentur für Arbeit 2021) differentiating between unskilled and semi-skilled, skilled and complex tasks workers have to carry out. Rather than comparing *between* occupations, this measure captures differences *within* an occupation, thus it is more suitable to detect changes over the career trajectory, for instance due to receiving further training or being promoted. The results are plotted and described in more detail in Appendix C. The confirm upgrading in all regions. Full-time working women in regions with high increases in childcare tend to remain in the middle of the skill distribution more often. This can be found for part-time workers as well, though less pronounced. Instead, for them larger childcare increases are associated with larger shares of women working in jobs that demand more complex tasks.

Taking the findings for skills and experience together suggests that larger childcare supply is associated with more stable employment relationships among women, which, in turn, induces upgrades in the skill levels of tasks that women perform in their jobs. This finding is more pronounced for women who work in part-time which is consistent with the larger increases of part-time work

[14] See also Figure C.3 in the Appendix.

where childcare increases are larger, as well as with the overall higher prevalence of part-time work among mothers.

6.2 Decomposition of the Changes in Wage Inequality

Having shown that regions with larger increases in their childcare supply exhibit smaller increases in wage inequality and differential developments of workforce composition, this section assesses the contribution of workforce composition to changes in wage inequality. To this end, I decompose inequality growth between 1986 and 2010 into a composition and a price component. I provide multiple decompositions for full-time and part-time workers as well as on the regional level differentiating between the entirety of West Germany and three regions with low, medium and high increases in their supply with childcare slots. The decompositions show that workforce composition is more important to explain inequality in the lower part of the wage distribution in regions with larger childcare increases. This is primarily driven by participation decisions rather than choices of women who were already part of the workforce.

Approach To quantify the effects of observable worker characteristics, I rely on the reweighting approach introduced by DiNardo, Fortin, and Lemieux (1996). This approach allows to construct counterfactual wage distributions that hold the characteristics of the workforce constant at the levels of a given baseline. It decomposes differences between two groups (in this paper's case between two years) into one part, that is due to differences in the characteristics of the groups and into a second—residual—part.[15] Specifically, I use the composition of the workforce in the baseline year $t' = 1986$ to estimate weights ψ_z to reweight the wage distribution in year $t = 2010$ to obtain the distribution of wages that would have prevailed if the workforce composition in terms of observable characteristics z had remained at its baseline level in year t'. Comparing how actually observed and reweighted distributional statistics change between years t' and t allows to decompose the total change into two effects. First, the *composition effect* is given as the change in a statistic that can be explained by changes in observable characteristics. Second, the unexplained part of the total effect is commonly referred to as wage structure or *price effect*. This is due to changes in how the labor market values both observed and unobserved characteristics of workers. The underlying assumption to identify the contribution of workforce composition changes on wages is that the relationship between characteristics z and wages does not change because of the change in z, i.e. that there are no general equilibrium effects.[16]

In the following, I use several decompositions. First, I differentiate between full-time and part-time workers. Second, I differentiate within full- and part-time workers, between a full sample and

[15] Section D in the Appendix gives a formal description of the decomposition.
[16] This assumption is common for most decomposition methods (Fortin, Lemieux, and Firpo 2011).

region-specific subsamples. The full sample includes all working women in West Germany. The region-specific samples split them with respect to regions with low, medium and high increases in childcare supply. The DFL weights are always calculated and applied specific for each subsample. Splitting the data into subsamples has the advantage of being able to account for two factors. First, it allows for different initial conditions in each subsample, for instance for lower wages or different education levels of the workforce (see Table 3). Second, it is able to capture differential trends across subsamples, both in the development of wages as well as workforce composition (as shown in the previous subsection).

In addition to differentiating between subsamples of the data, I use two sets of explanatory variables to calculate the DFL weights. The first set includes three education and five age categories as well as all interactions between them. The second set of explanatory variables consists of those in the first one and adds interactions between age group and experience in the current job (where the interaction accounts for the potential mechanical relation between age and experience) as well as indicators for occupation (at the 3-digit-level) and industry (1-digit-level). Compared to the first one, the second set of variables includes characteristics that are more likely subject to recent choices made by workers. Given participation in the labor market, a worker's choices rather affect their job, occupation or industry while education typically remains unchanged.[17] A comparison of these two sets of explanatory variables thus allows to make a distinction between mechanical compositional changes that happen when workers change their participation status and changes that happen when workers, who are already part of the labor force, sort to different employers or into different jobs.

It has to be noted though, that both sets of explanatory variables identify the joint effects of all included variables. The numerical difference between results from the second and first set cannot necessarily be attributed exactly to the added variables because for neither of them a bias due to omitted variables can be fully ruled out.

Women Working Full-time Table 4 lists actual and reweighted changes in the log wage gaps between the 85th and 15th, the 85th and 50th as well as the 50th and 15th percentile for women in full-time work between 1986 and 2010.[18] The top part of the table shows results for the full sample, the bottom part differentiates between regions with respect to their childcare supply increases. In the full sample, the p50–p15 wage gap, representing the lower part of the wage distribution, increases stronger (by 12.7 log points) than the p85–p50 wage gap (10.6 log points). This adds up to an overall increase in the p85–p15 wage gap by 23.3 log points. Decomposing with respect to age

[17] This holds especially since individuals in vocational training and marginal employment (that could cover a number of students who work parallel to their studies) are excluded.

[18] The corresponding levels for full- and part-time workers are reported in Table A.3 in the Appendix. They are in line with the findings from Section 5.2, especially that the p50–p15 wage gap in 1986 increases in childcare supply changes while it decreases in 2010.

Table 4: Observed and reweighted changes in wage inequality among full-time working women, 1986–2010.

		I: education, age		II: education, age, experience, occupation, industry	
	Observed change	Composition	Price	Composition	Price
Full sample					
p85–p15	0.233	0.108 (46%)	0.125	0.124 (53%)	0.109
p85–p50	0.106	0.046 (43%)	0.061	0.059 (56%)	0.047
p50–p15	0.127	0.063 (50%)	0.064	0.065 (51%)	0.062
By regional increase in childcare supply					
p85–p15					
Low	0.250	0.094 (38%)	0.156	0.108 (43%)	0.142
Medium	0.216	0.112 (52%)	0.104	0.129 (60%)	0.087
High	0.195	0.104 (54%)	0.090	0.115 (59%)	0.078
p85–p50					
Low	0.110	0.041 (38%)	0.068	0.052 (47%)	0.058
Medium	0.096	0.049 (51%)	0.047	0.070 (72%)	0.027
High	0.106	0.037 (35%)	0.069	0.051 (48%)	0.054
p50–p15					
Low	0.140	0.053 (38%)	0.087	0.056 (40%)	0.084
Medium	0.119	0.062 (52%)	0.057	0.059 (50%)	0.060
High	0.089	0.068 (76%)	0.021	0.064 (74%)	0.023

Notes: Observed and reweighted changes in inequality measures for log imputed daily wages between 1986 and 2010. The observed change is decomposed into a composition effect (columns 3 and 5) and a price (wage structure) effect (columns 4 and 6). Percentage values indicate the contribution of the composition effect to the observed change. Price effects correspond to the change from observed values in 1986 to reweighted values in 2010. Estimates in Panel I use three education and five age categories as well as all possible interactions to estimate DFL weights, in Panel II experience in the current job along with its interaction with the age categories, occupation (3-digit) and industry (1-digit) identifiers are added. The lower part of the table reports results separately for regions with low, medium and high increases in their childcare supply between 1986 and 2002. *Source:* Own estimations using the SIAB data described in Section 2.1.

and education (see Panel I of the table) explains between 43 (p85–p50) and 50 percent (p50–p15) of inequality increases. When adding experience, occupation and industry to the decomposition (see Panel II), these shares increase to 56 and 51 percent, respectively. Thus, for the upper end of the wage distribution the additional variables explain a substantially larger fraction of wage inequality increases. In the lower part of the wage distribution, the mechanical factors age and education, i.e. those that pick up changes in participation, are more important.

In the bottom part of Table 4, I collect region-specific results where the weights are calculated separately for regions with low, medium and high increases in their childcare supply. Overall, the observed changes in percentile wage gaps are within a similar range compared to the full sample analysis. While the regional differences for the p85–p50 wage gap are relatively small, they are more pronounced for the p50–p15 gap. Here, larger increases in childcare supply are associated with

smaller increases in wage inequality (14 log points in regions with low increases compared to 8.9 log points in regions with a high increase). This finding is consistent with the graphical results in Figure 3 that show smaller increases in the 85th and 50th percentiles of wages in regions with larger increases in childcare while the 15th percentile shows little regional variation. The reweighting analysis for the lower part of the wage distribution shows that the fraction of the inequality change, for which workforce composition accounts, increases in childcare supply changes. Depending on the choice of the explanatory variables around 40, 50 and more than 70 percent of the increase in the p50–p15 wage gap are explained. The overall pattern for low wages is qualitatively similar for the p85–p15 wage gap. It is less pronounced though, as there is no relationship between childcare increases and inequality for higher wages. Both in the full sample and in the region-specific decomposition adding experience, occupation and industry add explanatory power to the composition effect in the upper end of the wage distribution, whereas the additional variables yield only minor changes for the lower end. This confirms the finding from the full sample that for low earning women the participation decision and the associated mechanical factors age and education are the primary drivers of increasing inequality.

Women Working Part-time Table 5 reports observed and reweighted inequality changes for women working in part-time. The results for the full sample in the upper part of the table indicate an increase in overall wage inequality by 19.8 log points. Compared to full-time workers (23.3 log points) this is a smaller increase but broadly within a similar range. The larger part of the increase in the p85–p15 wage gap is due to workers in the upper end of the wage distribution, which is a clear difference to full-time workers. The p85–p50 gap increases by 10.9 log points whereas the p50–p15 wage gap increases by only 8.8 log points. This is in line with the graphical evidence in Figure 2 which shows relatively large increases in the 15th wage percentile for a major part of the observation period.

The results for reweighted wages allow to draw two main conclusions on the composition of female part-time workers. First, for all parts of the distribution, the fraction of the inequality increase that workforce composition can explain is substantially smaller than in the full-time sample (see Table 4). Depending on the specification, compositional changes account for around three to ten times less (in total between 5 and 18 percent) of the increase in inequality compared to full-time workers. Given the nonetheless sizeable compositional changes among part-time workers (as documented in the previous section), this results seems counterintuitive at first. As shown in Section 2.1, the possibility of changes in working hours as a driver of wage inequality can be largely ruled out. An other explanation is the large influx of women into part-time work itself. As the share of women working in part-time increased by on average 50 percent, this likely introduced additional changes in the composition of workers beyond those that are observable and can be used in the

Table 5: Observed and reweighted changes in wage inequality among part-time working women, 1986–2010.

		I: education, age		II: education, age, experience, occupation, industry	
	Observed change	Composition	Price	Composition	Price
Full sample					
p85–p15	0.198	0.016 (8%)	0.181	0.024 (12%)	0.174
p85–p50	0.109	0.012 (11%)	0.097	0.007 (6%)	0.102
p50–p15	0.088	0.004 (5%)	0.084	0.016 (18%)	0.072
By regional increase in childcare supply					
p85–p15					
Low	0.218	0.016 (7%)	0.202	0.033 (15%)	0.184
Medium	0.196	0.017 (9%)	0.179	0.023 (12%)	0.174
High	0.154	0.013 (8%)	0.141	0.016 (10%)	0.137
p85–p50					
Low	0.105	0.014 (14%)	0.091	0.010 (9%)	0.095
Medium	0.111	0.013 (12%)	0.098	0.013 (12%)	0.097
High	0.122	0.010 (8%)	0.112	0.009 (7%)	0.112
p50–p15					
Low	0.113	0.001 (1%)	0.112	0.024 (21%)	0.089
Medium	0.086	0.004 (5%)	0.082	0.010 (12%)	0.076
High	0.032	0.004 (11%)	0.029	0.007 (22%)	0.025

Notes: Observed and reweighted changes in inequality measures for log imputed daily wages between 1986 and 2010. The observed change is decomposed into a composition effect (columns 3 and 5) and a price (wage structure) effect (columns 4 and 6). Percentage values indicate the contribution of the composition effect to the observed change. Price effects correspond to the change from observed values in 1986 to reweighted values in 2010. Estimates in Panel I use three education and five age categories as well as all possible interactions to estimate DFL weights, in Panel II experience in the current job along with its interaction with the age categories, occupation (3-digit) and industry (1-digit) identifiers are added. The lower part of the table reports results separately for regions with low, medium and high increases in their childcare supply between 1986 and 2002. *Source:* Own estimations using the SIAB data described in Section 2.1.

decomposition. In addition, this finding also underlines that working in full-time is a particular choice, that only a selected part of the female workforce makes—for instance, women before they have their first child or who do not have children as well as those who are distinctly career-oriented. For such a group, unobservable factors are less likely to play a role. Part-time working women, on the other hand, are likely to have more diverse backgrounds as not working full-time after childbirth was a common choice during the observation period that was made by mothers from a variety of backgrounds. Since during this time mothers decreased their time on parental leave and with childcare additionally promoting maternal labor supply, increasing heterogeneity in unobservable characteristics becomes more relevant.

Second, the impact of adding more explanatory variables (results are listed in Panel II) is clearly different between the lower and upper part of the wage distribution. For the p85–p15 wage gap,

adding experience, occupation and industry decreases the fraction of its change explained by composition from 11 to 6 percent. For the p50-p15 wage gap, it more than triples the contribution of composition from 5 to 18 percent. The relative size of these changes is large compared to full-time workers. It provides further indication on the greater heterogeneity of part-time workers such that a reweighting procedure that only relies on age and education is more likely to miss some of the changes the workforce underwent. The direction of the bias differs. For higher earners, age and education alone explain larger increases than with additional variables, suggesting counteracting effects of the added explanatory variables. In the lower part of the wage distribution, I observe the reverse, such that experience, occupation and industry rather contribute to a raise in inequality.

The lower part of Table 5 lists separate results by regions with low, medium and high increases in childcare supply. The change of the p85–p15 wage gap of part-time working women is smaller in regions where childcare supply increased stronger. For low-increase regions, I measure 21.8 log points, for medium-increase regions 19.6 and for high-increase regions 15.5 log points. These overall increases are the result of differential patterns in the upper and lower part of the wage distribution. The p85–p50 wage gap increases slightly in childcare supply (from 10.5 to 12.2 log points), the p50–p15 wage gap decreases substantially from 11.3 to just 3.2 log points. The impact of workforce composition, again, differs between earners of high and low wages. The mechanical factors age and education explain explain fractions of the p85–p50 gap that decrease in childcare supply changes (from 14 to 8 percent; see Panel I). For the p50-p15 wage gap, I observe the opposite. Age and education explain increasing fractions of its change, just 1 percent in low-increase regions and 11 percent in high-increase regions. Noting that age and education are mostly deterministic once a person entered the labor market, these findings show that the participation decisions of low earners increase in their importance in explaining inequality with larger changes in childcare, but decrease for high earners. Adding experience, occupation and industry to the decomposition (see Panel II) leads to no or just small changes for the p85–p50 wage gap. For the p50–p15 wage gap, more variables add substantial explanatory power. Moving from low to high childcare supply increases, the fraction of inequality explained by composition increases by 21, 2.4 and 2 times to levels between 12 and 22 percent. The large increase in regions with small changes in childcare supply stands out and thus has to be treated with some caution. Nevertheless, these results provide evidence that the impact of factors that are more strongly related to workers' choices beyond participation have effects that decrease in their relative importance in regions with larger changes in childcare supply. Put differently, this underlines the importance of the mainly participation-related factors age and education, which increases with larger childcare supply changes.

Summary of the Main Findings The decomposition of the growth in wage inequality allows to draw the following conclusions. Observable worker characteristics are distinctly more relevant

to explain the increase in wage inequality among women who work full-time. For the more heterogeneous group of part-time workers, there is a greater degree of residual changes. Regardless of part-time status, there is no or only little association between childcare and inequality in the upper part of the wage distribution. Inequality among women with lower wages increases less strongly with more additional childcare supply. Larger fractions of these smaller increases can be explained by mechanical factors that are mostly related to changes in participation. This suggests that for women with lower earnings potential, the incentives to take up work provided by additional childcare options are more relevant. Changes in decision making by women who are already part of the workforce but opt, for instance, into different occupations show no clear relationship with childcare. The larger relevance of participation decisions, in particular in the lower part of the wage distribution, is consistent with the institutional details of the childcare expansion. It did not start at zero levels, but rather provided additional supply that was relatively affordable, especially in comparison to, at this time, scarce alternatives on the private market. Therefore, it rather addressed a demand among those women with lower earnings potential and thus the lowest willingness to pay for childcare. Higher earning women with a higher willingness to pay for childcare, on the other hand, have likely organized their labor market participation already before the policy change.

Robustness I assess the robustness of the results from the re-weighting exercise by using DFL weights that include additional explanatory variables as well as by comparing the findings for women with results for men. Panel I of Table A.4 in the Appendix repeats the decomposition for full-time working women in Panel II of Table 4, but with finer, 4-digit instead of 3-digit, occupation codes and adds indicator variables for four groups of required skills in the occupation. As the more detailed explanatory variables lead to some loss in the number of observations, the results differ, but the patterns described for the main results remain generally unchanged. Panel II of Table A.4 performs this test for women working in part-time (thus, it is to be compared with Table 5). Similar to full-time workers, adding explanatory variables to the re-weighting does not lead to noteworthy changes.

To test if there is a common trend that affects both female and male workers Table A.5 in the Appendix repeats the decomposition for full-time working women in Table 4 for men. The overall increase in wage inequality between 1986 and 2010 as measured by the p85–p15 wage gap is larger for male workers compared to female workers (27.7 vs. 23.3 log points). Further similarities are that inequality in the lower end of the wage distribution shows the stronger increase (15.1 vs. 12.5 log points) and that the p50–p15 wage gap tends to increase less in regions with larger additional childcare supply, though the relationship is markedly weaker than for women. Importantly, the share of the difference between 1986 and 2010 in all wage gaps that can be explained by workforce composition does not show an association with regional childcare supply increases. Thus, there is

no sign that the findings on the association between wage inequality and childcare for women are driven by a common trend that affected both genders alike.

7 Inequality Between Women and Men

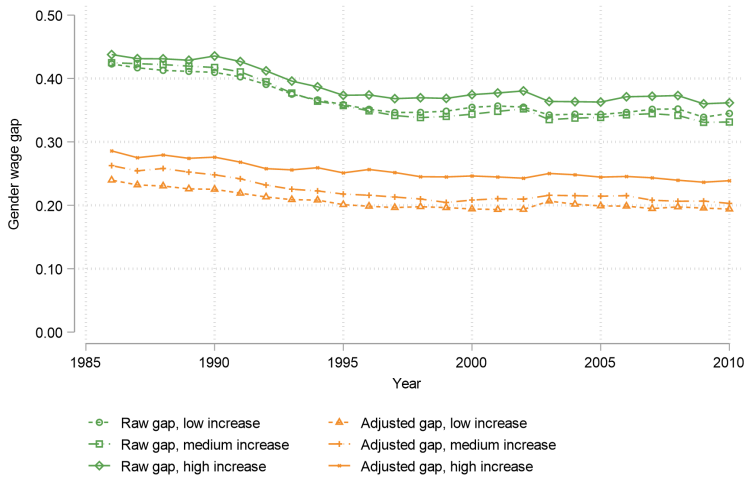


FIGURE 8: Raw and adjusted gender wage gaps of full-time workers by development of childcare supply between 1986 and 2010.

Notes: The figure plots the raw (in green) and adjusted (in orange) gender wage gaps, i.e. the average difference between the log wages of men and women. The plot differentiates between regions with low (plotted as short-dashed lines), medium (plotted as long-dashed lines) and high increases (plotted as solid lines) in childcare supply. Adjusted gender gaps control for interactions of age group with education, experience in employment and experience in the current job as well as for occupation (3-digit-level), industry (1-digit-level) and if an individual's wage is censored. To improve readability, the gender gap is shown as a positive number. *Source:* Own estimations using the SIAB data described in Section 2.1.

Even though larger expansions in childcare supply are associated with less strongly increasing levels of wage inequality among women, it is—ex ante—ambiguous if and how it changed the position of women relative to men. To assess this question and to provide further context to the previous findings, this section studies the development of the gender wage gap.

Figure 8 plots the evolution of the raw (plotted in green) and adjusted (plotted in orange) gender gaps in log full-time wages[19] for regions with low, medium and high increases in their childcare supply. It shows that those regions with the largest increase in their childcare supply initially have the largest raw gender differences in pay (around 44 vs. 42 percent in other regions). Regions with medium or low increases differ only slightly. This pattern persists over the entire observation period

[19] I restrict attention to workers in full-time since part-time working men likely follow different selection patterns compared to their female counterparts and their number is too small to serve as a comparison group.

while pay differences decrease substantially. The most pronounced decrease is in the early 1990s when the wages of men stagnate or even decline (see Dustmann, Ludsteck, and Schönberg 2009) while the wages of women, on average, continue to increase (see Figure 2). This leads to a marked decrease of the gender gap by around 6 to 7 percentage points. Until 2010, the raw gaps fall to levels between 33 and 36 percent.

The adjusted gender wage gap indicates the remaining, unexplained pay differences after controlling for age, experience (total and in the current job), occupation, industry and a dummy for censored wages. Over time, it decreases in all regions. In 1986, the adjusted gender gap ranges between 24 and 28.6 percent, in 2010 between 19.4 and 23.9 percent. For each year though, its levels increase clearly in the regional change in childcare. This correlation suggests that the finding that the overall position of women in the labor market in regions where childcare increased stronger is worse in terms of observable characteristics (see Table 3) extends to residual gender inequality as well.

To further assess the role of workforce composition in comparison to other factors, I use the DFL weights to decompose the change in the gender wage gap. Precisely, I recalculate the raw gender wage in 2010 with the characteristics of the female part of the sample reweighted to match its characteristics in 1986. Observations from men are not reweighted. This approach assess the contribution of the compositional changes in the female workforce to the decrease in the gender wage gap. Table 6 reports the results for the full sample and by regional childcare increase.

TABLE 6: Observed and reweighted changes in the gender gap in log wages among full-time workers, 1986–2010.

	Observed			I: age, education		II: age, education, experience, occupation, industry	
	1986	2020	$\Delta_{2010\text{-}1986}$	Composition	Price	Composition	Price
Full sample	0.426	0.341	−0.085	−0.089 (105%)	0.004	−0.073 (86%)	−0.012
By regional increase in childcare supply							
Low increase	0.423	0.345	−0.078	−0.100 (128%)	0.022	−0.085 (109%)	0.007
Medium increase	0.425	0.331	−0.094	−0.083 (88%)	−0.011	−0.068 (72%)	−0.026
High increase	0.438	0.362	−0.076	−0.064 (84%)	−0.012	−0.046 (61%)	−0.030

Notes: Columns 2–4 of the table reports estimates of the raw gender gap in log wages in 1986 and 2010 along with the difference between the two years. Columns 5–8 decompose the change in the gender gap into a composition and a price effect using the DFL weights described in Section 6.2. Percentage values indicate the contribution of the composition effect to the observed change. Estimates in Panel I use three education and five age categories as well as all possible interactions to estimate DFL weights, in Panel II experience in the current job along with its interaction with the age categories, occupation (3-digit) and industry (1-digit) identifiers are added. The lower part of the table reports results separately for regions with low, medium and high increases in their childcare supply between 1986 and 2002. *Source:* Own estimations using the SIAB data described in Section 2.1.

In the full sample for all workers in West Germany, the gender wage gap decreases by 8.5 percentage points. The composition effect measured when reweighting with respect to age and education ex-

ceeds the actual decrease slightly, indicating that composition alone would have led to an even stronger reduction but that the price effect dampens it. Adding experience, occupation and industry to the weights reduces the impact of composition to 86 percent of the total change, implying that the female workforce became more similar to the male one in terms of age and education[20] but this is counteracted by differences with respect to experience or selection into occupations which have an increasing effect on the gender wage gap.

The decomposition of the gender gap by regional childcare increases is reported in the lower part of Table 6. Size and contribution of the composition effect follow a distinct pattern. For both sets of explanatory variables, workforce composition explains substantially larger fractions of the reduction of the gender wage gap in regions with lower increases in childcare supply (128 vs. 84 percent and 109 vs. 61 percent respectively). This result is a somewhat reverse picture compared to the reweighting analysis of wage inequality within female workers (see Table 4) where composition explains larger fractions of the changes in the lower end of the wage distribution when childcare supply increased stronger. It underlines that those compositional changes that reduced the increase in wage dispersion among women, at the same time, did not contribute to further reductions of wage inequality between genders. This is consistent with the previous findings that larger increases in childcare supply rather affect the participation of low-earning women. It, further, provides an example for the relationship between rather negative selection into employment and the gender gap. As shown, for instance, by Mulligan and Rubinstein (2008) and Olivetti and Petrongolo (2008), those women who work are on average a positive selection from all women such that measures of the gender wage gap include a selection bias. When a policy—such as an expansion of childcare provision—draws more women into employment, the selection bias decreases such that observed wage differentials between women and men increase.

8 Conclusion

The large expansion of publicly provided childcare over the 1990s marked a major shift in German policy towards promoting maternal labor supply. In this paper, I utilize this reform to demonstrate the role of a family policy as a labor market institution for women and assess its contribution to wage inequality. I provide the following main findings.

While wage inequality among women increases over the period of observation between 1986 and 2010, these increases are lower where childcare supply was expanded more. This is primarily driven by the lower end of the wage distribution. Assessing the role of workforce composition, I find that in regions with larger increases in childcare larger fractions of the change in wage inequality can be

[20] Note, that this does not imply the same levels of pay given the same observable characteristics of men and women. Though, it contributes to a decrease in average pay differences.

explained by compositional changes while in other regions residual effects have larger impacts. In these regions, more women select into part-time work, and medium levels of education are more common, whereas in other regions there are more female workers from the lower and upper end of the education distribution. Women also exhibit higher levels of experience and work in more stable jobs where childcare increased stronger. The relationship between childcare and wage inequality is stronger for lower wages and in regions with larger increases in childcare. Age and education, which are mostly affected by changes in participation, play a larger role in explaining changes in wage inequality than factors as experience, occupation or industry choices. Thus, the observed patterns are rather the result of women changing their participation status than of choices of women who were already part of the workforce.

Even though inequality among women decreases with stronger increases in childcare, the opposite holds for inequality between women and men, i.e. the gender wage gap. Both the raw and adjusted gender gap in wages is the largest in those regions with the strongest increases in childcare supply. Consistently, in these regions workforce composition explains the smallest fraction of the overall decrease of the gender gap over time.

My findings are overall similar for women in full- and part-time. For the latter, the relationship between larger increases in childcare and smaller increases in inequality is stronger. Taken together, they suggest that childcare had an impact on wage inequality mostly by changing the participation decisions of women with lower earnings potential.

While I conclude a contribution of additional childcare to less unequal wages among women, I find no indication that it improved the overall composition of the female labor force relative to men beyond existing trends. Therefore, this childcare expansion provides an example for a family policy that improved female labor supply such that women are better off, both due to current earnings but also in the long-run due to increased pension contributions. At the same time, however, there is no direct contribution to a lower gender wage gap as more participation of women rather decreased the selection bias in measuring female wages.

Some limitations apply to this paper's results. I focus on a period during which more women become part of the workforce, they upgrade in terms of education and occupations and mothers reduce the time they spend on parental leave. The expansion of public childcare slots, thus, was one of multiple changes related to female labor supply. Hence, it rather contributed to general trends such that they became stronger in regions with larger increases in childcare supply but did not lead to a shift in trends. Further, the policy change addressed primarily a demand for childcare of those with lower willingness to pay for it, i.e. women with lower potential wages. My results, therefore, do not necessarily generalize to other expansions in care for children of different age level as their mothers likely have different preferences and face different constraints. For this particular childcare expansion, my findings are nevertheless consistent with expectations and with the institutional

details, as the reform increased relatively affordable care for children of age three to school entry. Thus, it did not address the needs of highly career-oriented women who tend to re-enter the labor market sooner after childbirth. Instead, it provided incentives to take up or expand work for women with lower potential earnings.

The specific nature of the policy change this paper studies opens opportunities for further research. Since 2013 for instance, children of age one and above have a legal claim to a slot in public childcare in Germany. Presumably, this reform addressed the needs of more high-earning women such that consequences for wage inequality are likely different. Hence, it is worthwhile to extend the analysis of wage inequality to other reforms in childcare as well as to other family policies.

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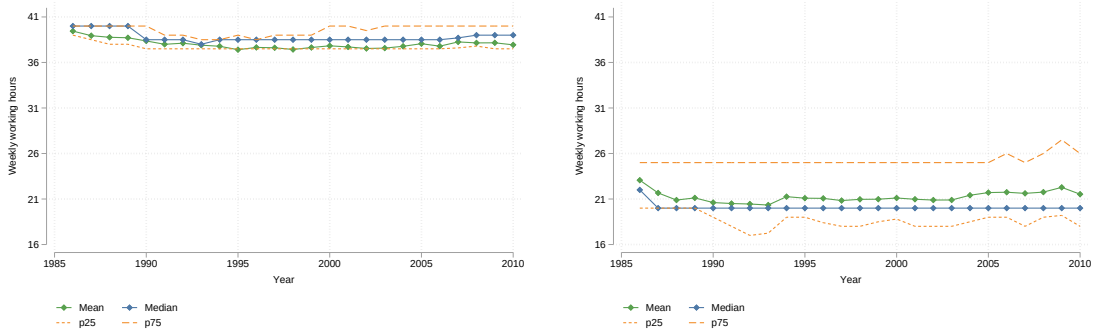
Appendix

A Additional Figures and Tables



(A) Full-time workers

(B) Part-time workers

FIGURE A.1: Weekly working hours of females between 1986 and 2010 (SOEP data).

Notes: The figure plots usual weekly working hours of women aged 21 to 60 in regular employment in West Germany between 1986 and 2010. *Source:* Own estimations using the SOEP v37 data (Wagner, Frick, and Schupp 2007). Sample restrictions similar to those for the SIAB data described in Section 2.1 are applied.

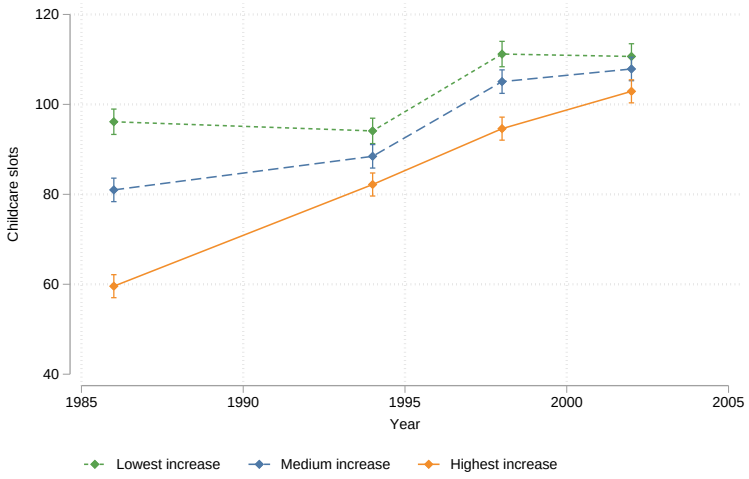


FIGURE A.2: Number of childcare slots for children of kindergarten age between 1986 and 2002, grouped by counties with low, medium and high increases.

Notes: The figure documents the increase in childcare supply between 1986 and 2010 along with 95-percent confidence bands. Childcare supply is measured at the county-level as the number of slots in public childcare for children of kindergarten age per 100 children aged three to five. Values above 100 do not indicate excess supply with childcare but rater that kindergarten age can include age levels up to age seven. As population data by age is not available for this group, the number of children of age three to five is used for scaling. The analyses in this paper use the relative supply measure plotted in Figure 1. *Source:* Own representation using the county-level data described in Section 2.2.

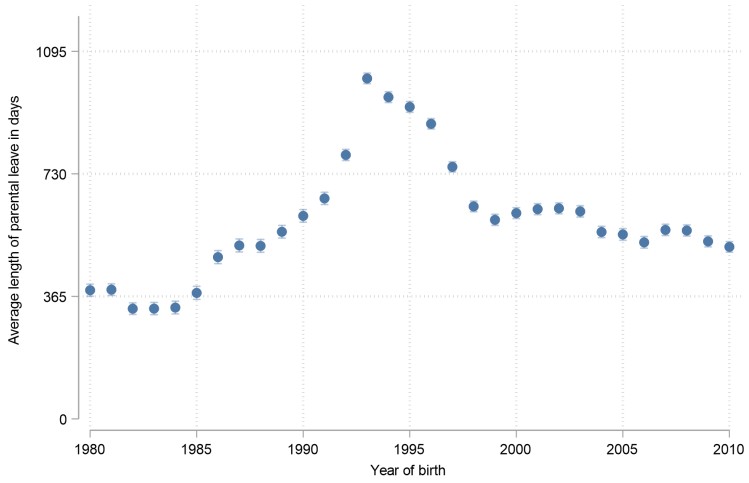
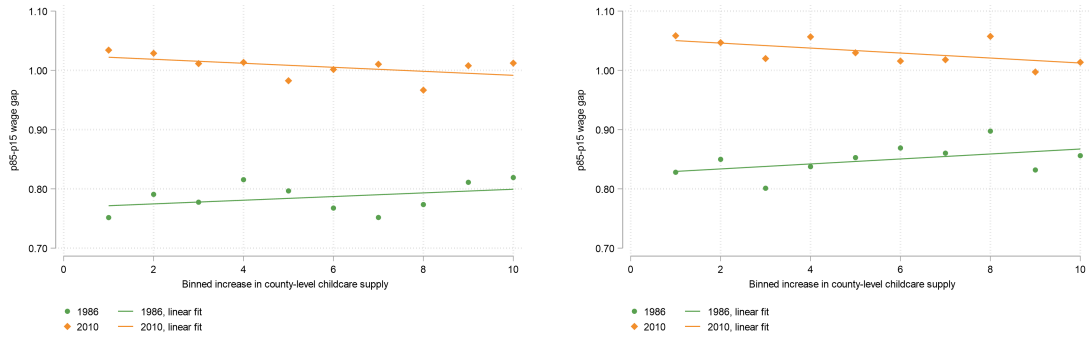


FIGURE A.3: Average length of parental leave taking by birthday of the first child (1980–2010).

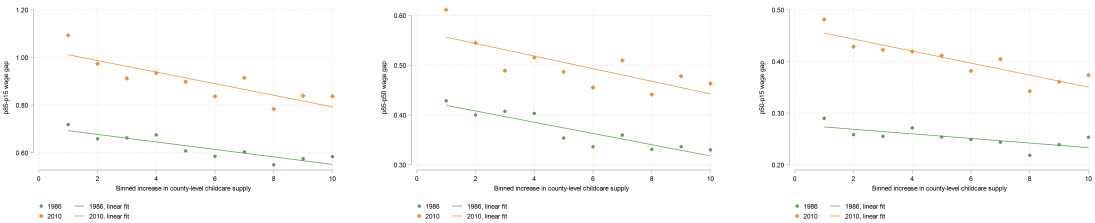
Notes: Average length of parental leave in days after the birth of the first child. The plot restricts observations to mothers who return to the labor market after at most six years after childbirth. Without this restriction the levels for the years before 1993 are similar to those in 1993, the trend that the length of parental leave decreases which starts at around 1994 remains unaffected. Mothers are identified based on the length of their absence from work following D. Müller, Filser, and Frodermann (2022). *Source:* Own estimation using the SIAB data described in Section 2.1.



(A) Full-time workers (B) Part-time workers

FIGURE A.4: p85–p15 wage gap of women in 1986 and 2010 by binned regional increase in childcare supply.

Notes: The figure plots the p85–p15 gap in log daily wages of women by binned regional increase in childcare supply. The relationship in 1986 is plotted in green, results for the year 2010 are plotted in orange. Each bin contains 32–33 counties where those in the first bin increase their childcare supply by on average 6.5 additional slots per 100 children and those in the tenth bin by on average 54 additional slots. *Source:* Own estimations using the SIAB data described in Section 2.1.



(A) p85–p15 wage gap (B) p85–p50 wage gap (C) p50–p15 wage gap

FIGURE A.5: p85–p15, p85–p50 and p50–p15 wage gaps of full-time working men in 1986 and 2010 by binned regional increase in childcare supply.

Notes: The figure plots the p85–p15 gap in log daily wages of full-time working men by binned regional increase in childcare supply. The relationship in 1986 is plotted in green, results for the year 2010 are plotted in orange. Each bin contains 32–33 counties where those in the first bin increase their childcare supply by on average 6.5 additional slots per 100 children and those in the tenth bin by on average 54 additional slots. *Source:* Own estimations using the SIAB data described in Section 2.1.

Table A.1: County-level relationship between increase in childcare supply and wage inequality (in standard deviations), 1986 and 2010, male workers.

	Male full-time workers		
	1986	2010	$\Delta_{2010\text{-}1986}$
p85–p15	−0.539***	−0.532***	0.007
p85–p50	−0.493***	−0.413***	0.080
p50–p15	−0.444***	−0.522***	−0.078

The tables reports the relationship between the increase in childcare supply and percentile wage gaps for male workers in 1986 and 2010. Each value indicates by which share of a standard deviation the percentile gap would change if the increase in childcare supply was stronger by one standard deviation (additional 13.36 slots per 100 children). The row marked with Δ indicates the change from 1986 to 2010. All results are obtained from linear regressions on the county level, weighted with each county's observations share. */**/*** indicate significance at the 10/5/1 percent levels. *Source:* Own estimations using the SIAB data described in Section 2.1.

Table A.2: County-level relationship between increase in childcare supply and wage inequality (in standard deviations) controlling for the change in GDP, 1986 and 2010.

	Full-time workers			Part-time workers		
	1986	2010	$\Delta_{2010\text{-}1986}$	1986	2010	$\Delta_{2010\text{-}1986}$
p85–p15	0.132**	−0.104	−0.236	0.033	−0.138**	−0.171
p85–p50	−0.007	−0.054†	−0.047	−0.125**	−0.034	0.091
p50–p15	0.161**	−0.085	−0.246	0.105*	−0.146***	−0.246

The table reports the relationship between the increase in childcare supply and percentile wage gaps for female workers in 1986 and 2010. The values for each year indicate by which fraction of a standard deviation the percentile gap would change if the increase in childcare supply was stronger by one standard deviation (additional 13.36 slots per 100 children). The columns marked with Δ indicate the change from 1986 to 2010. All results are obtained from linear regressions on the county level, weighted with each county's observation share and additionally controlling for the change in log per-capita GDP between 1992 and 2010. 1992 is chosen as baseline year as earlier data is not available. */**/*** indicate significance at the 10/5/1 percent levels; † indicates significance of the change in GDP at the 10 percent level. *Source:* Own estimations using the SIAB data described in Section 2.1.

Table A.3: Percentile gaps in log wages of women, 1986 and 2010.

	I: full-time workers		II: part-time workers	
	1986	2010	1986	2010
Full sample				
p85–p15	0.791	1.023	0.834	1.032
p85–p50	0.343	0.449	0.374	0.484
p50–p15	0.448	0.575	0.460	0.548
By regional increase in childcare supply				
p85–p15				
Low	0.775	1.025	0.812	1.030
Medium	0.792	1.008	0.837	1.033
High	0.793	1.008	0.863	1.017
p85–p50				
Low	0.339	0.449	0.376	0.481
Medium	0.345	0.441	0.374	0.485
High	0.339	0.445	0.362	0.484
p50–p15				
Low	0.436	0.576	0.436	0.549
Medium	0.447	0.567	0.463	0.549
High	0.454	0.543	0.501	0.533

Notes: The table reports percentile gaps in log imputed daily wages in 1986 and 2010. Panel I reports values for full-time workers, Panel II for part-time workers. The lower part of the table reports wage gaps separately for regions with low, medium and high increases in their childcare supply between 1986 and 2002. *Source:* Own estimations using the SIAB data described in Section 2.1.

Table A.4: Observed and reweighted changes in wage inequality among women with additional explanatory variables, 1986–2010.

	I. Full-time workers			II. Part-time workers		
	Observed change	Composition	Price	Observed Change	Composition	Price
Full sample						
p85–p15	0.221	0.110 (50%)	0.111	0.196	0.023 (12%)	0.173
p85–p50	0.102	0.055 (54%)	0.047	0.108	0.009 (8%)	0.100
p50–p15	0.118	0.055 (46%)	0.064	0.087	0.014 (16%)	0.073
By regional increase in childcare supply						
p85–p15						
Low	0.241	0.099 (41%)	0.142	0.217	0.031 (14%)	0.186
Medium	0.204	0.116 (57%)	0.088	0.194	0.025 (13%)	0.169
High	0.197	0.110 (56%)	0.086	0.154	0.019 (12%)	0.135
p85–p50						
Low	0.107	0.047 (44%)	0.059	0.104	0.008 (8%)	0.095
Medium	0.093	0.065 (70%)	0.028	0.109	0.015 (14%)	0.094
High	0.108	0.051 (47%)	0.057	0.123	0.011 (9%)	0.112
p50–p15						
Low	0.134	0.052 (39%)	0.083	0.113	0.022 (20%)	0.091
Medium	0.110	0.051 (46%)	0.060	0.085	0.010 (11%)	0.075
High	0.089	0.059 (67%)	0.030	0.031	0.008 (27%)	0.023

Notes: Observed and reweighted changes in inequality measures for log imputed daily wages between 1986 and 2010. The observed change is decomposed into a composition effect (columns 3 and 6) and a price (wage structure) effect (columns 4 and 7). Percentage values indicate the contribution of the composition effect to the observed change. Price effects correspond to the change from observed values in 1986 to reweighted values in 2010. Estimates in Panel I are for full-time workers, Panel II reports them for part-time workers. All specifications use three education and five age categories as well as all possible interactions, experience in the current job along with its interaction with the age categories, occupation (4-digit), four groups of skill requirements in the occupation and industry (1-digit) to estimate DFL weights. The lower part of the table reports results separately for regions with low, medium and high increases in their childcare supply between 1986 and 2002. *Source:* Own estimations using the SIAB data described in Section 2.1.

Table A.5: Observed and reweighted changes in wage inequality among full-time working men, 1986–2010.

		I: education, age		II: education, age, experience, occupation, industry	
	Observed change	Composition	Price	Composition	Price
Full sample					
p85–p15	0.277	0.075 (27%)	0.202	0.105 (38%)	0.171
p85–p50	0.125	0.060 (48%)	0.066	0.054 (43%)	0.071
p50–p15	0.151	0.016 (10%)	0.136	0.051 (34%)	0.100
By regional increase in childcare supply					
p85–p15					
Low	0.309	0.101 (33%)	0.208	0.136 (44%)	0.172
Medium	0.274	0.078 (29%)	0.196	0.107 (39%)	0.166
High	0.257	0.075 (29%)	0.182	0.109 (42%)	0.150
p85–p50					
Low	0.139	0.084 (61%)	0.054	0.080 (58%)	0.058
Medium	0.130	0.064 (49%)	0.066	0.060 (46%)	0.070
High	0.130	0.065 (50%)	0.066	0.067 (51%)	0.064
p50–p15					
Low	0.170	0.016 (10%)	0.154	0.056 (33%)	0.114
Medium	0.144	0.014 (10%)	0.130	0.047 (33%)	0.096
High	0.126	0.010 (8%)	0.116	0.042 (33%)	0.086

Notes: Observed and reweighted changes in inequality measures for log imputed daily wages between 1986 and 2010. The observed change is decomposed into a composition effect (columns 3 and 5) and a price (wage structure) effect (columns 4 and 6). Percentage values indicate the contribution of the composition effect to the observed change. Price effects correspond to the change from observed values in 1986 to reweighted values in 2010. Estimates in Panel I use three education and five age categories as well as all possible interactions to estimate DFL weights, in Panel II experience in the current job along with its interaction with the age categories, occupation (3-digit) and industry (1-digit) identifiers are added. The lower part of the table reports results separately for regions with low, medium and high increases in their childcare supply between 1986 and 2002. *Source:* Own estimations using the SIAB data described in Section 2.1.

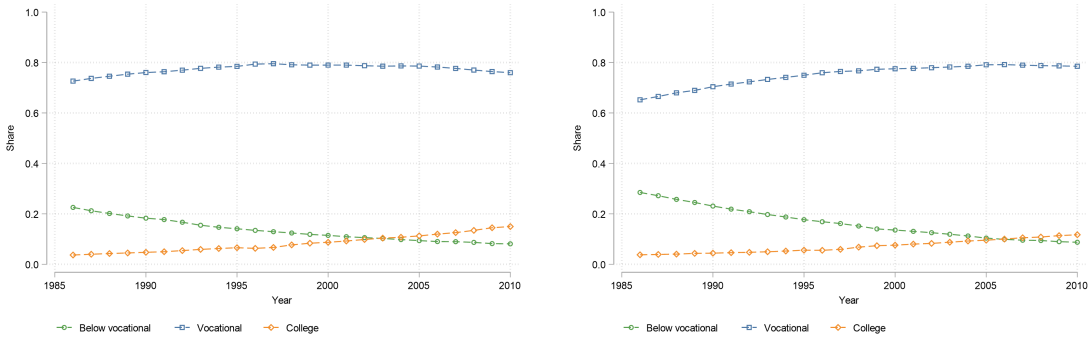
B Imputation of Wages Above the Social Security Threshold

To impute right-censored wages, this paper builds on the wage imputation by Dauth and Eppelsheimer (2020) who follow the two-step approaches by Dustmann, Ludsteck, and Schönberg (2009) and Card, Heining, and Kline (2013). The imputation is done separately by year, education group (no vocational training, vocational training and university or similar) and gender. The first step fits Tobit regressions of observed log wages on variables for experience (linear and squared terms) and different age profiles for older and younger workers. Predictions based on the regression coefficients $\hat{\beta}$ and observable characteristics $\mathbf{X}$ as the expected value $\mathrm{E}\left[ln(\text{wage})\right] = \mathbf{X}\hat{\beta}$ are likely to exhibit a too strong correlation with $\mathbf{X}$ since they neglect the contribution of unobservable factors. Therefore, a normally distributed random term is added to the expected value. Assuming that wages follow a log-normal distribution, the additional random term is chosen such that for each individual i the following equation holds.

$$ln\left(\text{wage}_i^{\text{imputed}}\right) = \epsilon_i\hat{\sigma} + \mathbf{X}_i\hat{\beta} \tag{1}$$

ϵ_i is drawn from the distribution of wages above the censoring limit and $\hat{\sigma}$ refers to the standard deviation of the residuals in the Tobit regression. Gartner (2005) and Dauth and Eppelsheimer (2020) describe the procedure in more detail.

The imputed wages are then used to calculate mean wages at the worker- and establishment-level where always the contribution of the current observation is omitted. In the second step, the Tobit regressions from the first step are repeated, but with these mean wages as additional control variables. They serve as proxies for time-constant effects at the worker- and establishment level, i.e. follow the idea of controlling for worker- and establishment fixed effects. After the second regression, again a random term as described above is added to the prediction from the regression and wages are adjusted to be not larger than ten times the 99th percentile of the predicted wage distribution.



(A) Full-time workers

(B) Part-time workers

FIGURE C.1: Shares of education levels of the female workforce between 1986 and 2010.

Notes: Education of women by year. Education below the vocational level is plotted in green, vocational education in blue, and university education in orange. *Source:* Own estimations using the SIAB data described in Section 2.1.

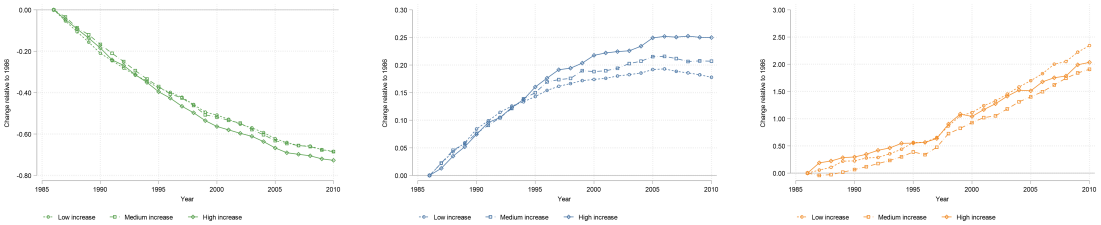
C Additional Evidence on Changes in Workforce Composition

This section collects further evidence on changes in the composition of the female workforce, complementing section 6.1.

Education Figure C.1 plots the composition of the female full- and part-time workforce with respect to education. Figure C.2 focuses on women worker in part-time and plots the development of education by increases in childcare supply.

Selection into Occupations and Associated Skills Figure C.3 plots the shares of women in three occupation categories by increase in regional childcare supply. The categories are derived from the occupation groups constructed by Blossfeld (1985) and indicate occupations that require on average low, medium and high levels of qualification.[21] For both full- and part-time working women, there is clear evidence for upgrading in terms of occupations. Over time, the share of women working in low-qualified occupations decreases, while there are more women working in qualified and highly qualified occupations. This is consistent with the findings for education. Differentiating by the increase in childcare supply reveals substantially different levels between regions among full-time workers (plotted in the left-hand panel), though no different trends. In regions with high childcare increases, more women are in low qualified occupations and fewer in qualified and highly qualified ones. Part-time workers (depicted in the right-hand panel) show

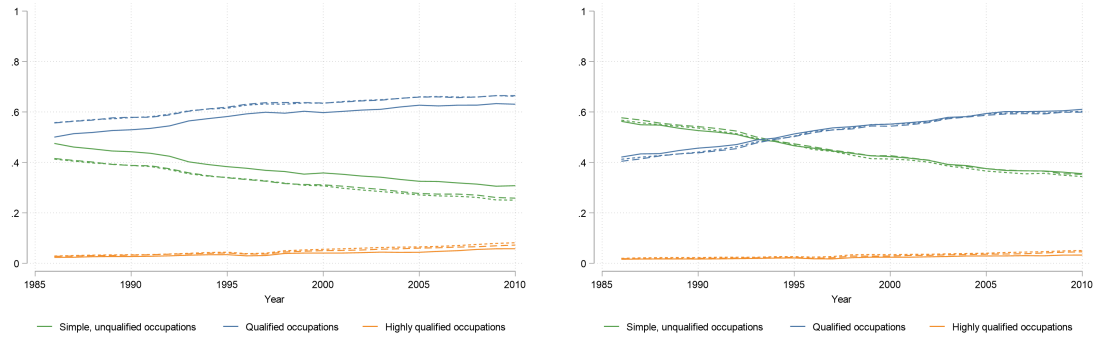
[21] Table C.1 provides the mapping between the Blossfeld groups and the categories by qualification, Table C.2 reports average wages and employment shares by occupation categories.



(A) Below vocational education (B) Vocational education (C) University or equivalent education

FIGURE C.2: Changes in education of female part-time workers relative to 1986 by year and development of childcare supply.

Notes: Changes in the education levels of the female part-time workforce over time by development of childcare supply. Plots indicate changes relative to 1986. Observations are grouped by the position of a region in the distribution of the change in childcare supply between 1986 and 2002. The tercile of regions with the largest increases is plotted as a solid line, the second tercile as a long-dashed line, and the tercile of regions with the smallest increases as a short-dashed line. *Source:* Own estimations based on the SIAB data described in Section 2.1.



(A) Full-time workers (B) Part-time workers

FIGURE C.3: Shares of women working in occupations of different qualification levels by development of childcare supply between 1986 and 2010.

Notes: Occupations of women by year change in the supply of childcare. Occupations requiring simple, unqualified work plotted in green, those requiring qualified work in blue, and highly qualified occupations in orange. The tercile of regions with the largest increases in childcare is plotted as a solid line, the second tercile as a long-dashed line, and the tercile of regions with the smallest increases as a short-dashed line. *Source:* Own estimations using the SIAB data described in Section 2.1.

Table C.1: Occupation categories derived from the Blossfeld occupation groups.

Simple, unqualified	Qualified	Highly qualified
Agricultural	Qualified manual	Engineers
Simple manual	Technicians	Professionals (service sector)
Simple service sector	Qualified service sector	Managers
Simple clerks, office jobs	Semi-professionals	
	Qualified office and administrative	

Notes: The table shows the mapping of occupation groups defined by Blossfeld (1985) to the broader occupation classifications by qualification level that is used in Figure C.3.

Table C.2: Average wages and employment shares of occupation categories.

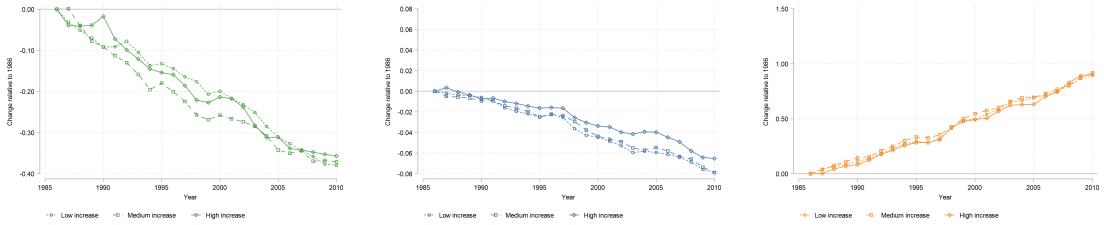
	Simple, unqualified	Qualified	Highly qualified
Wage			
1986	4.21	4.41	4.79
2002	4.30	4.60	5.01
Employment share			
1986	46.2%	51.3%	2.5%
2010	29.9%	63.8%	6.3%

Notes: The table reports the average log daily wages of women per occupation group in 1986 and 2010. Occupation groups are defined as described in Section C and Table C.1. *Source:* Own estimations based on the SIAB data described in Section 2.1.

initially higher shares of women in low qualified occupations. Their trends for all categories are similar to the ones of full-time workers. There are only negligible regional differences.

To provide an additional perspective on occupations, I also plot how the workforce composition in terms of the required skills within occupations develops. This measure is derived from the fifth digit in the occupation classification KldB 2010 (Bundesagentur für Arbeit 2021). It differentiates between unskilled and semi-skilled, skilled and two levels of complex tasks workers have to carry out. I aggregate complex tasks into one category since they appear only in small proportions among women. In comparison to the measure used in Figure C.3 which compares *between* occupations, this measure of tasks also captures differences *within* an occupation. A nurse, for instance, can fall into all skill categories depending on their specialization and exact place of work. This measure is more suitable to detect changes over the career trajectory, for instance due to receiving further training or being promoted.

Figure C.4 plots how the task-related skill levels of female full-time workers change over time by regional increases in childcare supply relative to 1986. It confirms the substantial amount of upgrading that education and occupations show as well. Complex and highly complex tasks almost double in their frequencies (from 10 to 19 percent), unskilled tasks become less frequent by around



(A) Un-/semiskilled tasks (B) Skilled tasks (C) Complex and highly complex tasks

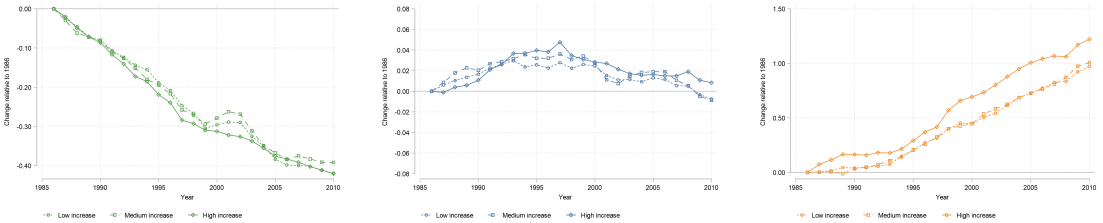
FIGURE C.4: Changes in the skill levels of female full-time workers relative to 1986 by year and development of childcare supply.

Notes: Changes in the skill level derived from occupations of the female full-time workforce over time by development of childcare supply. Plots indicate changes relative to 1986. Observations are grouped by the position of a region in the distribution of the change in childcare supply between 1986 and 2002. The tercile of regions with the largest increases is plotted as a solid line, the second tercile as a long-dashed line, and the tercile of regions with the smallest increases as a short-dashed line. Results for part-time workers are plotted in Figure C.5. *Source:* Own estimation based on the SIAB data described in Section 2.1.

37 percent (from 7 to 4.5 percent). For both of these skill levels, regional differences are negligible. The share of women in skilled tasks decreases, though less strongly compared to the other two skill groups (from 83 to 77 percent). Regions with low or medium increases in childcare show the largest decreases by up to 8 percent. In regions with higher increases in childcare, the decline in skilled tasks is less pronounced. This divergence starts in the early 1990s; up until 2010 the decrease is only 6.5 percent.

Part-time workers (plotted in Figure C.5) show similar decreases in unskilled tasks. Their trend for skilled tasks is not a continuous decline but rather follows a reverse u-shape, that reaches its peak in the mid of the 1990s. The overall changes until 2010 are small, though. Similar to full-time workers, in regions with high childcare increases, skilled tasks are slightly more frequent but the regional differences are less clear. For complex and highly complex tasks, the high childcare increase regions stand out, where they increase by 122 percent. In medium- and low-increase regions the change in more complex tasks is just 101, respectively 98 percent.

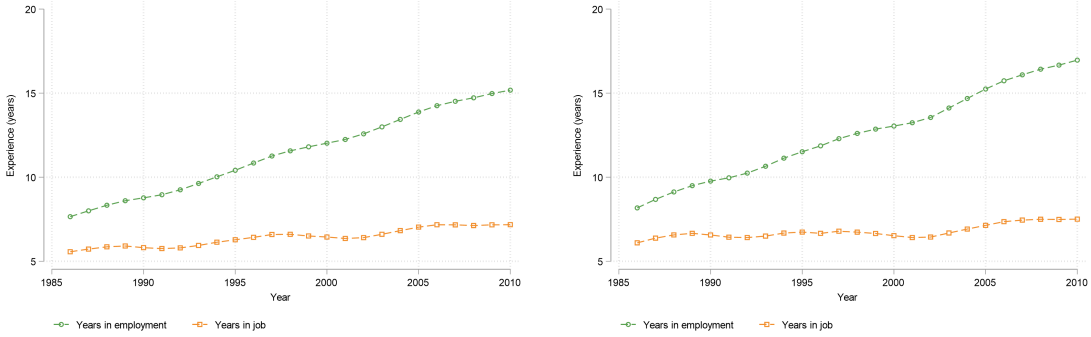
Overall, there are almost no regionally different trends in between-occupation selection. Within occupations, however, full-time workers in regions with high increases in childcare tend to remain in the middle of the skill distribution. This can be found for part-time workers as well, though less pronounced. Instead, for them larger childcare increases are associated with larger shares of women working in jobs that demand more complex tasks.



(A) Un-/semiskilled tasks (B) Skilled tasks (C) Complex and highly complex tasks

FIGURE C.5: Changes in the skill levels of female part-time workers relative to 1986 by year and development of childcare supply.

Notes: Changes in the skill level derived from occupations of the female part-time workforce over time by development of childcare supply. Plots indicate changes relative to 1986. Observations are grouped by the position of a region in the distribution of the change in childcare supply between 1986 and 2002. The tercile of regions with the largest increases is plotted as a solid line, the second tercile as a long-dashed line, and the tercile of regions with the smallest increases as a short-dashed line. *Source:* Own estimation based on the SIAB data described in Section 2.1.



(A) Full-time workers (B) Part-time workers

FIGURE C.6: Work experience of the female workforce between 1986 and 2010.

Notes: Development of work experience measures over time. Total work experience is plotted in green, tenure in the current job in orange. *Source:* Own estimations using the SIAB data described in Section 2.1.

D DiNardo, Fortin and Lemieux Reweighting

The reweighting approach by DiNardo, Fortin, and Lemieux (1996) follows the idea of the Oaxaca-Blinder decomposition (Oaxaca 1973; Blinder 1973), but extends it from differences in means to the entire distribution such that other statistics as variance or quantiles can be calculated. This property is particularly important to assess changes in specific parts of the wage distribution. The reweighting procedure treats each individual observation (of wages w and individual characteristics z at a time t) as an element of a joint distribution at a given point in time, $F(w, z|t)$. The density of wages at t, $f_t(w)$, is then equal to the integral of the density of wages that is conditional on z at time t_w, $f(w|z, t_w)$, over the distribution of characteristics $F(z|t_z)$ at time t_z (where t_w and t_z refer to the points in time when w and z are measured). Formally, this can be written as

$$\begin{aligned} f_t(w) &= \int_z dF(w, z|t_{w,z} = t) \\ &= \int_z f(w|z, t_w)\, dF(z|t_z = t) \\ &\equiv f(w; t_w = t, t_z = t) \end{aligned} \tag{1}$$

where the last line refers to the density of wages that is actually observed, i.e. when both w and z are measured at time t. For this paper, the aim of the reweighting procedure is to obtain a counterfactual wage distribution for time t that would have prevailed if individual characteristics z remained unchanged at the levels at time t'. Formally, the counterfactual density of wages at time t given the characteristics z being measured at time t' is given by $f(w; t_w = t, t_z = t')$. By definition, this is unobservable. Using the second line of equation (1) to rewrite the counterfactual density gives

$$\begin{aligned} f(w; t_w = t, t_z = t') &= \int_z f(w|z, t_w = t)\, dF(z|t_z = t') \\ &\equiv \int_z f(w|z, t_w = t)\, \psi_z(z)\, dF(z|t_z = t). \end{aligned} \tag{2}$$

This expresses the counterfactual wage density as the integral of the density of wage at time t over the distribution of individual characteristics at time t'. Multiplying with $\frac{dF(z|t_z=t)}{dF(z|t_z=t)}$ allows to rewrite the expression as the integral of the wage density at time t over the distribution of z at time t, weighted by ψ_z. The weights are given as

$$\begin{aligned} \psi_z \equiv \frac{dF(z|t_z = t')}{dF(z|t_z = t)} &= \frac{\Pr(z|t_z = t')}{\Pr(z|t_z = t)} \\ &= \frac{\Pr(t_z = t'|z)/\Pr(t_z = t')}{\Pr(t_z = t|z)/\Pr(t_z = t)}. \end{aligned} \tag{3}$$

To go from the first to the second line of equation 3, Bayes' rule is applied to express $\Pr(z|t_z = t')$ as $\Pr(t_z = t'|z)$. In the last line of equation (3), the conditional probabilities can be estimated using a logit or probit model that pools the observations from t and t' and estimates the probability of t' conditional on z. The unconditional probabilities are obtained as the sample shares of observations from time t and t'.

The estimated weights $\hat{\psi}_z$ can be used to calculated weighted statistics for wages in year t. The observed change between years t' and t can be decomposed into a *composition effect* and a *wage structure effect* (commonly also referred to as *price effect*) (Fortin, Lemieux, and Firpo 2011). For instance, for the percentile difference between the 85th and the 15th percentile PD_{85-15} the composition effect is given as $\mathrm{PD}^{t,c}_{85-15} - \mathrm{PD}^{t}_{85-15}$, i.e. the reweighted counterfactual percentile difference in year t net of its unweighted observed analog. The wage structure effect is given as $\mathrm{PD}^{t'}_{85-15} - \mathrm{PD}^{t,c}_{85-15}$, i.e. as the difference between the observed value in the base year and the counterfactual value in year t. Note, that for the common case of increases in both the observed statistic and the reweighted statistic where the reweighted one is smaller than the observed one both effects are defined as negative numbers. This highlights their counterfactual nature as they report by how much a statistic would have been smaller in year t if workforce composition or wage structure had remained at their levels in year t'. To improve readability and to highlight that both effects typically contribute to increases, this paper displays them as positive numbers.

Note that, specifically in the context of this paper, this approach shows indirect effects of changes in the childcare supply on inequality, i.e. that childcare, first, affects workforce composition via changing participation decisions and sorting into, for instance, occupations which, in turn, affects inequality. An approach that follows the suggestion by DFL to assess inequality consequences of unionization (or other binary-coded changes) directly is not applicable here. It would, instead of an indirect one, require that there is a direct effect of childcare supply on wages, similar to union membership usually implying to be covered by collective bargaining.

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