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DIFFERENCES IN THE ESTIMATES OF GENDER WAGE GAP OVER THE LIFE CYCLE

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Differences in the Estimates of Gender Wage Gap Over The Life Cycle

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Abstract

Given theoretical premises, there is some ground to expect the gender wage gap adjusted for individual characteristics to be age specific. We rely on a long panel of data from the German Socio-Economic Panel covering the 1984-2008 period. We employ the DiNardo et al. (1996) technique to disentangle cohort and age effects. Our results indicate that the gender wage gap increases over the lifetime, but decreases with time. This finding runs contrary to the hypothesis that it is during the reproductive age that women's wages relative to men's wages suffer most. We suggest explanations for this pattern.

Keywords:

gender wage gap, age, decomposition, non-parametric estimates

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1 Introduction

Although age is almost absent from the economic analyses of the gender wage gap, there are at least two reasons why it could matter for the gender disparity in earnings.¹ First, because individual characteristics relevant for productivity – various measures of human capital – may be measured in a gender biased way. For example, due to inactivity episodes associated with child bearing and rearing, women accommodate labor market experience at a different pace than men. Consequently, although the *de nomine* tenure or experience are similar, differences in the underlying human capital – unobservable, or poorly observable in the data – may widen as a birth cohort ages. This process may be viewed from the perspectives of, at least, two theoretical strands of the literature. In the standard human capital theory (Becker 1985), the age-specific gender wage gaps would basically uncover the unmeasurable or poorly measurable actual differences in productivity, attributable to observable characteristics such as educational attainment or self-reported work experience in years. The hysteresis theory (Blanchard and Summers 1986) in Post Keynesian economics explains such a long-term effect out of an earlier event through a trickle-down process. An event in the past will continue to have an impact on future outcomes, because it cannot be easily compensated or it reflects a stable social pattern or social norm (e.g. sticky wages). Hysteresis also seems a plausible explanation for future effects of implicit gender biases. Consequently, initial gender differences in the labor market stemming from gender norms about the gender division of labor will constrain future career options that stem directly from the periods of inactivity due to child bearing and rearing. According to this approach, the differences in careers between women and men are not related to the objective differences in human capital, but rather are a consequence of path dependence – absent during the rounds of promotions in their late 20s and early 30s, women are not as frequently promoted in the subsequent years, leading to the widening gap in professional attainment. This theory faces the same problem of lacking adequate measurement, as standard classifications of occupations relate to the educational attainment necessary to perform highly ranked tasks rather than to the extent of responsibilities, which too are reflected in the compensations.

A second reason of why age matters relates to the assumption that employers seek to minimize labor cost for their total workforce of men and women, taking the prevalent gender division of labor as given. For example, because of child bearing, hiring a young male worker may involve less absences than in the case of a young female worker. It is rational to discount this differential in the wages offered to female labor market entrants, even if they do not have yet any children. Similarly, if caring functions are asymmetrically distributed between men and women, this reinforces the risk of lower presence/effort at work by the more burdened (hence, time-constrained) sex. This explanation, often referred to as “double burden” (Bergmann 1981), cannot be measured directly in most datasets, as the number of hours worked is self-reported and rarely takes into account coming late or leaving early for family reasons, no data is typically available for actual effort when at work.²

Yet, if all the reasons for why the gender wage gap should widen with age were related to child bearing or elderly care, the overall trend of decreasing fertility rates and increasing institutionalized childcare and elderly care should reduce the strength of these mechanisms. Thus, the age factor cannot be analyzed in isolation from cohort factors. Cohort specific effects might result from institutional changes, such as a revision of gender roles inside the household; technological changes, as the adoption of new technologies that reduce the effort demanded by household activities; and behavioral changes, as in the the surge in university enrollment by women in the last thirty years in most countries, as well as the decisions to postpone births or to have no children at all.³

¹In the reminder of this paper, unless stated otherwise, by the term ‘gender wage gap’ or ‘gender differences in earnings’ we refer to the differential adjusted for individual characteristics. The unadjusted gap is identified by the term ‘raw’.

²Please note that this explanation differs substantially from the “double penalty” explanation, i.e. compounding of disadvantage groups embodied in a person (Duncan and Loretto 2004). The latter is clearly a taste-based explanation.

³Importantly, alternative explanations for the persistent gender wage gap even after accounting for individual characteristics – such as lower wage expectations of women (Blau and Ferber 2011, Reuben et al. 2013), taste-based discrimination (Becker 1971, Lang 1986, Duncan and Loretto 2004) – have no clear time related patterns.

But can adjusted gender wage gaps be even the same between the age groups? Policy reports – such as OECD (2012) – show that raw differences in earnings tend to increase as men and women grow older. Moreover, the differences in educational attainment by young men and women are large and in many cases widening, with men falling behind. With the average raw wage gap remaining fairly constant in most OECD countries, these two stylized facts suggest there are considerable changes in the adjusted gender wage gap for the consecutive cohorts and possibly also in the life cycle patterns. Thus, while looking deeper into the age and cohort differences in adjusted wage gaps seems particularly relevant, this dimension is nearly absent in the literature. Our objective in this paper is to fill this gap.

A variety of studies recently emphasized the role of distribution effects Machado and Mata (2005), Arulampalam et al. (2007), Albrecht et al. (2009), Picchio and Mussida (2011) and participation effects Nopo (2008), Olivetti and Petrongolo (2008) in providing reliable and informative estimates of the gender wage gap. Clearly, the contribution of this literature has been to show that the estimates of the gender wage gap adjusted for characteristics are biased downwards unless one accounts well for the non-participation. Moreover, the distribution effects play a non-negligible role, making estimates at average or median only weakly informative. However, this literature has made relatively small progress in explaining the time trends in the estimates of the adjusted gender wage gap. Perhaps the most advanced are attempts to link the time trends to the institutional dimension, see Blau and Kahn (2003), Weichselbaumer and Winter-Ebmer (2007). Yet, the time spans under the analysis combines declines in fertility, absolute and relative increases in women’s educational attainment, changes in occupational and industrial structure as well as a number of societal and life-style changes. In addition, there is an additional technical challenge associated with the fact that age and cohort effects are at play jointly, together with the time effects. To separate them statistically poses significant issues, given that age equals year minus cohort.

One of the possible ways to address the identification problem is to rely on long panel data and employ individual’s own wages from various stages in life as counter-factual for other stages. This is the approach we pursue in this paper. Using the panel data from German Socio-Economic Panel (GSOEP) spanning 23 years we estimate age and cohort specific gender wage gaps adjusted for individual characteristics. Given the panel dimension of the data, we exploit the DiNardo et al. (1996) method to capture both age and cohort effects. We thus dissect the age and cohort effects, providing a double decomposition of the gender wage gap: *against the same birth cohort* at different points in time and *against a different birth cohort* at the same point in time.

In addition to the high quality of the data, there are also policy reasons why Germany is an instructive case to analyze. Among the European economies, Germany has the highest worker productivity and high female employment rates. Also, Germany has one of the highest raw gender wage gaps in Europe – substantially above the OECD average of pp. 15%. Moreover, this gap is steadily growing over time despite a secular increase in female educational attainment vis-a-vis men and equally secular decrease in fertility. With the decreased fertility and increased educational attainments, one would expect lowering gender wage gaps for consecutive cohorts.

Our estimations provide several interesting results. First, the adjusted gender wage gap tends to decrease over time, especially during the 90’s, with a relative stabilization towards the end of the analyzed period. Second, the adjusted gap increases with age, though this growth is non monotonous. The maximum occurs among the middle-aged workers in the sample over the analyzed period (i.e. the age of 40-45).⁴ This relation of the adjusted gap with age provides some support for the “double standard of aging” effect more than for the explanations derived from the pure human capital theory. This is especially visible from the specifications which control for fertility. Third, we document the relationship between the changing characteristics of the labor force and the gender wage gap among the labor market entrants. We find that the decrease in fertility and increase in educational attainment among women may have translated to lower gender wage gaps experienced by the labor market entrants, especially along the wage distribution. This result is consistent with a hypothesis

⁴Estimates from workers over 60 years old might be more sensitive to selection bias, see below

of a statistical discrimination. Yet, double decomposition suggests strong age-related pattern, i.e. the unexplained part of the wage differential increases with age. These results are consistent with a hysteresis effect.

The paper is structured as follows. First, we provide a review of the theoretical foundations and empirical evidence on this topic. We then move to specifically describing the methodology employed to dissect cohort, age and time effects. Data properties of the GSOEP have already well established features, so in our description we focus on the distinctive utilization in this paper. Results are reported in Section 5, complemented with policy recommendations in the concluding section.

2 Theoretical insights and empirical evidence

Feminist economists have argued convincingly that explanations of the gender wage gap that refer to differences in taste between male and female workers and for employers about male and female workers is not satisfactory because taste cannot be tested. Moreover, there is no reason to expect why preferences would be distributed systematically according to gender rather than randomly. (Bergmann 1974, Lang 1986). The taste based discrimination is dismissed in empirical studies, mostly because there is a high number of economic explanations which break the link between the estimates of the adjusted gender wage gap and the very notion of discrimination (Neumark 1999). When age is added to gender, it is plausible that men and women experience the aging process differently, as argued by a “double standard of aging” approach (Sontag 1982).⁵ Indeed, the overlap of numerous reasons for being disadvantaged (i.e. age and gender) may result in penalties which are different (usually larger) than the sum of the penalties associated with each of the reasons, see Deusch et al. (1986), Wilcox (1997), England and McClintock (2009). This approach finds some empirical support: Kuhn and Shen (2013) analyze job-ads from China, where law allows firms to indicate their preferred gender, age, and looks (requiring photos to be sent in with job applications), and argue that some job openings – such as those with a direct contact with the client – are subjected to strong bias towards young and attractive women. Moreover, firms tend to prefer men when looking for older workers, see also Lincoln and Allen (2004), Duncan and Loretto (2004). Hence, women’s age may be a more salient characteristic in labor demand than men’s age - although we do not know why that might be the case.

In this section we review the theories which implicitly or explicitly suggest a clear life cycle pattern of the adjusted gender wage gap as well as the theories which relate it to the secular trends observed in the subsequent cohorts. Against these insights we discuss the specificity of the German labor market as well as the available empirical evidence on the gender earnings disparities in this country.

2.1 Life cycle, secular trends and the gender wage gap

Human capital theory stresses the role played by the formation of a household (marriage and kids) for the existence of a gender wage gap and its developments over the life-cycle. Proponents of this theory argue that the prospects of child bearing and rearing exert a considerable influence on women’s career decisions (Mincer and Polachek 1974). In the standard human capital model, the household burdens have a direct interpretation. Women that suspend careers to engage in domestic activities do not accumulate experience at the same rate as men do, and therefore they lag behind them in wages. Moreover, as household activities demand more effort than leisure, those who engage in them have less energy to devote to work and thus become less productive, even if they spend the same number of hours at work (Becker 1985).

Another argument derived from the human capital model refers to the career path. Worker’s decision to invest further in skills depends on the difference between the cost of acquiring the skills and the discounted returns of the investment. Women that anticipate breaks in careers, should expect a lower return on human capital investment, i.e. should be relatively discouraged from further

⁵Sontag (1982) relates it to the dominant role of the appearances in determining the value of women to the society. [REF] links to a reproductive value to the society, which covers a substantially shorter time span for women than for men.

education, as argued by Mincer and Polachek (1974). A similar argument applies to women’s decision on which career to follow. Anticipating future interruptions, women might select the careers that impose a lower penalty on these interruptions, even if they offer lower wages and/or lower growth prospects. Goldin and Katz (2008) provide support for this claim, as women with more children tend to work in careers with lower penalties.

An intervening variable in the human capital arguments is marriage. In fact, as Iversen and Rosenbluth (2006) emphasized, marriage allows for a division of roles inside the household, where the women focus on domestic activities, letting men develop work-related skills. Marriage acts as a warranty that the earnings from men and women’s work might be split evenly inside the couple, thus allowing for efficient specialization, as proposed by Becker (1985). However, when women consider divorce as a probable outcome of the marriage⁶, the potential benefits of specialization over the long run are smaller, and thus women have more incentives to remain in the labor market. From a sociological perspective, Goldin and Katz (2008) claim that age at marriage explains the variation in participation rates across birth cohorts. They argue that postponing marriage allows women to create an identity that it is not related to their role in the household (wife, mother), but rather to their position in the labor market. This identification, in turn, increases labor market participation and reduces the hysteresis effect at later ages.⁷

Human capital explanations of the gender wage gap are constrained by the methodological assumptions, in particular the emphasis on the role of agents over norms and a narrow interpretation of rationality (Ferber and Nelson 1993). The human capital theory attributes the gender wage gap entirely to individual decisions based on perfect information, a unitary household utility function with equal sharing of income between husband and wife, and rational expectations; assumptions that various researchers shown to be biased (Kabeer 1994, Bergmann 1996, Agarwal 1997).

The theoretical explanations stemming from the human capital theory need not address only the raw gender wage gap. In fact, with the gender-specific measurement error of education and experience, these processes will likely be reflected of individual characteristics rather than actual differences in the characteristics.⁸ Thus, these processes would be equally relevant for the analyses of the raw and the adjusted gender wage gaps as long as human capital measurement remains troublesome. Note also, that because human capital theory so strongly stresses the child bearing, with a secular trend of decreasing fertility, also the disparity in wages – adjusted or unadjusted – should decrease. Thus, the predictions of the human capital theory relate it to both life cycle patterns and cohort patterns.

Parallel to the human capital theory but now from the demand side of the labour market, we can find arguments stemming from contract theory. Rational employers – expecting women to be giving birth and subsequently carrying a larger share of the effort related to the household activities – will expect to discount that in wages. In turn, rational workers of both genders will incorporate that in formulating the reservation wages, renegotiating wages, etc. Indeed, if hiring is not a costless activity, anticipating costs such as hiring and training a new employee to fill a position during the maternity leave, a rational employer might want to refuse the candidacy of to-be-pregnant women whenever the law allows to do it. When this is not possible, the employer might pass on this cost *via* lower wages. This is statistical discrimination (Dahlby 1983). Hence, women would have lower reservation wages than men, even when they do not plan to marry or have children: they simply include employers’ statistical discrimination into their own expectations of wages to be earned.

⁶In Germany, the average divorce rate was around 2.2 per thousand individuals between 1983 and 2013, while the marriage rate was 5.4 person per thousand individuals

⁷This aspect has been explored by Polachek et al. (2014) who developed a two-period model: in the first, workers choose how much they want to invest in human capital and how much time they want to devote to forming a family. In the second stage, workers enter the labor market and receive their wages. The trick is that men can start a family in any period, while women only in their youth. This limitation encourages women to form a family instead of investing in personal development. While the relation appears clear in theory, when the model is contrasted with empirical evidence it shows its shortcomings, as men and women tend to be of similar age when they decide to give birth. In our database, the average age at first birth for men is 30 years old while for women is 28 years old. While statistically significant, two years are not enough to justify the observed wage differences.

⁸In other words, women and men with the same years of experience might not be comparable, as women might need to exert more effort between the labor market and household activities to reach the same outcomes.

The evolution of the adjusted gender wage gap over the life cycle might reflect different starting (or reservation) wages: first received wage may shape future earnings paths *via* expectations and benchmark for raises. Indeed, some studies indicate that men and women settle for different wages, *ceteris paribus*.⁹ While the empirical evidence speaks to lower expectations, it remains an empirical challenge to disentangle if young females report so because they internalize a non-zero gender wage gap as a fact or because dominant gender norms discourage women to bargain as tough as a man.¹⁰ Babcock et al. (2002), Rigdon (2012) show that women simply “don’t ask” or rather “ask for less”.¹¹

The augmentation of these effects stems from two sorts of self-selection. The first is the self-selection into child-bearing. While indeed employment at lower starting wage and less frequent renegotiation of wages may be related to household activities, this is not to say that women willingly *choose* to be penalized. Women who intend to have children differ – on average – from those who have no such intention or expect to have less children. The average adjusted difference between women and men would then stem from the composition effects: some women accept employment at discounted wages, thus reducing the adjusted average for all women relative to men. This is not so much a choice but a matter of adaptive preferences in the face of statistical discrimination (Sen et al. 2003).

The second selection concerns the career options. Being a woman in a society with gendered norms about the social status of parenthood, the responsibility for child care, the internalization of gendered norms in identities, all add up to supply side and demand side factors reinforcing the gender wage gap over time. This is the hysteresis effect of a small gender wage gap at the beginning of a career. It will lead to slower career making, and hence, slower increases in earnings of women as compared to men. This, in turn, will increase the gender wage gap with age, as a slower pace of wage increases for women as compared to men will lead to an increasing gap in accumulated earnings over time.

Summarizing, the human capital theory predicts diverging wages of men and women – adjusted for the observable characteristics – due to unmeasured discrepancy in experience or knowledge, in relation to child bearing and rearing. Lower expectations of women in response to employers’ statistical discrimination are also consistent with the persistence of the unexplained component of the gender wage gap. Moreover, it also provides an explanation for why it could widen with age: a lower starting point predetermines also slower growth of wages. Differences in bargaining behavior may explain differences *per se*, but this theory would speak also in favor of gender wage gaps increasing in age. Note, also that from any theory that justifies gender wage gaps adjusted for individual characteristics with child bearing and rearing, decreasing fertility should imply lower penalties over the subsequent cohorts.

The separation of the life cycle patterns from the secular trends (i.e. time and cohort effects) necessitates tackling separately the “starting point” of the adjusted gender wage gap and its subsequent evolution. For instance, in the light of the human capital theory, decreasing fertility should be associated with gradually lower “entry” gender wage gaps for the subsequent cohorts. Since fertility has not been reduced to zero, the argumentation favoring an increasing life cycle pattern still holds. Similarly, there should be level effects due to secular trends and slope effects due to age in the light of the bargaining theories. In the reminder of this section we discuss the relevant aspects of the labor market in Germany relating to these insights, as well as discuss the conclusions of the earlier empirical studies on the gender wage gap.

⁹For example Blau and Ferber (2011) analyzed the expected earnings of male and female students of business schools, indicating that there are no significant differences at the beginning of their careers, but women expected significantly lower wages after ten years of work and even more important differences in 20 years time, even after controlling for the part-time episodes in careers. A variety of studies tried to disentangle the *ceteris paribus* in experimental and field context, usually reaching the same conclusion: women expect to earn less in all types of careers, see Reuben et al. (2013) for a review and contribution.

¹⁰For example Rizzo and Zeckhauser (2007) provide evidence that not only male doctors set for themselves higher reference incomes than women, but also that they react stronger to deviations from the expected earnings.

¹¹Moreover, women may be forced to negotiate even against their preference – notably over the flexibility of the working hours. Goldin (2014) explores the effects of non-linearities in hourly payment in female occupational choice. She argues that household burden might encourage female employment in “flexible” jobs, where hours are not fixed, even though these jobs offer lower hourly wages. However, to the best of our knowledge, there is no evidence for such effects in the context of adjusted gender wage gaps.

2.2 The case of Germany

Despite of its economic leadership in Europe, as stressed by the OECD (2012) report, Germany presents the highest raw gender wage gap in the EU. The report estimated that the gap at the median was of 22% of men's wages. Not only the difference is well above the OECD average (15% gap), but also it is the only country where the difference has actually grown in the last ten years, although only slightly. The persistence of the differences invites a serious reflection on the determinants and the possible actions that can be taken to improve the situation of women. From the same report, it can be inferred that the differences in earnings are not constant over time, and in fact they tend to increase, which is partially explained by the different labor market experiences of men and women as workers.

Human capital explanations rely heavily on individual, utility-maximizing division of roles inside the household to explain the differences in the pay. But, as argued above, this is not an appealing assumption. Rather, it seems that dominant gendered norms in society affect the behavior of men and women in households, with women facing more constrained choices about jobs, hours of work, and as a consequence, wages. This feminist institutional explanation might be particularly suited for Germany in the period under analysis, 1984-2008. Treas and Widmer (2000) conducted a comparative study of the attitudes of different European societies towards women's supply of labor in different stages of their life-cycle. They find that in Germany, women were not expected to work full-time in the first years of the child rearing, between giving birth and the child's first classes, in fact only one percent of the respondents (male and female) declared otherwise. Only after all children leave for education, it becomes socially acceptable for women to re-enter the full-time labor market (above 50% of the respondents supported this option).¹²

These social norms were reinforced by the mix of the welfare policies. A prominent example is the so-called "tax splitting", which means that taxes on earning are calculated for the couple as twice the average of the two salaries, which – especially coupled with the progressive tax system – leads to a reduction of the overall taxes if a women does not work full-time. In addition to lowering the average tax rate for the household, this system imposes a high shadow tax rate for women's work, thus generating incentives for women to settle for lower paying jobs or part-time employment.¹³

In addition to the incentives from the tax system, also the care system provides disincentives for women to work. Notably, childcare facilities are rare, with only 3% of the children aged below 3 attending these institutions in the late 80's. Despite the subsequent increased availability, in the early 2000s, the percentage still hovered around 12%, i.e. one in as many as eight children. Without childcare facilities, professional work implies a high shadow price due to the high cost of individual childcare providers. Hence, families have limited options: they can either pay someone to attend their children, delegate the responsibilities to older members of the extended family (such as grandparents) when possible, or stay at home and raise the children by themselves.

Third, the design of the parental leave also provided incentives for the specialization of women in household activities. Several aspects of this policy deserve to be mentioned. First, pregnant women must not work for a 14 weeks period, which are split as six weeks before and eight after giving birth. This raises the costs for employers who can foresee the breaks in women's careers. In addition to this forced time off the labor market, the parental leave enjoys full employment protection. The parental leave could last a maximum of 4 months in 1984, but it was subject to several extensions until it reached 34 months in 2006. Also, after the mandatory leave, women can choose to receive additional benefits for a period that can be extended over two more years. While women receive these benefits, they cannot work under a full time employment contract. However, the total weekly hours compatible with these additional benefits increased from 15 hours in 1986 to 30 since 2001.

Finally, the childcare benefits to be paid to the mother during the leave are fixed and do not depend

¹²Figure B.4 in the appendix provides some intuition on the changes in the fertility patterns across time.

¹³Triebel (2013) finds, that while increase in salaries of women leads to reduced labor supply of men due to this mechanism, the reverse does not hold for women. Namely, married women do reduce working hours, because of the "tax splitting", but cohabiting women do not.

on previous earnings. While the benefits are inclusive (also non-working women are eligible), they provide strong disincentives for many working women to have children, as they receive an amount lower than their previous earnings. The additional childrearing benefits are means-tested, often implying that with a second earner in the household, the family is no longer eligible. Also an increase in salary – such as a raise or promotion – could imply a reduction or even suspension of these benefits.¹⁴

This legislation has been proven to adversely affect women’s labor supply. Merz (2004) finds that the amount of working hours per employed women has decreased along the increase of participation rates. There was also a doubling in the fraction of married women taking a full parental leave (i.e. without part-time employment), as emphasized by Schober (2012). These two papers demonstrate that the welfare system generates incentives to stay out of the labor market, which are reinforced by the existing prejudices delineated by Treas and Widmer (2000).

In addition to the gender dimension, age-based discrimination represents another concern in Germany. The *de iure* minimum eligibility retirement age is set at 65. Nonetheless, and partially due to the generous early retirement programs, the effective age of leaving the labor market and claiming pension benefits is around 60 (or even 58 if workers decide to retire and claim the unemployment benefit for two years). In addition, workers were eligible for reducing from full-time to part-time beyond 55 years of age. Though the scheme was optional, many employers *de facto* included commitment to retire early clauses in the employment contracts until 1992, when they were abolished. The pattern of early retirement also puts people in their 40’s in a difficult position at the time to search for a job, as firms might not find it worthy to invest resources in their training. In addition, it is still allowed to terminate the contract based on reaching certain age as long as it is justified by objective reasons. Examples of those reasons include the entitlement to state pensions, decrease of physical capabilities due to age as well as “maintaining a balance in the age composition of workers”.

All in all, it seems that an institutional explanation, with its stronger constraints on labor market choices for women than for men plus statistical discrimination on the labor demand side is likely to help interpret the high gender wage gap in Germany. In addition, it is likely to explain the reinforcement of the wage gap for women when they get older, as the hysteresis effect of the initial gap.

2.3 The evidence on the gender wage gap in Germany

Our paper is not the first to study the size and the determinants of the gender wage gap in Germany, though to the extent of our knowledge is the first to focus on the relation with age and the life-cycle. Machin and Puhani (2003) provided a comparative analysis of the gender wage gap in Germany and the United Kingdom using labor force surveys from both countries for 1996. Their results show that the unexplained component is twice as large in Germany than in Great Britain, with estimates in the range of 17.5% to 20% of male wages in the first case and between 7% and 11 % in the latter. The lower values correspond to estimations where field of education was accounted for.¹⁵ Arulampalam et al. (2007) also performed a comparative analysis, though their study covered all EU15 countries using the European Community Household panel. Their results contrast with those from previous research, as they found that Germany is in a relatively good position. It has the fourth lowest raw gap and is the country where the unexplained component represents the smallest share of the raw gap, only behind the Netherlands.

Focusing exclusively on Germany, two sources are normally employed: the GSOEP (that we also employ) and the matched employee-employer database provided by LIAB. Hinz and Gartner (2005) used the later to estimate several measures of the adjusted gap in 2001. Their results were in the range of 13% to 17% of males’ wages, however they employed less controls (occupation and industry were added one at a time) an a simpler methodology - a dummy variable in a linear regression. Working

¹⁴This legislation was changed in 2007: benefits are not means-tested and they are proportional to previous earnings. Yet, the effects of this reform are to be observed after our analyzed span of 1984-2006.

¹⁵Reimer and Schröder (2006) also explores the relation between the adjusted wage gap and the field of education, but it does so in a much homogeneous population (university students). Their results indicate that the adjusted gap among former students was between 4.3% and 7.6 % of female’s wages. Though the value is much lower than in the previous case, it must be reminded that the sample covers only individuals at the beginning of their career.

with the same database, Heinze (2006) obtained slightly higher estimates of the gender wage gap. The adjusted gap was estimated to be around 20 % of women’s wages. Moreover, they showed that firm size had little influence on the gap. Estimations within large and small firms provided similar values.

Lauer (2000) as well as subsequently Holst and Busch (2009) employed the GSOEP data as well and thus their studies constitutes a valuable reference point for our analysis. Holst and Busch (2009) use the database to explore the existence of a glass ceiling effect on Germany by studying people in managerial positions. Their findings indicate that the unexplained component within the top occupation is approximately 40% of males wages, once selection bias is taken into account. However, methodological differences make it difficult for a direct comparison of their results with those from Arulampalam et al. (2007).

Given the literature available on the country, our paper provides to fill two voids. First, it adds a life-cycle perspective. Lauer (2000) studied changes over time, but she focused the analysis on two points (1984/1987 and 1994/1997, which prevented her from doing a life-cycle analysis. Second, we consider as well the existence of different cohorts. By looking at the mean values of the society, her paper neglects the effect of the entrance of new cohorts into the labor market. In an extreme example, it is possible that the reduction observed by Lauer (2000) was due only to the entrance of better prepared cohorts, with no real improvements for older generations. Finally, the use of a larger sample adds robustness to our results. In fact, it is possible that results presented in Lauer (2000) were influenced by the phase of the economic cycle on which the Oaxaca-Blinder decomposition was estimated.

3 Empirical strategy

As demonstrated in a recent review (and review) **remove** by Fortin et al. (2011), there is a great variety of methods available to estimate the gender wage gap adjusted for individual characteristics, each of them with their relative advantages and weaknesses. The methods range from the highly popular Oaxaca (1973)-Blinder (1973) type decompositions which provide estimates at the mean, to a variety of more complex methods, accounting for non-random selection into employment, distributional effects and the (possible lack of) comparability of (men and women as) **male and female** workers. Among the quantile-based approaches, Machado and Mata (2005) with subsequent extensions of Melly (2006) and Albrecht et al. (2009) as well as Firpo et al. (2007) allow to measure the differences at each percentile of the distribution. Yet, these methods too require a functional form for wages; moreover, the functional form should be the same for each quantile. On the other hand, Ñopo (2008) offers a non-parametric alternative which also controls for the bias arising from the lack of a common support, in other words from the fact that men and women might have different characteristics. However, this decomposition suffers from the curse of dimensionality, common to most non-parametric methods: i.e. the more variables we add, the smaller the common support and hence the results are less informative about the gap in general.

DiNardo et al. (1996), henceforth DFL, introduced a powerful in-between alternative, by proposing a semi-parametric approach for the decomposition of the entire wage distribution. As the first stage is based on a probit model, the method does not suffer from the curse of dimensionality mentioned before, and as the estimation of the differences is based on a non-parametric kernel, it also avoids the problems related to a specification of a functional form for wages.¹⁶ The flexibility of DFL allows to create a variety of counterfactual distributions according to the needs of the researcher.

¹⁶Though originally intended to measure the consequences of the changes in the unionization rate, it was adopted to measure the impacts of other variables as well, among them gender. Warman et al. (2010) use the DFL decomposition to measure the differences in earnings between university professors in different periods, from the early 70’s to the early 00’s. Their analysis bears some similarities with ours, as we also consider a time dimension. However, the most important difference is that in our paper we focus on the gender wage gap at different ages. Sierminska et al. (2010) also employ the DFL decomposition for Germany, using data from the GSOEP as well to study the wealth gap, of which the salary is just one of the components.

DFL decomposition is based on a simple idea. Average wages are the integral over density functions. Then, in order to build a counterfactual distribution one can modify the density function and adapt it to the group of interest. Thus, to obtain women's distribution of wages if they were paid as if they were men, it is enough to reweight the density function of men according to women's distribution. In order to do it, the authors propose to introduce the function $\Psi(x)$ in the distribution function. This function 'weights' all men observations by the probability of being a women given their characteristics.

The function $\Psi(x)$ can be non-parametrically estimated, using perfect matching and calculating the probability of being a man (woman) within each of the resulting bins. However, this approach is unfeasible when the number of covariates increases as some of the bins will not have men/women observations (dimensionality curse). An alternative, parametric, procedure consists of estimating a probit model, where the dependent variable is the membership to a group of interest (men or women, young or old, etc), and saving the fitted values. In case we want to obtain a counterfactual distribution of womens' wages for the year t , the value of $\Psi(x)$ would be given by:

$$\Psi(x) = \frac{P(X = x | s = \text{women}, j = t)}{P(X = x | s = \text{men}, j = t)} * \frac{P(s = \text{men}, j = t)}{P(s = \text{women}, j = t)}$$

Clearly, the previous equation can be used to distinguish between any two groups, not just male and female workers. We can also employ it to compare the distribution of wages of female workers in two periods, and even to compare between men and women in different periods. We only need to adjust the reference groups. We use this possibility to produce a double decomposition across time and gender.¹⁷ Let Δ_t be the raw gender wage gap in year. As with other decompositions, Δ_t is the sum of the explained (by differences in endowments) and the unexplained (due to differences in rewards, also known as adjusted wage gap) components:

$$\begin{aligned} \Delta_t &= \underbrace{\int f_{i,j}(w|x) h(x|g = i, t = t) dx - \int f_{i,j}(w|x) \Psi(x) h(x|g = i, t = t) dx}_{\text{Explained component}} \\ &+ \underbrace{\int f_{i,j}(w|x) \Psi(x) h(x|g = i, t = t) dx - \int f_{i,j}(w|x) h(x|g = i, t = t) dx}_{\text{Unexplained component}} \end{aligned}$$

where the first line corresponds to the explained and the second to the unexplained components.

The next step is to estimate the changes across time, in short $\Delta_t - \Delta_{t-1}$. This difference can be decomposed in four different components, presented in **the Appendix A**. First, we obtain expressions corresponding to changes in the characteristics of men and women, keeping the rewards to the characteristics constant at the level of men in the initial period. The interpretation is similar to a difference-in-differences. A positive sign indicates that the change in endowments was larger for men than for women. Next we obtain the change in the unexplained components, keeping the characteristics fixed at the level of women from the initial period. A positive change indicates that the adjusted wage gap grew over the period under analysis. Finally, residuals correspond to interactions between changes and endowments and changes in rewards and have no interpretation. The full decomposition is presented in the Appendix A.

The decomposition proposed above offers a straightforward analysis of the changes in the wage gap over time for the entire population. Clearly, the equation could also be employed to study the changes over time for a particular cohort. For example, we can decompose the changes in the wage structure for women age 30 to 34 in 1989, with respect to their situation in 1984, when they were 25-29. At this point, the advantage of using GSOEP becomes evident. By following the same individuals over their life-cycle, we may control for individual and cohort specific fixed effects.¹⁸

¹⁷Other works working with a double decomposition include Yun (2009), who explores the shortcomings of double decompositions in the context of Juhn et al. (1993) decompositions, Cho and Cho (2011) in the context of cross country comparison and the mentioned Lauer (2000), that conducts a double decomposition using Oaxaca-Blinder type decompositions in the first stage.

¹⁸A possible downside of this decomposition is that the changes observed in the unexplained component can be due to

4 Data

In this study, we work with data extracted from the German Socio-Economic Panel (GSOEP) for West Germany for the period 1984-2008 (see Pannenberg 2000, SOEP Group 2001). The sample for Germany includes data from the first year of the survey till the onset of the global financial crisis. While data from East Germany is also available, we decided to restrict the sample to the West due to the cultural differences existing between the two regions. As shown in (Lange et al. 2007), women in East and West Germany faced different institutional constraints and incentives that lead to a higher participation of women in the former. These constraints ranged from a more egalitarian mindset (reflected in the greater coverage of childcare facilities) to a more acute need for a second income to support the family. Second, and from a methodological perspective, we want to emphasize the time dimension, and series are longer for West Germany.

The GSOEP is a longitudinal survey conducted in face-to-face interviews every year (with interviewer or respondents filling the questionnaire) with about 11 thousand households in the Federal Republic of Germany. A very important aspect of GSOEP data is its panel dimension. The time lapses between each survey allows to observe the same individual over longer time horizons. Though we cannot observe all individuals in each of the 25 years, the GSOEP presents some good retention rates: around one quarter of the sampled population in 1984 (2300 individuals) were observed all the way through 2008.

The GSOEP data has an exceptionally rich variety of variables. Individuals report their family situation, which includes their marital status and household composition. Along this household variables, the GSOEP also provides valuable information on the labor market status of the individuals: it provides information on gross and net wages, hours of worked, type of employment (whether part-time or full-time), experience (also divided between part and full time) and tenure. Finally, it offers information on the firm employing the individual, such as the industry, its size and the location. Unfortunately, income data is usually prone to be non-reported in survey data and GSOEP is no exception from this rule. About 10% of working individuals failed to report earned income in each of the survey years.

In order to measure the age effects, we divide the workers in seven age groups, each of them covering five years. The youngest of this groups includes those individuals aged between 25-29, which roughly corresponds to the incorporation on the labor market of workers with a tertiary degree; and the oldest represents the workers from 55 to 59 years old. Even though the official retirement age in Germany throughout the period was 65, many individuals opted for early retirement programs as well as part time employment in the later stages of their career. As a result, the effective age of retirement was substantially lower: around 59 years old. Early retirement, and its expectation, can affect labor market outcomes for the older age groups. The division in age groups leads to a similar division into cohorts.

Figures B.1, B.2 and B.3 in the Appendix provide a first insight on the changes experienced by women in the period. It shows the ratio of men to women in selected human capital and household variables. We observe a clear pattern towards postponing marriage and forming a family in favor of pursuing a career. Between 1984 and 2008, the proportion of women living with at least one child in their household fell by almost one third. The incidence of marriage also seems to have decrease, though the case is somehow weaker. These changes were accompanied by an almost twofold increase in the number of women with tertiary degrees.

Men experienced similar trends towards postponing the family, only at a lower level – in each year men were less likely to be marry or have children. When it comes to education, we observe a positive trend, but the slope is flatter for men than for women. In fact, towards the end of the sample the

an age effect inasmuch as a period effect. The latter may result from changes in family policies, such as the reduction in the maternity leave, or from changes in the economic cycle, during recessions wage structures are more compressed and the adjusted component decreases. To overcome this impasse, we assume that period specific effects are independent of age. Thus, we can use relative changes to determine which groups experienced larger increases in the adjusted wage gap.

proportion of women with tertiary education among the youngest age group exceeded that of men.

5 Results

As in other decompositions, our variable of interest is (log) hourly wages. The variable was constructed from monthly wages and average working hours, thus excluding overtime work. While the GSOEP includes measures of both gross and net wage, we employed the latter in our estimations.¹⁹ Given the time span of our analysis we made two additional transformations to our variable. First, we deflated wages using the CPI provided in the same database. Second, we converted all pre 2003 wages to Euros using the official exchange rate.

The first stage in the DFL decomposition is the estimation of a probit model, where the dependent variable is gender, which in our case takes the value of one if the observation comes from a male worker. In the main specification we include variables connected to human capital and firm characteristics. Among the first, we include experience, divided between full and part time, tenure and highest level of education, primary, secondary or university studies. Among labor market variables, we included industry dummies for manufacture, construction, market services and non-market services; and two dummies for occupation level, high-skill (ISCO 1-3) and medium-skill (ISCO 4-6), low skill workers constitute the baseline category. Given the importance of household composition, for example due to the existing tax schemes and the traditional gender roles, we added two variables for gendered institutions: a dummy for married women and a dummy for the presence of children younger than 5 years old in the household.

Finally, while in Germany the minimum working age is fifteen years old, and the retirement age is 65, we have conducted our estimations in the subsample of workers aged 25 to 59. Both restrictions are related to the actual participation in the labor market. Though workers can incorporate earlier in the labor market, in our panel we have that for the most recent year, only 30% of youngsters entered the labor market before their 25th birthday (back in 1984 this percentage was twice as much). In the case of older workers, the existence of various types of early retirement schemes and unemployment benefits effectively reduced the average age of retirement to 59. This is also reflected in the GSOEP. While 50% of those aged between 50 and 60 work, the proportion of workers among those older than 60 remained below 10% during the entire sample period.

The DFL decomposition relies on the quality of the first stage probit. If the probit is not able to distinguish between men and women, it is hard to provide adequate weights. We can evaluate the quality of the models by looking at the ROC curve.²⁰ The results are presented in figure C.1 in the annex. The graph indicates that the model performs well in older age groups, and is slightly less accurate in the case of younger groups. Among the youth, the predictive ability of the model also varies across time. In the early years, our probit models distinguish between male and female with more accuracy than in the last years of the sample. These trends can be interpreted also in terms of the differences in observable characteristics of male and female workers. In most ages, the gap in endowments appears to be closing, especially after 1994. At the same time, differences are larger among older cohorts.

Figure 1 provides an intuition of the changes experienced by different cohorts as they aged for two example cohorts.²¹ There, we observe that both the raw and the adjusted gap followed a similar inverse u-shape pattern, with a strong increase in the early stages of the career, before the 30th birthday, that peaks one decade later. In the final stage of the career, we observe a gradual decrease in the gender wage gap, raw and adjusted. While the tendency appears general, specific cohort effects appear to be also in place. This implies that women born between 1954 and 1958 experienced (on average) a flat profile of adjusted gender wage gap as compared to those in younger cohorts.

¹⁹Results are not affected by this decision.

²⁰The ROC curve indicates how the number of correct predictions (positive and negative) varies with the cut-off probability - the probability for which the prediction is considered positive. The area under the ROC curve has a maximum of 1.

²¹Given that each of our cohort consists of five years, we use the age of the median cohort to construct figure 1.

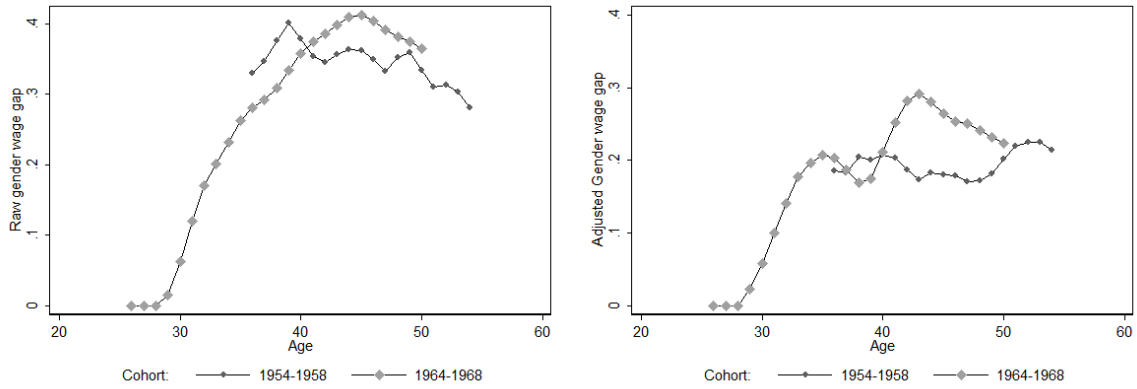


Figure 1: Evolution of the raw and adjusted gender wage gap for selected cohorts (expressed in % of mens' wages). Source own computation based on the GSOEP 1984-2008

The results from our original decomposition can be seen in Figure C.2 in the Appendix. This graph shows the specification when we use gross wages, we include part- and full-time workers and both household and personal characteristics. Each of the columns in the graph represents the adjusted wage gap for a given period, from 1984 (at the left) to 2008 (to the right). We show only one in five years, so as the sample is completely different between two adjacent columns. Clearly, each column represent a different cohort. We distinguish these cohorts by assigning them specific colors, thus red represents the cohort born between 1951 and 1955; orange, the group born between 1956 and 1960; and so on. Columns in blue are other cohorts, for which we do not have enough observations to follow them over more than three periods. In addition to the adjusted wage gap, figure (C.2) also presents the participation rate of full time employment for each age group in each period, which is measured on the right vertical axis.

Figure C.2 shows several interesting facts. First, we observe that the wage gap grows over the years, from very low values in the late twenties, which for some increase all the way to the late forties, with a small decrease in the last period.²² As a general trend, we can also observe that the adjusted gender wage gap tends to first decrease, and then stagnate in the most recent years of the sample. The only group that does not fit well into this pattern is that aged 50 to 54, for which there is a marked increase since the early 2000. The colored lines allow us to view how the ageing process affected each cohort. In the case of the oldest cohort, born between 1951 and 1955, we can observe a clear U-shape pattern, with a peak in the early forties. The same pattern is not so clear for the rest of the cohorts, for whom the differences seem to increase with age, though to a moderate rate.

The relation between the participation rate and the adjusted wage gap is not constant. For the younger cohort, both variables seems to be positively correlated. This is consistent with self-selection of women in the labor market, in which only the more productive women participate in the labor market. As the number of female workers increases, the differences expand: for the groups older than 34 there is no clear relation; for those between 35 and 44 the participation rates seem to be unaffected by the differences in wages and *vice-versa*; whereas for the higher age groups there seems to be a negative relation. While Figure C.2 provides some interesting results, it leaves several open questions that we intend to analyze using panel data techniques. For this, we first construct a panel where the dependent variables are the estimates of the adjusted gender wage gap, the time dimension is the year for which they were calculated and the unit of analysis is the youngest cohort in the age group²³. In each equation we include dummy variables for the different age groups, a time trend and the participation rate.

The results in Table 1 reveal very interesting age patterns, depending on the part of the distribution

²²We have not included the results for the oldest groups due to its highest volatility

²³Notice that we estimated the gender wage gap for each age group within each sample year which increases the number of observations to 175 (7 age groups and 25 years).

that we focus on. At the mean, the pattern resembles that of an inverse U-shape. Differences increase rapidly in early stages of the career and then they stabilize during the 40's. The gender wage gap then decreases for the older groups, what might result from self-selection into employment in this age group. The pattern seems to be robust to the inclusion of additional controls, such as the employment rate of male and females in the sample and year specific fixed effects. With the addition of cohort specific fixed effects ²⁴, the picture is more blurred, but seems to confirm the previous results. The additional controls also have interpretations. In the case of the time coefficients, reported in Figure C.3, we observed a decrease in the gender wage gap with respect to 1984 levels that is specially acute in the last years of the sample, though the coefficients do not appear to be significantly different from each other. A positive estimate of the coefficient on female employment rate is counter-intuitive, as it suggests that more working women correlate with higher penalty for women. However, as suggested by the distributional analysis, this effect comes predominantly from the upper part of the wages distribution. Thus, it suggests that the more women actually make it to the upper quartile of the distribution, the higher the adjusted gender wage gap in that group.

At the first quartile of the distribution (within each age group), the results do not exhibit clear pattern relating age and the wage gap. While results appear to be larger and statistically significant for women in their forties, the results do not hold for every specification, as a spike emerges in the age group closer to the retirement age. However, there are other valuable results in this group. First, the differences are decreasing over time, with changes similar to those observed at the mean. It appears that at this quartile self-selection is less important. The positive sign on the male employment rate might be related to the economic cycles, as during expansions, when participation is larger, employers enjoy greater flexibility to set wages.

²⁴A cohort for the group is the year of birth of the youngest member of the age group.

Table 1: Gender wage gap and age patterns

	At the mean			First quartile (.25)			Third quartile (.75)		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
25-29									
30-34	0.068** (0.032)	0.085** (0.039)	0.122*** (0.045)	0.077** (0.037)	-0.020 (0.044)	0.067 (0.053)	0.019 (0.048)	0.146** (0.064)	0.110* (0.065)
35-39	0.083*** (0.032)	0.090** (0.036)	0.134*** (0.048)	0.065* (0.037)	-0.023 (0.042)	0.068 (0.056)	0.063 (0.048)	0.156*** (0.060)	0.159** (0.068)
40-44	0.140*** (0.032)	0.134*** (0.034)	0.192*** (0.050)	0.132*** (0.037)	0.055 (0.039)	0.159*** (0.058)	0.125** (0.048)	0.175*** (0.056)	0.226*** (0.071)
45-49	0.148*** (0.032)	0.139*** (0.033)	0.213*** (0.056)	0.163*** (0.037)	0.092** (0.038)	0.193*** (0.066)	0.132*** (0.048)	0.169*** (0.054)	0.307*** (0.080)
50-54	0.073** (0.032)	0.098*** (0.031)	0.155** (0.068)	0.070* (0.037)	0.052 (0.035)	0.125 (0.080)	0.062 (0.048)	0.142*** (0.050)	0.312*** (0.097)
55-59	0.109*** (0.032)	0.241*** (0.062)	0.195* (0.101)	0.062* (0.037)	0.226*** (0.071)	0.180 (0.119)	0.093* (0.048)	0.301*** (0.102)	0.365** (0.145)
Emp. Rate M		0.151 (0.320)	-0.133 (0.319)		1.337*** (0.365)	0.623 (0.376)		-0.739 (0.525)	-0.367 (0.457)
Emp. Rate F		0.627*** (0.231)	0.377 (0.335)		0.229 (0.264)	0.159 (0.395)		1.459*** (0.380)	0.590 (0.480)
Year			-0.010*** (0.004)			-0.008* (0.005)			-0.014** (0.006)
Cohort fixed effects		Yes	Yes		Yes	Yes		Yes	Yes
Year fixed effects		Yes	Yes		Yes	Yes		Yes	Yes
Observations	175	175	175	175	175	175	175	175	175
R-squared	0.151	0.425	0.649	0.128	0.422	0.624	0.071	0.269	0.661

Notes: Table presents the results from regressions of the adjusted gender wage gap on the characteristics of the individuals at different points of the distribution: first quartiles, the mean and the third quartile. For each quartile, it presents 3 regressions: One with only age, the second with age groups and year and employment rate for males and females; and the third with also cohorts specific fixed effects.

Finally, at the third quartile, closer to the glass ceiling, the age patterns presents some variations. Unlike the other two cases, we have more evidence pointing towards an increase in the gap at later stages of the professional career, similar to what can be expected from a “double standard” effect of aging. This pattern emerges after controlling for time trends (control for changes in education, among others). Moreover, it appears that the gap is closing faster for this group. As in the first case, the significant results in female participation rate suggest that self-selection might be at force, but the size of the effect is not precisely estimated.

While these results are interesting by themselves, they leave some questions unanswered. One might wonder what lies behind the time trend. A first possible explanation are changes in the institutional set-up, and in particular of gendered institutions. The availability of daycare facilities for toddlers, for instance, almost doubled 1984 and 2002: from around 15 places per thousand children in 1984 to over 35 in 2002. Similarly, childcare facilities for children aged 3 to 6 also grew during the same period, reaching levels of one place per child.²⁵ Greater availability of these facilities might affect the adjusted gap in both ways. On the one side, it allows mothers to focus more on their careers, with the potential to decrease the gender gap. However, the provision of daycare might also increase the participation of women who suffer from a very strict gender division of labor at home, experiencing little or no help in childcare from their male partners. These women may struggle hard to combine a job with a high unpaid work burden at home. The lowering of the entry barriers might then lead to increases in the gender wage gap.

At the same time, the effects of some institutions might change over the course of the time. An example is the joint taxation scheme implemented in Germany, which penalizes the second earner. If women close the gap in endowments, and consequently the explained component of the gender wage gap, their wages become more similar to those of their husbands and the “bite” of the tax scheme is smaller, thus reducing also the unexplained component. An extreme example, correspond to women that are the main earners in the household.

²⁵Since 2006, measures for daycare availability changed in Germany making more recent figures not comparable to previous values.

Table 2: Gender wage gap and childbearing

	Mean	q(.25)	q(.75)	Mean	q(.25)	q(.75)	Mean	q(.25)	q(.75)
25-29	0.133*** (0.039)	0.107*** (0.042)	0.054 (0.053)	0.127*** (0.037)	0.121*** (0.045)	0.053 (0.050)	0.160*** (0.039)	0.146*** (0.049)	0.029 (0.052)
30-34	0.127*** (0.036)	0.078*** (0.039)	0.075* (0.048)	-0.037 (0.071)	0.077 (0.087)	-0.025 (0.097)	0.168*** (0.036)	0.123*** (0.046)	0.080* (0.049)
35-39	0.158*** (0.031)	0.133*** (0.034)	0.115*** (0.043)	-0.099 (0.099)	0.119 (0.122)	-0.047 (0.136)	0.206*** (0.033)	0.197*** (0.042)	0.129*** (0.045)
40-44	-0.450 (0.386)	-0.281 (0.417)	0.142 (0.523)	-0.838*** (0.364)	-0.499 (0.449)	-0.241 (0.500)	-0.712** (0.422)	-0.554 (0.538)	-0.294 (0.572)
Emp. Rate. M	0.337 (0.272)	0.024 (0.294)	0.614* (0.368)	0.944*** (0.282)	0.241 (0.348)	1.038*** (0.387)	0.303 (0.320)	-0.191 (0.409)	0.517 (0.435)
Emp. Rate. F	0.006 (0.004)	0.013*** (0.005)	-0.004 (0.006)						
Places for kids <3									
Fertility rate				-0.339*** (0.112)	-0.050 (0.138)	-0.221 (0.154)			
Fertility change							0.313** (0.178)	0.229 (0.228)	-0.230 (0.242)
Observations	76	76	76	100	100	100	80	80	80
R-squared	0.360	0.341	0.209	0.667	0.477	0.544	0.633	0.464	0.558

Notes: The dependent variable are estimates of the gender wage gap obtained at the mean, the first and third quartiles using DFL decomposition for women aged 25 to 44. ***, **, * represent significance at the 5%, 10% and 15% level respectively. All estimates have controls for year, in the first model we have a continuous variables, while in others we had fixed effects. Data on childcare facilities is only available up to 2002, thus the lower number of estimates on the first three columns. In the last three columns we drop the observations for which we did not have information on previous cohorts.

These two possibilities are explored in Tables 2 and 3, respectively.²⁶ Given that we expect childcare availability to have higher effects on women that are actually exposed to the challenge of combining the labor market activity and child caring, we restrict the sample to estimates from the first four age groups (25-29, 30-34, 35-39 and 40-44), where the latter group controls for outliers in childbirth. We also restrict our sample to the period before the change in the measurement of childcare availability, thus we employ observations between 1984 and 2002. In the second case, we did not add further restrictions as the necessary data can be recovered from the GSOEP.²⁷

The addition of controls in Table 2 does not lead to substantial changes in our conclusions regarding time or age patterns, though the parameters are less precisely estimated. Women still face increasing adjusted gender wage gap as they age. On the first three, we incorporated the availability of daycare facilities for toddlers (between 0 and 3 years old) and kids (between 3 and 6 years old). The positive coefficients suggest that the increase in the number of facilities allowed less productive women to enter the labor market, in other words it reduced the problem of self-selection. This conclusion gains additional strength from comparing the coefficients at the first and third quartiles. In the case of women with lower salaries (first quartile), expenses on childcare (babysitters, for example) might act as a deterrent for labor force participation; however, women with higher earnings might be in a better position to afford private daycare and therefore the increment of these institutions does not have a strong effect. The fact that the coefficient is negative might be interpreted as evidence of childcare allowing mothers to focus more on their career. However, the estimate is not precise enough to allow for the coefficient to be statistically significant.

If instead we focus on fertility rate, the picture is less clear. Changes in age do not have a significant impact on the gender wage gap. The (counter-intuitive) negative sign associated to fertility rate stems from the fact that fertility is higher at the early stages of the career, before women turn 35. Unfortunately, fertility rate presents a combination of patterns, with variation across time, ages and cohorts which are hard to disentangle in the data. With respect to the other variables of interest, the pattern towards a decrease of the gender wage gap over time appears especially robust with similar coefficients for the three estimates; while the self-selection into employment is also visible, especially among those with higher earnings.

As an attempt to disentangle the effects of fertility, we study how changes in the fertility rates between women in the current and the previous cohort. If employers offer lower wages to women to cover possible costs related to giving birth, they might base their *ex ante* expectations on the fertility patterns of the previous cohorts and adjust them based on those from the present cohort. Thus, if they observe an increase in fertility in the current cohort, it will be rational to ensure themselves by raising the gap between male and female wages. This theory of statistical discrimination receives a partial confirmation in Table 2, as the variable indicating the change is significant and positive at the mean. At other quartiles, the variable is not significant.

²⁶In the appendix, we include Tables , where we repeat these specification but we add cohort specific effects to the regression. The results are largely unaffected by these alternative controls.

²⁷GSOEP also provides information on the childcare attendance of kids in the household; but this information is only available for those that already made a decision to bring up kids. Parents-to-be might look at the constraints from another perspective.

Table 3: Gender wage gap and women's situation inside the household

	Mean	q(.25)	q(.75)	Mean	q(.25)	q(.75)	Mean	q(.25)	q(.75)
25-29				Base level					
30-34	0.159*** (0.045)	0.063 (0.051)	0.152*** (0.076)	0.122*** (0.046)	0.063 (0.052)	0.068 (0.076)	0.121*** (0.042)	-0.005 (0.049)	0.191*** (0.069)
35-39	0.166*** (0.043)	0.062 (0.050)	0.162*** (0.074)	0.119*** (0.041)	0.041 (0.046)	0.096 (0.067)	0.136*** (0.042)	-0.004 (0.049)	0.214*** (0.070)
40-44	0.213*** (0.042)	0.143*** (0.048)	0.181*** (0.071)	0.154*** (0.036)	0.099*** (0.041)	0.134*** (0.059)	0.183*** (0.041)	0.076* (0.047)	0.236*** (0.067)
45-49	0.219*** (0.042)	0.182*** (0.048)	0.175*** (0.071)	0.155*** (0.035)	0.127*** (0.039)	0.136*** (0.057)	0.186*** (0.040)	0.112*** (0.046)	0.229*** (0.066)
50-54	0.207*** (0.047)	0.175*** (0.054)	0.151*** (0.079)	0.112*** (0.032)	0.083*** (0.036)	0.113*** (0.052)	0.160*** (0.042)	0.079* (0.049)	0.220*** (0.070)
55-59	0.435*** (0.088)	0.442*** (0.101)	0.316*** (0.149)	0.260*** (0.063)	0.268*** (0.071)	0.261*** (0.103)	0.343*** (0.078)	0.269*** (0.091)	0.430*** (0.130)
Emp. Rate M	0.059 (0.312)	1.235*** (0.357)	-0.746 (0.529)	0.105 (0.320)	1.237*** (0.357)	-0.644 (0.523)	0.258 (0.320)	1.383*** (0.370)	-0.604 (0.529)
Emp. Rate F	1.292*** (0.314)	0.969*** (0.359)	1.512*** (0.532)	0.783*** (0.254)	0.572*** (0.284)	1.137*** (0.415)	0.797*** (0.243)	0.301 (0.280)	1.673*** (0.401)
% female main earner	-1.014*** (0.334)	-1.129*** (0.382)	-0.080 (0.567)	-0.641* (0.437)	-1.410*** (0.488)	1.325*** (0.715)			
% Tertiary educated									
% Tert. M - % tert F.							-0.746*** (0.354)	-0.317 (0.410)	-0.936* (0.585)
Observations	175	175	175	175	175	175	175	175	175
R-squared	0.461	0.456	0.269	0.434	0.455	0.286	0.443	0.425	0.282

Notes: The dependent variable are estimates of the gender wage gap obtained at the mean, the first and third quartiles using DFL decomposition for women aged between 25 and 59. ***, **, * represent significance at the 5%, 10% and 15% level respectively. All models include year fixed effects.

In Table 3, we explore how the changes inside households are related to changes in the gender wage gap. We focus on three changes: the percentage of married women that are the main earners in the household,²⁸ the percentage of women with tertiary education in the sample and the difference in the proportion of workers holding a tertiary degree between genders. At the mean, the incorporation of either variable has relatively little effect on the age-gender wage gap pattern, if anything we observe a change in the levels, but not in the relative position. Concerning the variables of interest, the percentage of women that are the main earners in the household has the expected negative sign. The results might either emerge from the fact that the raw gap is decreasing or due to the effects of the tax scheme.

5.1 Double decomposition

Given the results presented so far, it seems like there is an age-gender wage gap pattern that resembles a U-shape at the mean of the wage distribution and seems to increase with age for higher earners, possibly in a non-monotonic fashion. The inclusion of additional controls for gendered institutions, namely access to childcare facilities and differences in earnings inside the household, did add some explanatory power to the regressions; however, the general age gender wage gap pattern remains robust to these additional controls. Thus, we pursue the analysis further to investigate whether the changes are due solely to age effect using a double decomposition.

In Figure 2, we report the results of the double decomposition, where the reference structure of wages comes from the workers' own wages in the previous period.²⁹ Thus, we take into account the effect of cohort specific factors, related for example to preferences for families or economic situation at the entrance. Moreover, given that the estimates come from men and women that worked in both periods, the estimates also control for individual ability. We see a clear upward trend with the age, flattening at the age of around 40-45. This implies that while during the reproductive age the gender wage gap increases with age, in the post-reproductive age it stays relatively stable (all estimates relative to the 55-60 age group).

From Table D.3 we can observe that changes in the characteristics were not significant drivers of changes in the raw gap. The values on the first column, indicate the changes in the characteristics of men and women. A positive sign would indicate that men acquired more human capital during the period than women, while a negative sign suggests that women improved their relative situation. Similarly, a positive sign in the unexplained component indicates that males advantaged over women increased over the period. Although with some exceptions, particularly during the 1980's, relative changes in characteristics represented only a small fraction of the total change. Again with the 1980's exception, the unexplained components seemed to be the responsible for a large share of the changes. More importantly, we observe that the unexplained component tends to increase with age within every period, though non-monotonically, which corroborates the findings from previous tables.

The results can also be considered consistent with double penalty arguments, since changes for the oldest group are the largest in each period. However, we must interpret them with caution, as the self-selection into employment at later stages of life might be higher than during the youth. Thus, a similar pattern might emerge if, for some reason, only more capable women stay in the market or if double burden decreases due to more equal sharing between men and women within household.

The bottom part of Table D.3 should be interpreted with caution. While we control for endowments and cohort specific effects, we cannot completely erase time effects from the picture. In other words, the changes that we attribute to age might also results from year specific shocks. While this is possible, the significant and negative time trend found in each previous regression, suggest that controlling for these shocks would lead to higher and not lower estimates of the changes.

²⁸Notice that these effects do not necessarily correspond to the number of married women that earn more than their husband, nor the total income provided by women inside a household. While it is true in the case of traditional family structures, with two working parents, it does need to be so in the case of more complex and recent cases, where adult children (for instances) might live with their parents well beyond their incorporation to the labor market.

²⁹Detailed results reported in Table D.3 in the Appendix.

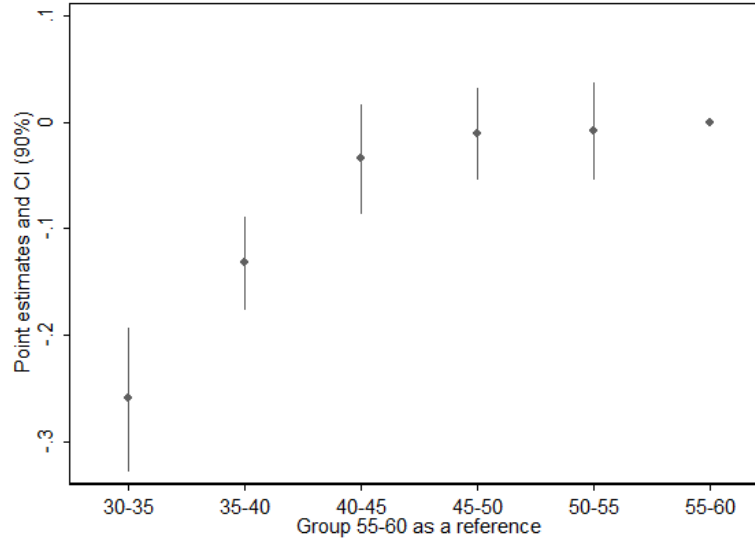


Figure 2: Age pattern of the adjusted gender wage gap

Note: The estimates account for year and cohort effects and are obtained by filling the matrix of counterfactual wage distribution for each j to $j + 1$ change (in both characteristics and counterfactual prices), and for each given $j +$, for each t to $t + 1$ change. Thus, we decompose the change $j + 1 - j$ and $t + 1 - t$ into two components, estimating the effects for each age group at $j + 1$, see Appendix A for a detailed explanation. Bootstrapped standard errors with 1000 repetitions.

6 Conclusions

Raw gender wage gaps prove to be remarkably stable over time and increasing with age. This tendency is accompanied by subsequent cohorts of women being much better educated, relative to men. Moreover, period of childbearing is gradually delayed, longevity exhibits in substantially longer professional life, whereas decreasing number of children as well as increasing availability of child facilities and gradually more equal division of housework between men and women suggest that the grounds for a reproductive age penalty are reduced. One potential explanation which reconciles the trends observed in raw gender wage gaps and the trends observed in individual endowments is that the patterns of the adjusted gender wage gap are age-specific. Such explanation has strong theoretical foundations. Referring to differences in the accumulation of human capital for both genders (hysteresis effect) some theories predict a hump shaped pattern of the adjusted wage gap with respect to age. This is our reproductive age penalty hypothesis. However, given the secular trends, the initial penalty should be reduced for the subsequent cohorts (reduction in statistical discrimination effect). Other positive explanations, such as different bargaining over wages between men and women do not give a clear prediction as to the lever or slope effects for the relationship between age and adjusted gender wage gap.

Our objective in this paper has been to verify whether these theoretical predictions find confirmation in the data, reconciling the contradicting time trends in raw gap and endowments/characteristics. To this end we employ a long panel of individual data for Germany and a decomposition technique developed by DiNardo et al. (1996), which provides great versatility in defining the counterfactual structure of wages. Exploiting the longitudinal dimension of the data and the properties of this decomposition we are able to identify the cohort and the age patterns for the adjusted gender wage gaps. We identify a hump-shaped pattern relative to age and a decreasing cohort effects. This means that adjusted gender wage gap grows as female workers get older, while at the same time it is lower for the younger cohorts. Thus, we argue that both hypothesis find support in the data, in

a complementary way. In other words, for younger cohorts, we see a lower wage penalty during reproductive age, while over a lifetime, we observe not only a reproductive age penalty but also a post-reproductive wage penalty.

In addition, we sought to explain these patterns by the secular trends observed in German society: educational attainment of young women was initially much lower, but eventually surpassed that of men, whereas marriage and childbearing have become substantially more seldom and occur much later. Indeed, there seems to be some weak negative link between age-and-time specific fertility and the age-and-time specific estimates of adjusted gender wage gaps, especially in the lower part of the wages distribution. Conversely, better educational attainments seem to be associated with a higher gap amongst the high earners. Thus, while in former context we find evidence that the scope of statistical discrimination is reduced, in the case of the latter the opposite seems to be the case. Trends in education, fertility or marriage have no explanatory power in the case of the age pattern for the adjusted gender wage gap.

An obvious caveat of our study is that it only concerns one country – Germany. While it is an interesting case for a number of policy-related reasons, it may also prove singular in a sense that the secular trends in education and fertility experienced in Germany were particularly strong. While we find no evidence to support the argumentation about labor market features such as maternity leave, part-time employment or secondary earner taxation, such gendered institutions may indeed play an important role in other economies. Thus, the results of our analysis should be taken with caution.

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Appendix A. Double decomposition method

As noted by DiNardo et al. (1996), the distribution of wages can be written in the following form:

$$f(w) = \int f(w|x) f(x) dx, \quad (\text{A.1})$$

which indicates that the distribution of wages (w) equals to the integral of the conditional distribution of wages on the set of characteristics multiplied by the distribution of this characteristics. We notice that x can include variables of different type: those related to the personal attributes, such as gender and education; those related to firm characteristics, such as its size or the industry; and those related to the environment, such as time and region. We can also write a gender-time specific formula in the following manner,

$$f(w|g = i, t = j) = \int f_{i,j}(w|x) f(x|g = i, t = j) dx, \quad (\text{A.2})$$

where g refers to gender, t to the time period and $f_{i,j}(w|x)$ is the conditional distribution of wages on the characteristics, the gender and the period. From this equation, two alternative paths arise. The first of them is to estimate how the distribution of wages for the entire population would look like if all workers receive the same treatments than females, as in DiNardo and Lemieux (1997). The second is to estimate how would the male wage distribution look like if they were treated as females, as in DiNardo et al. (1996). We follow this second path as it allows to estimate the adjusted wage gap. Given previous equation, we can write male's wage distribution if they had female characteristics as follows:

$$f(w|g = m, t = j) = \int f_{m,j}(w|x) f(x|g = f, t = j) dx \quad (\text{A.3})$$

We observe that this equation is similar to the previous one, in fact we can rewrite it as follows

$$f(w|g = m, t = j) = \int f_{m,j}(w|x) \Psi(x) f(x|g = m, t = j) dx \quad (\text{A.4})$$

where $\Psi(x)$ is the reweighting factor and is defined as

$$\Psi(x) = f(x|g = f, t = j) / f(x|g = m, t = j) \quad (\text{A.5})$$

Notice that although we do not observe the counterfactual distribution of wages, we can estimate the re-weighting factor $\Psi(x)$ using either parametric and non-parametric approaches. Though the second is more flexible, it suffers from the dimensionality curse mentioned above; therefore, we prefer to use a probit model to estimate the propensity score for each observation. The estimated model is then the following:

$$\Psi(x) = \frac{Pr(g = f|x, t = j)Pr(g = m|t = j)}{Pr(g = m|x, t = j)Pr(g = f|t = j)} \quad (\text{A.6})$$

This formula allows to re-weight male distribution in order to obtain the distribution that would have prevailed if male workers had the same characteristics than their female counterparts. Once we had this distribution, we can calculate the values for the explained and the unexplained components of the gender wage gap. The explained component equals the difference between the actual male distribution and the counterfactual; while the unexplained component equals the difference between the counterfactual and the female distribution.

Notice that we could derive an expression similar to equation (A.5) to estimate the counterfactual distribution of wages that would prevail in 1989 if the distribution of characteristics were the same as 1984 under the assumption that the distribution of characteristics does not affect the rewards (DiNardo et al. 1996). Though this assumption may be seen as unrealistic, it is standard in the decomposition literature.

Even though it is possible to use the re-weighting procedure to estimate the counterfactual male salary if it had women's characteristics as much as the inverse (female salary if it had male

characteristics), the results from both may differ. The problem lies in the possible lack of a common support on male and female. If for some characteristics combinations (cells) we have only male observations, then imposing this structure on females will result on a bias. Hence, following the suggestions by Black et al. (2006), we use the characteristics from the disadvantage group; we estimate the wage of males if they had the females characteristics. When we decompose the changes over time, we use the distribution of characteristics from the initial period in the re-weighting equation.

As a first strategy to measure the effects of age in the gender wage gap, we estimate the raw component for different age groups, cohorts and periods. With those estimates, we create a panel, where cohort is the group unit and the year for it was calculated as the time dimension. Then, we can use the properties of the panel to separate the age effects from those from the other confounding factors.

In addition to the results from the panel estimation, and as a robustness check, we propose another measure of the changes in the unadjusted wage gap as people age. In particular, we adapt the formula proposed by Yun (2009) in the equation (5) of her paper. In order to do this, we define the wage gap in period j as

$$\Delta_j = \int f_{m,j}(w|x) f(x_{m,j}) dx - \int f_{f,j}(w|x) f(x_{f,j}) dx$$

where, $f(x_{i,t}) = f(x|g = i, t = j)$, for $i = m, f$. Consequently, we can define the difference between two periods as follows,

$$\begin{aligned} \Delta_{89} - \Delta_{84} &= \int f_{m,89}(w|x) ((f(x_{m,84}) - f(x_{m,89}) - (f(x_{f,89})) - f(x_{f,84}))) dx \\ &+ \int f_{m,84}(w|x) (f(x_{m,84}) - f(x_{f,84})) dx - \int f_{m,89}(w|x) (f(x_{m,84}) - f(x_{f,84})) dx \\ &+ \int f_{m,89}(w|x) (f(x_{f,84}) - f(x_{f,89})) dx - \int f_{f,89}(w|x) (f(x_{f,84}) - f(x_{f,89})) dx \\ &+ \int (f_{m,84}(w|x) - f_{m,89}(w|x) - (f_{f,84}(w|x) - f_{f,89}(w|x))) (f(x_{f,84})) \end{aligned} \quad (A.7)$$

In equation (A.7), we have decompose the change in the raw gaps into four different components: a) the first line shows the convergence in characteristics between men and women; b) the second, the differences remaining in the last period; c) the third, the differences in the wage structure in the final period; and d) the fourth, the convergence in the wage structure between periods. The first two components constitute the explained component while the second represents the unexplained part. From the equation (A.7), we can see that the last component is similar to the difference in the unexplained components from equation, but not exactly the same. If we just take the difference in the unexplained components, we will end also with a part which is due to changes in the characteristics of female from period t to $t_{\zeta} + 1$. The last term of equation (A.7) provides a "cleaner" view on the effects of the changes in the wage structure by maintaining the same characteristics as the basis for the calculations.

A natural analysis of the changes in the gender wage gap as people ages follows the same cohort over different periods, which is possible given the panel nature of our data, which is described in greater detail below. Thus, we apply equation (A.7) to decompose the changes in the wage structure for women that were 25-29 years old in 1984 with respect to the same observations in 1989, that is when they are 30-34. This allows us to control for unobserved individual effects that depend on the cohort. Unfortunately, it is more difficult to disentangle the effects of the period from the changes in age. The alternative is to measure the age differences in the gender wage gap within the same period. This provides us an estimate free of the period effects, but confounds the effects of age and cohort. By conducting both types of analysis, we obtain results which though flawed on their own, taken together can be considered robust.

Appendix B. Descriptives

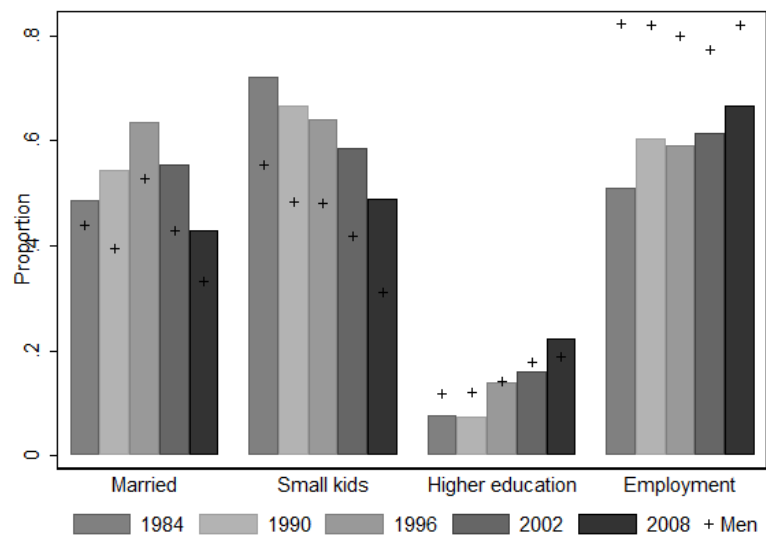


Figure B.1: Trends in characteristics of women 25-34. Source German statistical office

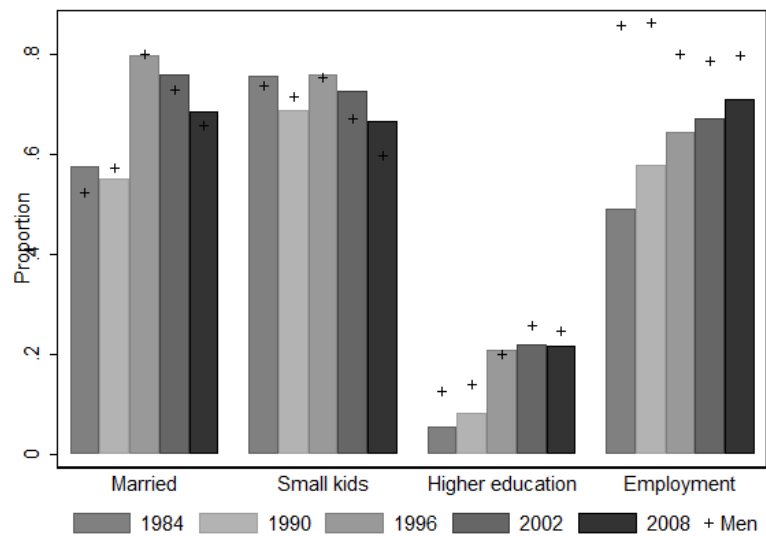


Figure B.2: Trends in characteristics of women 35-44. Source German statistical office

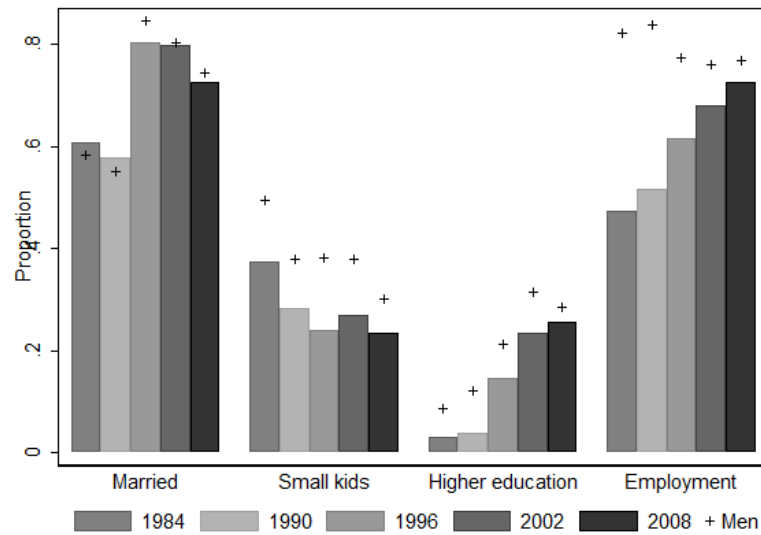


Figure B.3: Trends in characteristics of women 45-54. Source German statistical office

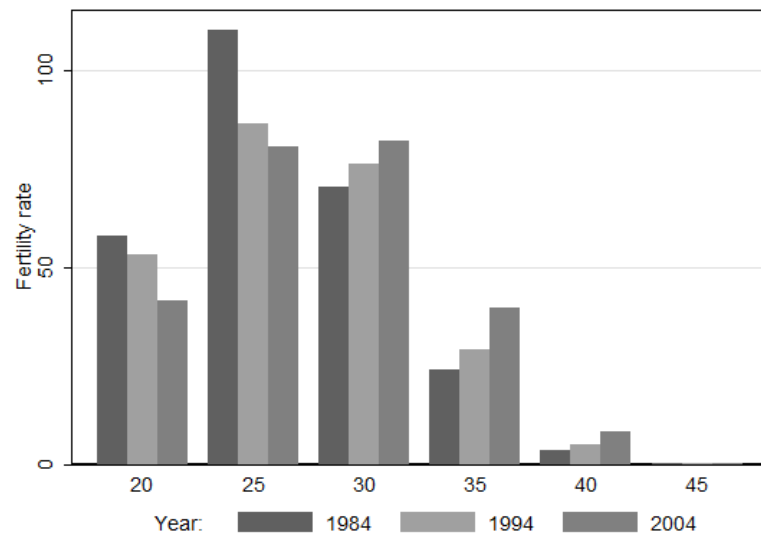


Figure B.4: Changes in women's fertility rate of different ages across time. Source German statistical office

Appendix C. Statistical properties of the estimates

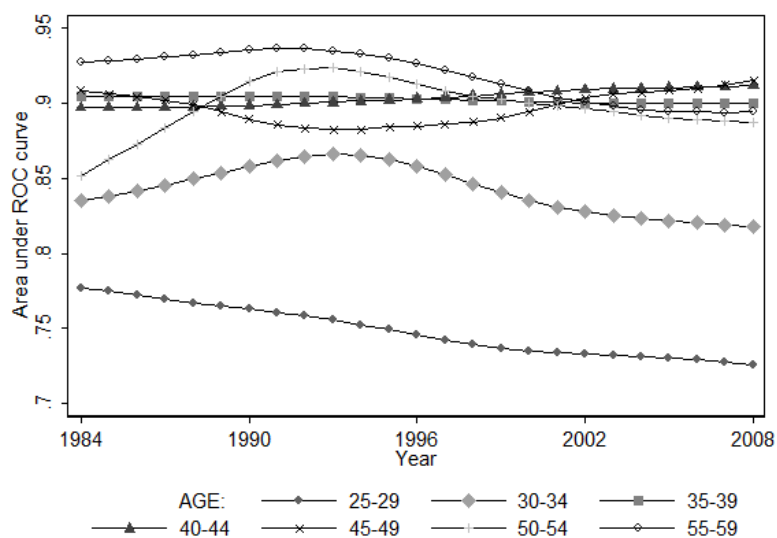


Figure C.1: Area under the ROC curve for different years and age groups. Source: own computation based on GSOEP 1984-2008

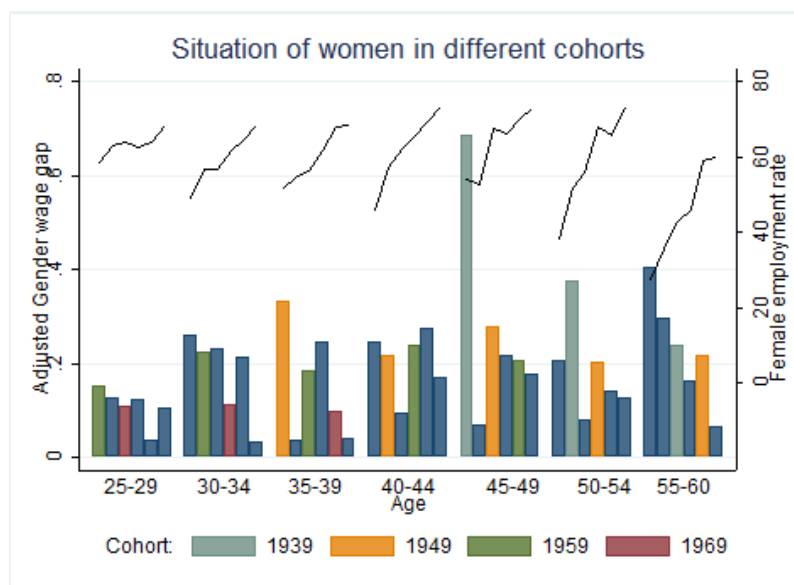


Figure C.2: The unexplained component for different ages and periods. Source: own computation based on GSOEP 1984-2008

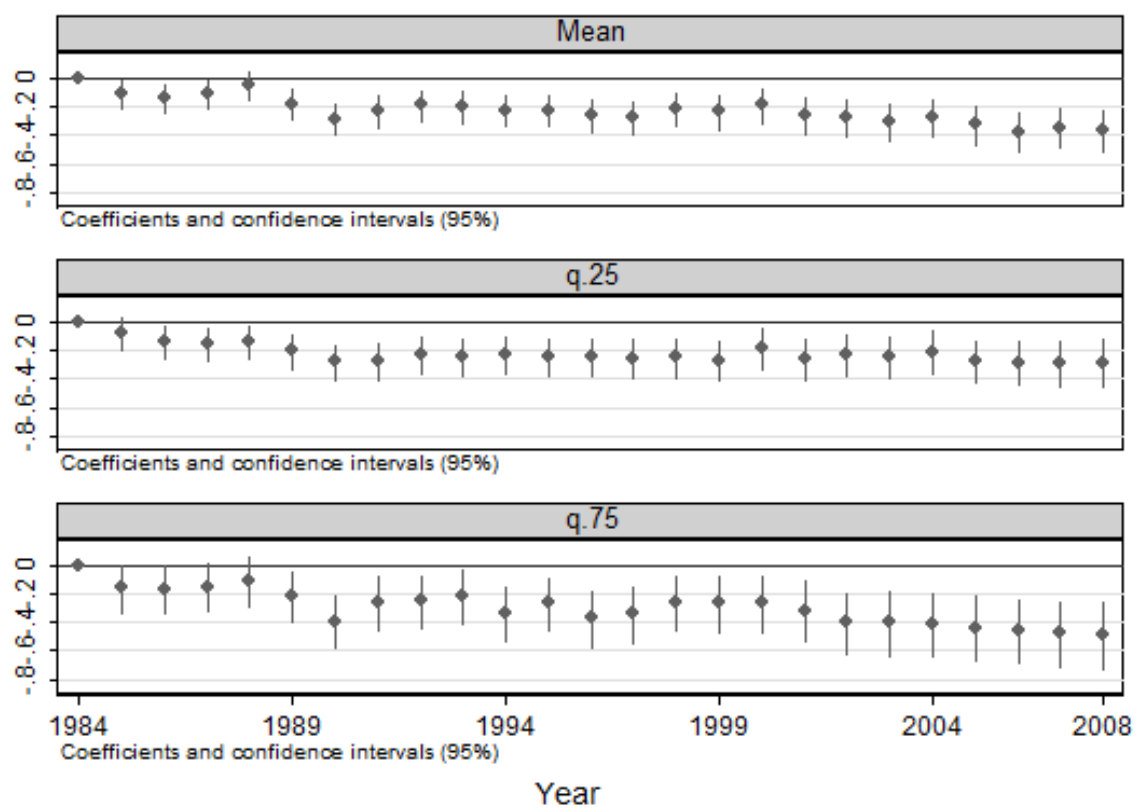


Figure C.3: Value of year fixed effects from table 1, columns 3, 4 and 5. Source: own computation based on GSOEP 1984-2008

Appendix D. Robustness checks

Table D.1: Gender wage gap and childbearing: alternative controls

	Mean	q(.25)	q(.75)	Mean	q(.25)	q(.75)	Mean	q(.25)	q(.75)
25-29				Base level					
30-34	0.022 (0.075)	-0.010 (0.075)	-0.034 (0.101)	-0.009 (0.040)	0.054 (0.046)	-0.121*** (0.055)	0.014 (0.035)	0.037 (0.044)	-0.087* (0.053)
35-39	-0.045 (0.087)	-0.108 (0.087)	-0.006 (0.116)	-0.168** (0.085)	0.022 (0.097)	-0.247*** (0.115)	0.034 (0.034)	0.047 (0.042)	-0.021 (0.051)
40-44	-0.057 (0.111)	-0.082 (0.111)	0.045 (0.149)	-0.209* (0.126)	0.099 (0.143)	-0.269* (0.170)	0.110*** (0.043)	0.176*** (0.053)	0.048 (0.065)
Emp. Rate. M	-0.133 (0.619)	-0.073 (0.620)	0.997 (0.833)	0.157 (0.412)	-0.087 (0.470)	0.992** (0.557)	0.507 (0.466)	0.370 (0.574)	0.871 (0.701)
Emp. Rate. F	-0.077 (0.489)	-0.626 (0.489)	0.305 (0.658)	0.082 (0.366)	-0.580 (0.417)	0.187 (0.495)	-0.208 (0.344)	-0.639* (0.423)	-0.227 (0.517)
Places for kids <3	0.009** (0.005)	0.012*** (0.005)	-0.000 (0.007)						
Fertility rate				-0.322*** (0.117)	-0.057 (0.133)	-0.334*** (0.158)			
Fertility change							0.202* (0.129)	0.068 (0.159)	0.119 (0.194)
Observations	76	76	76	100	100	100	80	80	80
R-squared	0.667	0.706	0.594	0.750	0.665	0.667	0.783	0.705	0.679

Notes: The dependent variable are estimates of the gender wage gap obtained at the mean, the first and third quartiles using DFL decomposition for women aged 25 to 44. ***, **, * represent significance at the 5%, 10% and 15% level respectively. All estimates have cohort fixed effects. Data on childcare facilities is only available up to 2002, thus the lower number of estimates on the first three columns. In the last three columns we drop the observations for which we did not have information on previous cohorts.

Table D.2: Gender wage gap and women's situation inside the household: alternative controls

	Mean	q(.25)	q(.75)	Mean	q(.25)	q(.75)	Mean	q(.25)	q(.75)
25-29									
30-34	0.062* (0.041)	-0.018 (0.046)	0.030 (0.058)	0.079** (0.047)	-0.051 (0.054)	0.098* (0.066)	0.051 (0.041)	0.001 (0.048)	0.021 (0.059)
35-39	0.021 (0.039)	-0.062 (0.045)	0.008 (0.056)	0.041 (0.051)	-0.115** (0.059)	0.096 (0.072)	0.004 (0.042)	-0.046 (0.049)	-0.007 (0.060)
40-44	0.026 (0.048)	-0.018 (0.055)	0.003 (0.069)	0.051 (0.063)	-0.087 (0.073)	0.111 (0.090)	0.006 (0.051)	-0.001 (0.060)	-0.015 (0.074)
45-49	-0.006 (0.063)	-0.032 (0.072)	0.012 (0.090)	0.024 (0.082)	-0.127 (0.095)	0.148 (0.117)	-0.024 (0.064)	-0.005 (0.075)	-0.003 (0.092)
50-54	-0.120** (0.071)	-0.164*** (0.081)	-0.058 (0.102)	-0.083 (0.094)	-0.265*** (0.107)	0.105 (0.133)	-0.147** (0.074)	-0.131* (0.087)	-0.081 (0.106)
55-59	-0.142** (0.083)	-0.196*** (0.095)	-0.086 (0.119)	-0.093 (0.101)	-0.267*** (0.116)	0.102 (0.143)	-0.182*** (0.089)	-0.147 (0.105)	-0.121 (0.128)
Emp. Rate M	-0.120 (0.321)	0.686** (0.368)	-0.353 (0.460)	-0.136 (0.321)	0.649** (0.368)	-0.386 (0.455)	-0.222 (0.328)	0.503 (0.385)	-0.452 (0.471)
Emp. Rate F	0.310 (0.354)	-0.160 (0.406)	0.518 (0.507)	0.381 (0.337)	0.112 (0.386)	0.624 (0.478)	0.363 (0.335)	0.140 (0.393)	0.577 (0.481)
% female main earner	0.207 (0.345)	0.988*** (0.396)	0.222 (0.494)						
% Tertiary educated				-0.099 (0.393)	1.108*** (0.451)	-0.803 (0.558)			
% Tert. M - %tert F.							0.695 (0.600)	0.938 (0.704)	0.667 (0.861)
Observations	175	175	175	175	175	175	175	175	175
R-squared	0.650	0.644	0.661	0.649	0.644	0.667	0.653	0.630	0.662

Notes: The dependent variable are estimates of the gender wage gap obtained at the mean, the first and third quartiles using DFL decomposition for women aged between 25 and 59. ***, **, * represent significance at the 5%, 10% and 15% level respectively. All models include cohort fixed effects.

Table D.3: Double decomposition

Age	Gap due to characteristics	Gap due to residuals	Gap due to unexplained part
	Years 1984-1989		
30-34	-0,05	0,08	0,05
35-39	-0,04	0,04	0,15
40-44	-0,17	0,20	0,13
45-49	0,35	-0,45	0,36
50-54	0,00	0,01	0,22
	Years 1990-1999		
30-34	0,00	-0,10	0,14
35-39	0,00	-0,43	0,56
40-44	0,03	-0,02	0,11
45-49	0,00	-0,07	0,20
50-54	0,01	-0,28	0,4
	Years 2000-2008		
30-34	0,05	-0,17	0,14
35-39	-0,18	0,03	0,22
40-44	-0,11	-1,16	1,43
45-49	-0,12	-0,47	0,74
50-54	-0,18	-0,53	0,80
	Gender wage gap changes for the 1959-1963 cohort		
30-34	-0,08	0,11	0,04
35-39	-0,01	-0,12	0,15
40-44	0,16	-0,19	0,15
45-49	0,02	-0,41	0,20
50-54	-0,26	0,25	0,05

Notes: Table presents double decomposition for women in different age groups between the initial and the end periods (age at the end of the period is presented in column 1). Residuals are additional elements of the decomposition that lack a clear interpretation and not a measure of the quality of the model. The bottom panel presents the double decomposition for the same women as they aged.



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