

Working from Home: Heterogenous Effects on Hours Worked and Wages

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Abstract

Working from home has become more and more common, especially among high-skill workers, since the early 2000s. In this paper we investigate how such alternative work arrangements affect hours of work including overtime, wages, job and life satisfaction. We exploit five waves of the German Socio-Economic Panel between 1997 and 2014, a period during which the revolution in telecommunication technologies has dramatically reduced the costs to perform certain tasks at home. Controlling for individual fixed effects, we find that home-based work has led to an expansion of overtime hours among full-time employees, especially among women. However, these overtime hours seem to pay off in terms of wages for men only. We do not find that childless women are affected differently from mothers. We also control for selection into employment in a panel setting when time-varying unobserved preferences or characteristics may affect employment decision.

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1 Introduction

In the past two decades, progress in telecommunication technologies has made it easier to perform several job tasks outside the workplace because of better connectivity through broadband Internet technologies, cheaper and user-friendly computers. This technological shock made working from home technically feasible and less costly in many occupations. In fact, using data for the Netherlands, [de Graaff and Rietveld \(2007\)](#) present evidence that a wage penalty of 19% for working at home is almost reduced to zero once workers have access to the internet. This suggests that recent technological advances substantially increase the productivity of working from home. At the same time, the share of workers valuing the increased flexibility associated with working from home has likely increased during the last decades as female labour force participation rose. Indeed, [Mas and Pallais \(2017\)](#) find that working from home is the most valued type of flexible arrangements in the U.S. and that women, particularly those with young children, have higher willingness to pay for working from home. Actually, from early on, the debate about home-based working emphasized that these work arrangements may help reconciling work and family responsibilities, see e.g. [Allen et al. \(2015\)](#) for a review of the early literature.

Hence, this suggests that both the demand for and supply of teleworkers has been increasing during the last one to two decades. Indeed, there is evidence that home-based work strongly gained in importance in recent years. [Lister and Harnish \(2011\)](#) report that between 2005 and 2009 regular telecommuting grew by 61% in the US. Moreover, [Bloom et al. \(2014\)](#) argue that working from home at least occasionally has become a mainstream practice with around 50% of managers of medium-sized firms in Germany, the United States, and the United Kingdom being allowed to work from home during contractual hours.

In light of the growing relevance of working from home (WfH), understanding how this form of work arrangement affects worker's wages and careers is of increasing importance. Yet, the theoretical expectations are far from clear-cut as the outcomes likely depend on the use and the underlying motives behind WfH. If WfH during contractual hours is mainly costly to employers due to e.g. high costs of monitoring, but, at the same time, facilitates the reconciliation of work and family responsibilities on the side of workers, WfH is likely to go along with a compensating wage differential, hence resulting in a wage and career penalty for those opting for WfH. If, on the other hand, workers are willing to expand overtime hours due to the reduced costs of working from home, firms may benefit from the availability of workers beyond usual office hours. In this case, there might even be a premium of doing WfH both in terms of wages as well as career prospects.

Hence, the expected effects of working from home are indeterminate and may vary across different groups of workers. The need to combine work and family, for example, tends to

be more pronounced among female workers. Yet, the empirical evidence on labour market outcomes of WfH is scarce. In this paper we aim at filling this gap by investigating whether working from home affects contractual and overtime hours, wages, job and life satisfaction for different groups of workers with different opportunity costs of working.

For this analysis, we exploit individual panel data from the German Socio-Economic Panel between 1997 and 2014, a period that was characterized by a pronounced increase of individuals working from home at least occasionally. In order to identify the effect of working from home on labour market outcomes, we control for individual fixed-effects as well as an extensive set of time-varying demographic and job-related variables. Compared to the existing literature that often relied on cross-sectional evidence only, we are able to take account of unobserved individual heterogeneity in abilities, preferences and working attitudes. This is a significant improvement as the sample of employees choosing WfH arrangements may be a selected sample. Actually, we show that failing to control for individual time-invariant characteristics lead to an overestimation of the effect of WfH on actual hours. Moreover, we also account for selection into employment as men and women are likely to make different employment decisions in ways that can affect their hours, wages and job satisfaction. To the extent that there may be unobserved shocks that affect male and female labour force participation, the fixed-effect approach might not suffice to deal with selection into the work force. Hence we also correct for sample selection bias due to time-varying unobserved preferences or characteristics using a control function approach in a panel data setting.

We find that the incidence of WfH in Germany has been increasing by about 50% between 1997 and 2014, and the increase has been even stronger for high-skilled workers. Moreover, although men used to work more often from home at the start of the 2000s, the gender gap in WfH decreased to almost zero over the period considered. In terms of outcomes, WfH has no impact on contractual hours for women and a small positive impact on men's contractual hours. It is associated with an increase in overtime hours by about 0.5 hour per week among full-time men and by about 1.4 hours per week among full-time women. While for men these additional hours go along with higher hourly wages, additional overtime does not seem to pay off for women. Hence, women's hourly wages based on actual rather than contractual hours even decrease significantly by 2.6%. By contrast, for men, contractual hourly wages increase significantly and compensate for the increase in actual hours. Compensation of overtime with days off does not explain the negative effect of WfH on women's actual hourly wages. Moreover, women do not report any increase in job or life satisfaction with HBW take-up so that differences in willingness to pay for alternative work arrangements do not explain the different results on wages either. The male wage premium associated with WfH is partly driven by men who obtain a promotion while women getting promoted and starting WfH do not receive similar wage

increase.

Our analysis contributes to two strands of the literature. First of all, our results add to the scarce literature on the labour market effects of working from home. The scarce empirical literature has found contradicting evidence regarding wage effects. While some studies suggest a wage penalty for WfH (Glass, 2004), others suggest positive wage effects (Weeden, 2005; Leslie et al., 2012). Moreover, Oettinger (2011) shows that an initial wage penalty vanished during the last two decades parallel to the trend towards increased shares of WfH. He interprets this as evidence that shifts in the demand of WfH outweighed shifts in the supply of WfH. The comparison of these studies, however, is often difficult as the definition of WfH varies between working permanently from home and WfH occasionally during overtime hours. Moreover, WfH may have effects on both contractual and overtime working hours. Since WfH reduces the disutility from working and saves on commuting time, there might be a positive effect on contractual hours. In line with this, Dettling (2017) finds a positive effect of broadband internet access on women’s labour force participation and interprets this as the result of saving time in home production and being able to telework. Moreover, Noonan and Glass (2012) found evidence that teleworkers, i.e. people WfH while using an Internet access, tend to work more overtime hours than non-teleworkers.

Secondly, our paper also contributes to the literature on gender differences in labour supply at the intensive margin and on gender wage gaps (Antonczyk et al., 2010; Goldin, 2014; Cortes and Pan, 2016). In particular, it is closely related to papers that investigate how flexible work arrangements affect men’s and women’s careers. Anderson et al. (2003) and Weeden (2005) look at how work-schedule flexibility affects the motherhood wage penalty or/and the gender pay gap in the U.S.. We complement these studies by exploring how a concrete form of flexible work arrangement, namely the ability to carry out some tasks at home, affect not only men’s and women’s wages but also working hours. By looking at home-based work as a complement to on-site work we depart from the papers that focus on workers for whom their home is their only work place (Edwards and Field-Hendrey, 2002; Oettinger, 2011).

The rest of the paper is organized as follows. In section 3 we describe the data and provide some facts and trends in home-based work usage and labour market outcomes across gender. we discuss the empirical strategy in section 4 and present the results in section 5. The last section concludes.

2 Literature Review

2.1 Labour supply effects from WfH

From a theoretical perspective, there are two reasons why WfH may have an extension effect on labor supply both at the extensive and intensive margin. On the hand, WfH can save on commuting time which would raise leisure for a certain amount of working hours. Hence, the implied outward shift of the budget constraint in a standard labor supply framework results in an extension of working hours as part of the gain in leisure is actually spent on increasing hours worked (Possenriede et al., 2016). At the extensive margin, it may also raise labor force participation as the lower disutility from working might motivate some people to start working (Blundell et al., 2013). On the other hand, WfH might even induce positive labor supply effects without saving on commuting time because WfH can reconcile schedule constraints that occur because working hours and hours spent on private needs such as childcare take place during the same hours of the day. Being able to combine conflicting schedules should raise an individual's utility just as leisure and consumption do in a standard labour supply model. As a result, workers should trade flexibility for either wage or leisure, hence potentially raising working hours (Golden, 2015).

Taken together, the flexibility of WfH could result in an extension of working hours and labor force participation, although the strength of these effects might actually be limited and concentrated among certain groups of workers. First of all, shorter commutes do not seem to have much of an effect on working hours (REF). Moreover, the reconciliation of conflicting time schedules should be of relevance for workers with pronounced schedule constraints only such as e.g. mothers. In fact, WfH has been considered to be one means of potentially narrowing the gender gap in working hours, especially in overtime, that has recently been considered as a main source of the gender wage gap (Goldin, 2014; Cortes and Pan, 2016).

Empirical studies on the effect of WfH on the extensive margin are almost non-existent. An exception is Dettling (2017) who demonstrates that access to broadband internet significantly increases female labor supply by about 4 percentage points on average and by 8 percentage points among high-skilled mothers as it saves time in home production and facilitates teleworking. Dettling (2017) hence concludes that improved opportunities for teleworking may actually encourage entry into the labour market especially by high-skilled workers with the strongest schedule constraints.

Studies regarding the effect of WfH on the intensive margin also scarce, but seem to suggest a moderate extension effect of WfH on overtime rather than contractual hours. (Possenriede et al., 2016) control for individual fixed effects and find that teleworking results in an extension of overtime hours for both men and women in the Netherlands, and a marginally significant increase in contractual hours for women only. Similarly, Lott

and Chung (2016) show for German workers that a switch from a fixed hours schedule set by the company to a schedule that allows for working-time autonomy results in increased overtime, especially among men, but less so among women. Consistent with these studies, evidence by Noonan and Glass (2012) points to a positive association of WfH and longer overtime hours in the US, although the use of a cross-sectional analysis may give rise to an estimation bias as workers who telecommute have been shown to be a positive selection with regard to hours worked as well as other performance measures. When controlling for job and pay system characteristics in a cross-sectional analysis, Peters et al. (2008) do not find any significant hours extension effect from teleworking, indicating that the selection of firms offering WfH may upward bias the estimated hours effect of WfH.

Hence, the limited evidence on labor supply effects of WfH tends to find positive effects both at the extensive margin and the intensive margin where the latter often seems to be limited to overtime hours. Whether WfH reduces the gender gap in actual hours, however, remains unclear. Finally, note that the predictions regarding the hours effect of WfH are c.p. only. If WfH simultaneously raises wages, for instance, this may induce a negative labour supply effect. Hence, we turn to the wage effects of WfH next.

2.2 Wage effects from WfH

In contrast to the expected labor supply effects of WfH, the theoretical effects on wages are ambiguous, potentially giving rise to both a wage premium or a wage penalty. In particular, the wage effect of WfH can be related to a productivity effect, a hedonic effect as well as a signaling effect.

The productivity effect can be both positive or negative. Positive productivity effects may arise if WfH increases job satisfaction in response to less conflicting time schedules or comes with a more productive work environment at least for certain tasks. On the other hand, monitoring a worker's effort at home is difficult and may result in shirking, especially when occasionally being interrupted by family or other private responsibilities. In a competitive labor market, such productivity effects would be reflected in a worker's wage level. Evidence on the productivity effects of WfH is inconclusive, but seems to suggest positive effects more often than negative effects. In an experimental setting, Bloom et al. (2014) find a 13% performance increase among call center employees that were allowed to work from home.

3 Data and descriptive statistics

3.1 The German Socio-Economic Panel

The German Socio-Economic Panel (GSOEP) provides detailed information about individuals' socio-economic characteristics. It is a panel dataset for the years 1984-2014 consisting of about 20,000 individuals living in Germany.¹ In particular, it provides information on home-based work (HBW) arrangements in the 1997, 1999, 2002, 2009 and 2014 waves.² We use a sample of employees between 20 and 65 years old for whom we have information on whether they worked from home or not in at least two waves. We exclude self-employed individuals, individuals in formal education and training and individuals in marginal employment (i.e. those earning less than 400-450 Euro per month). We end up with an unbalanced panel of 22,326 individuals, 47% of whom are women, who we observe for 2 to 5 waves over the period 1997-2014.

We also construct additional sub-samples to investigate how different populations use home-based work for different purposes and benefit differently from it. In particular, we extract a sample of full-time employees (excluding those working 30 hours or less) that consists of 18340 individuals, 35% of whom are women.

Individuals are asked whether they work from home sometimes and if so whether they do it at a daily, weekly or monthly basis. This information however does not permit to gain a precise picture about the intensity of home-based work, which could be done for a complete working day or for few hours in the overtime. We construct two dummy variables that are equal to one if the individual works from home at least once a month or at least once a week.

Concerning working hours, the data allows a distinction between contractually agreed weekly working hours and actual working hours. Overtime hours are calculated by the difference between actual working hours and contractually agreed working hours. To minimize potential errors we trim overtime hours excluding the 1st and the 99th percentile, so that we exclude those with negative overtime hours and 23 or more overtime hours per week. Hourly wages are measured through the self-reported monthly gross income divided by actual monthly working hours. We calculate real wages based on the CPI deflator using 2010 as the base year. In order to ensure that outliers are not driving the wage results we also trim wages excluding the 1st and the 99th percentile (individuals receiving an hourly wage lower than EUR 4 or higher than EUR 50) and we employ the standard logarithmic form for the wage regressions.

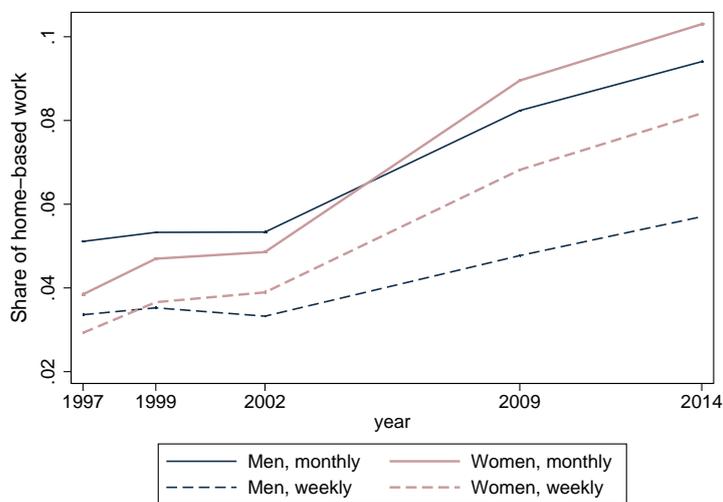
¹See [Kroh et al. \(2015\)](#) for details on the GSOEP data set.

²We use the expressions home-based work (HBW) and working from home (WfH) interchangeably for people who work from home occasionally as a complement to office work.

3.2 Trends in home-based work and descriptive statistics

The share of individuals working from home has increased in Germany over the past 20 years. Figure 1 shows that in 1997 men were more likely to work from home than women. This was the case for both working from home at least once a month and working from home done at a weekly basis. However, the increase in HBW has been much stronger among women which has resulted in a reversal of the gender gap in the share of employees working from home. Figure 2 displays this evolution for three groups with different educational levels. A much larger share of high-skill workers reports working from home compared to individuals with an apprenticeship degree or no post-secondary degree. In 1997, 18% of men with a tertiary degree work from home at least once a month, but only about 2% of men with an apprenticeship degree do so. Those figures are respectively 11% and less than 2% among women. Concerning gender differences, the reduction in the gender gap in HBW participation took place in all educational groups. Figure 3 additionally shows that HBW is more common at the top of the wage distribution both for men and women. Moreover, for the highest wage deciles women appear to work more often from home than men.

Figure 1: Trends in home-based work by intensity



Source: GSOEP. Full-time and part-time employees. 1997, 1999, 2002, 2009 and 2014 waves.

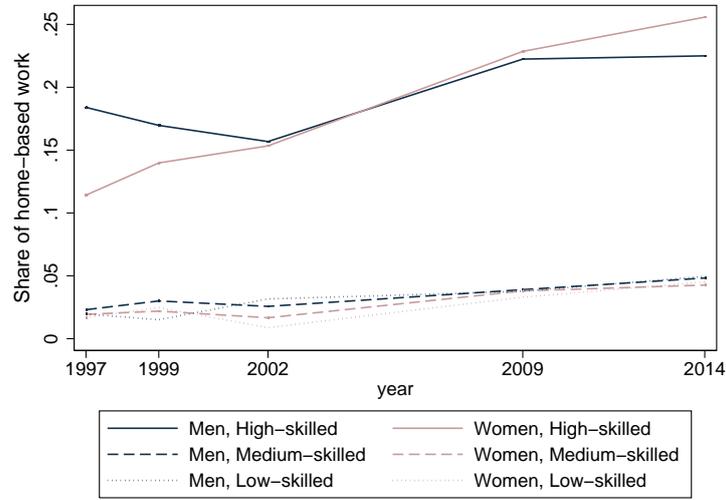
Table 1 provides summary statistics on our final sample including part-time and full-time workers. The contractual hours of women who never work from home are on average 31.7 hours, about two hours more than women doing home-based work. This difference is due to the larger share of women working part-time among women doing HBW compared to women not doing HBW (50% vs. 39%). The contractual hours of men who never work

Table 1: Summary statistics by home-based work status and gender

	Female			Male		
	HBW	no HBW	difference (t-stat.)	HBW	no HBW	difference (t-stat.)
<i>Panel A: Outcome variables</i>						
Actual working hours per week	36.32	35.24	1.08*** (2.81)	46.08	42.49	3.59*** (16.23)
Contracted working hours per week	30.91	32.85	-1.94*** (-5.70)	38.44	38.70	-0.26** (-1.99)
Overtime hours per week	5.41	2.39	3.02*** (20.66)	7.64	3.79	3.85*** (21.74)
works less than 30 hours per week	0.47	0.35	0.12*** (6.49)	0.07	0.02	0.05*** (8.73)
Gross hourly real wages	19.47	13.76	5.71*** (26.18)	21.70	16.46	5.23*** (22.17)
Gross monthly real wages	2965.66	2077.69	887.97*** (22.32)	4261.73	2986.22	1275.51*** (28.56)
<i>Panel B: Main explanatory variables</i>						
Tertiary education degree	0.69	0.21	0.48*** (29.20)	0.62	0.18	0.44*** (29.83)
Vocational degree	0.27	0.66	-0.39*** (-20.78)	0.34	0.70	-0.37*** (-21.55)
Part-time work experience	5.71	4.92	0.79*** (2.97)	0.91	0.42	0.49*** (7.90)
Full-time work experience	14.11	14.10	0.01 (0.03)	19.75	20.40	-0.64* (-1.65)
Migration background	0.13	0.19	-0.06*** (-3.84)	0.12	0.21	-0.09*** (-6.11)
Married (or cohabitating)	0.82	0.77	0.05*** (2.96)	0.87	0.80	0.07*** (4.70)
Age	45.10	42.60	2.50*** (6.21)	45.01	42.61	2.40*** (6.42)
Without children	0.26	0.31	-0.05*** (-2.71)	0.33	0.39	-0.06*** (-3.06)
Child aged 0-2	0.03	0.02	0.01*** (2.70)	0.07	0.08	-0.01 (-1.31)
Child aged 3-5	0.08	0.04	0.03*** (4.11)	0.08	0.07	0.01 (0.92)
Child aged 6-11	0.15	0.11	0.03*** (2.71)	0.16	0.14	0.02* (1.86)
Civil servant	0.62	0.37	0.25*** (13.05)	0.38	0.23	0.15*** (9.17)
Large firm (>200 empl.)	0.49	0.47	0.02 (0.82)	0.61	0.53	0.08*** (4.11)
Small firm (<20 empl.)	0.19	0.23	-0.04** (-2.14)	0.11	0.16	-0.06*** (-4.31)
Firm tenure	13.48	11.01	2.47*** (6.65)	13.15	12.81	0.34 (0.87)
Observations	676	9,761		774	11,115	

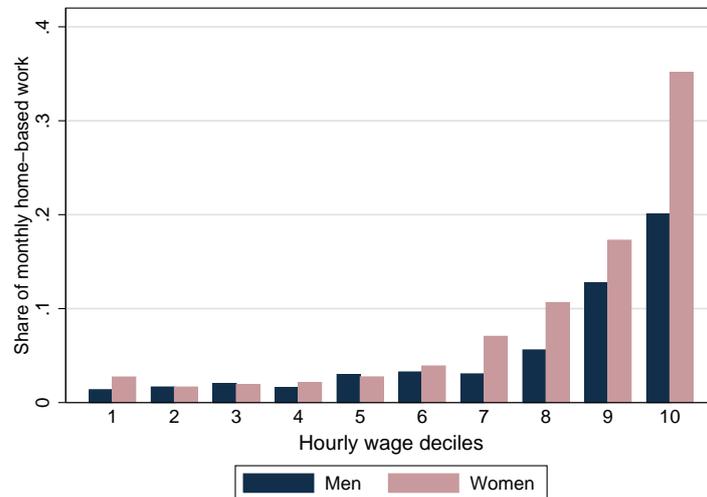
Source: GSOEP. Sample of Full-time and part-time employees in the 1997, 1999, 2002, 2009 and 2014 waves pooled together. The table displays summary statistics on the main variable of interest by HBW status.

Figure 2: Trends in monthly home-based work by educational level



Source: GSOEP. Full-time and part-time employees. 1997, 1999, 2002, 2009 and 2014 waves. Differently for employees with an university degree (high-skilled), with an apprenticeship degree (medium-skilled) and without a post-secondary degree (low-skilled).

Figure 3: Monthly home-based work along the wage distribution



Source: GSOEP. Full-time and part-time employees. 1997, 1999, 2002, 2009 and 2014 waves pooled together

from home are on average 38,7 hours, about seven hours more than women. Men doing HBW work on average 0,3 hours fewer hours compared to men not doing HBW, a small difference that is again due to a larger fraction of part-time workers among men doing HBW compared to men who are never working from home (7% vs. 2%). Overtime hours are larger among individuals doing HBW and men work more overtime hours compared

to women (5.1 vs. 2.3 hours among women and 7.78 vs. 3.8 among men). Hourly wages are also higher among individuals doing HBW and men earn higher hourly wages than women in both statuses. The former fact is in part explained by the higher educational level of individuals having HBW arrangements. The share of people with a tertiary education degree is 64% (60%) among female (male) workers with HBW arrangements, while it is 20% (18%) among female (male) workers without a HBW arrangement. Turning to demographic characteristics, people with HBW arrangements are older, live more often in couples and fewer of them have a migration background. A higher fraction of individuals doing HBW have children compared to individuals not doing HBW, especially among women. A fact that is consistent with the idea that HBW may be used to better combine work and family. Looking at job characteristics, there is a higher share of civil servants among HBW workers compared to non-HBW workers. Women with HBW arrangements have longer firm tenure and overall work experience.

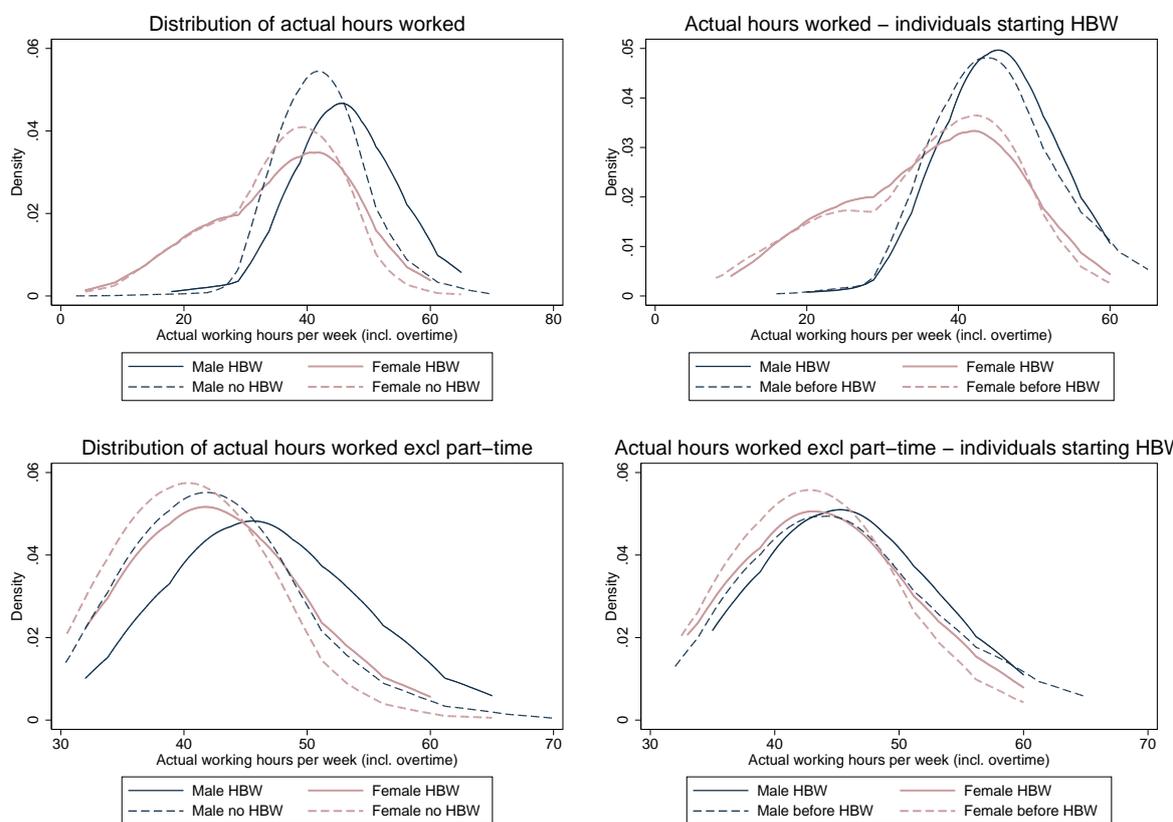
We have seen that people who do some HBW work more overtime hours on average. We want to document now how HBW arrangements are reflected in the distribution of worked hours and plot the distributions of actual hours for men and women with and without HBW take-up.

Figure 4 displays the distribution of actual weekly hours worked by gender for individuals that do some HBW and for those who do not. The graph on the upper left refers to the overall sample. We can see that women work fewer hours than men, and that a large share of women work less than 30 hours while almost no men work less than 30 hours. Individuals who do some home-based work appear to work a larger number of hours per week. This might be explained by the fact that university graduates and high-wage earners, who usually work longer hours, are more likely to work from home. Looking at the bottom left panel where we exclude the individuals working part-time, who are mostly women, we can see that the female and the male distributions are more similar. However, the male distribution always dominates the female distribution among people with the same HBW status. Women who do HBW tend to work more than men who do not, however those women still do not catch up in terms of hours with men who do HBW. The left panels compare people who might be intrinsically different as people more attached to the labour market might select themselves into HBW. The graphs in the right panels deal with this issue.

In the right panels, we only look at people who started HBW over the period, we plot their distributions of hours before and after the HBW take-up. The graph in the upper right panel shows the difference in hours worked for both full-time and part-time workers who change their HBW status. For men, we see as before a shift of the distribution of working hours to the right, albeit the difference appears to be smaller. For women the

distribution becomes more dispersed with HBW, i.e. some women who start working from home increase their actual working hours and others decrease their hours worked. This might be also related to different reasons why women might decide to start working from home. For instance, family reasons may lead to a decrease in hours worked while a promotion may lead to an increase in hours worked. The bottom right panel displays the distributions of full-time men and women who started to do some HBW. We notice here that the distribution of hours is shifted to the right with home-based work take-up also for women. We see also here that the male distributions dominates the female distributions. Even if women increase their hours by starting HBW, they do not completely catch up their male counterpart.

Figure 4: Distributions of actual hours by HBW status



Source: GSOEP. 1997, 1999, 2002, 2009 and 2014 waves

3.3 Determinants of home-based work status

Table 1 provides a picture of the composition of the male and female labour force with and without HBW arrangement. In table 2 we want to further document how individual and job characteristics are related to the probability of doing HBW using a regression

setting. As we saw in figure 4, the female distribution of hours worked after HBW take-up is double picked and show that some women switch to part-time when starting HBW. We therefore present here the results of a linear probability model on HBW probability separately for full-time men, full-time women and part-time women.

Columns (1) and (2) present the results on the sample of full-time men, columns (3) and (4) present the results on the sample of full-time women, while columns (5) and (6) present the results on the sample of part-time women. We see in columns (1), (3) and (5) that high-skill workers are more likely to work from home for all groups; the effect of tertiary education disappears when we control for occupation and occupational status fixed effects. Full-time men and women that are married or living with the partner are more likely to work from home. For part-time women, having a children between 3 and 12 year-old increases the probability to work from home compared to women with older children.

Table 2: Determinants of monthly HBW

	Male, Full-time		Female, Full-time		Female, Part-time	
	(1)	(2)	(3)	(4)	(5)	(6)
Migration background	-0.026*** (0.007)	-0.006 (0.006)	-0.007 (0.008)	0.012 (0.008)	-0.022* (0.012)	-0.011 (0.011)
Married (or cohabitating)	0.020*** (0.007)	0.017*** (0.006)	0.010 (0.006)	0.012** (0.006)	-0.006 (0.014)	0.004 (0.011)
Age	0.002 (0.002)	-0.001 (0.002)	0.004* (0.002)	0.003 (0.002)	0.006 (0.004)	0.005 (0.004)
Without children	-0.010 (0.008)	-0.004 (0.007)	0.008 (0.011)	-0.007 (0.010)	0.040* (0.022)	0.025 (0.018)
Child aged 0-2	-0.011 (0.010)	-0.011 (0.009)	0.039 (0.035)	0.025 (0.027)	0.067** (0.031)	0.040 (0.032)
Child aged 3-5	0.010 (0.011)	0.005 (0.010)	0.032 (0.022)	0.012 (0.020)	0.064*** (0.023)	0.052** (0.022)
Child aged 6-11	0.011 (0.008)	0.012 (0.008)	0.018 (0.014)	0.013 (0.013)	0.033** (0.014)	0.031** (0.013)
Tertiary education degree	0.122*** (0.013)	0.013 (0.014)	0.117*** (0.013)	0.016 (0.012)	0.227*** (0.023)	0.013 (0.019)
Vocational degree	-0.003 (0.007)	-0.010 (0.007)	0.006 (0.007)	-0.000 (0.007)	-0.009 (0.011)	-0.008 (0.011)
Part-time work experience	0.002 (0.003)	0.003 (0.003)	-0.001 (0.001)	-0.001 (0.001)	-0.000 (0.001)	0.001 (0.001)
Full-time work experience	-0.005*** (0.001)	-0.000 (0.001)	-0.002** (0.001)	-0.001 (0.001)	0.001 (0.001)	0.002** (0.001)
Urban region	0.021*** (0.006)	0.011* (0.006)	-0.003 (0.007)	-0.007 (0.007)	0.003 (0.013)	-0.003 (0.011)
Civil servant	0.011 (0.007)	-0.031*** (0.010)	0.023*** (0.008)	-0.006 (0.009)	0.036*** (0.010)	-0.007 (0.010)
Large firm (>200 empl.)	0.003 (0.006)	0.010* (0.006)	0.001 (0.008)	0.012* (0.007)	-0.012 (0.011)	0.009 (0.010)
Small firm (<20 empl.)	-0.000 (0.007)	0.004 (0.006)	-0.001 (0.008)	0.011 (0.008)	0.004 (0.013)	0.013 (0.012)
Firm tenure	0.001* (0.001)	0.001 (0.001)	0.001 (0.001)	-0.001 (0.001)	0.003* (0.002)	0.003 (0.002)
Job change		-0.004 (0.007)		-0.012 (0.008)		0.011 (0.012)
Occupation fixed effects	No	Yes	No	Yes	No	Yes
Occupational status FE	No	Yes	No	Yes	No	Yes
Industry FE	No	Yes	No	Yes	No	Yes
Observations	11591	11591	6687	6687	3750	3750
R-squared	0.079	0.172	0.074	0.238	0.155	0.348

Note: Linear probability model estimates. Standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Other control variables are year fixed effects (incl. interactions with gender), four macro-regions and age and tenure squared.

4 Empirical strategy

4.1 Specification at the individual level

To examine the effect of working from home on the gender gap in hours worked and then in the gender wage gap, we estimate the following regression on the pooled sample of men and women:

$$Y_{it} = \alpha + \beta_1 WfH_{it} + \beta_2 WfH_{it} \times Female_i + X'_{it}\lambda + \theta_t + \theta_{tf} + \theta_o + \theta_{of} + \theta_i + \mu_{it} \quad (1)$$

where the individual labour market outcome Y_{it} is the number of actual hours worked, the number of contractual hours and the wage of individual i at time t . WfH_{it} is a dummy variable indicating whether individual i works from home at least once every month in year t . X_{it} is a vector of individual time-varying characteristics such as education, actual experience, firm tenure, firm size, whether she/he works in the public sector, the region where she/he works; we also control for demographic characteristics such as the number of children and the marital status. Gender-specific year fixed effects θ_t and θ_{tf} are included. We also estimate equation (1) with gender-specific occupation fixed-effects θ_o and θ_{of} and exploit changes in individual HBW status within occupation only. μ_{it} is an unobserved and time-invariant individual specific effect.

4.2 Heterogeneity across groups

We investigate whether the effect of WfH differs across individuals with different demographic characteristics. In particular, we differentiate people with and without children. Indeed several studies show men's and women's career paths are differently affected by childbirth.

We also explore whether the effect of WfH varies across occupations depending on the hierarchical position as well as on the importance of working long hours. In particular, we investigate whether WfH allows women to close the gap in hours in managerial position where longer hours are particularly important. To do so we estimate equation (1) for the sample of female and male managers.

4.3 Identification

We first estimate equation (1) with OLS on the pooled sample of working men and women. OLS estimates are inconsistent if individual heterogeneity is correlated with the regressors and/or if selection into the labour force is endogenous, that is to say if working individuals systematically differ from individuals who are out of work and for whom we

have no information on potential hours, wages and home-based work status. The fixed-effect approach allows to control for unobservable time-invariant individual characteristics that may be linked to labour force participation decisions or WfH decisions and also affect working hours and wages. We then identify the effect of home-based work arrangements on people who change home-based work status over the period and we assume that selection is strictly exogenous conditional on the individual effect θ_i and on individuals' time-varying observable characteristics X_i . To be more precise, denoting $S_i = (s_{i1}, \dots, s_{iT})$ the vector of selection indicators where $s_{it} = 1$ if individual i works at time t , we assume that $E(\mu_{it}|\theta_i, X_i, S_i) = 0$. In other words, the specification eliminates any selection problem operating through θ_i like time-invariant preferences and ability or through some time-varying determinants of work decisions included in X_i like couple formation or childbirth.

5 Results

5.1 Effect of working from home on hours worked and wages

In this section, we present the results on the effect of home-based work, as a complement to on-site work, on actual hours that are the sum of contractual and overtime hours, hourly and monthly wages.

Table 3 shows the estimated coefficients of WfH on actual, contractual and on overtime hours for the overall sample. Column (1) provides the OLS estimate of WfH on actual hours and shows that men with WfH arrangements work 2,6 hours a week more than men without WfH arrangements. The association between WfH and hours is also positive for women but smaller than for men in the OLS results. Column (2) provides the results of the estimation of equation (1) with individual fixed-effects that control for unobserved time-invariant characteristics. The hour-premium associated with WfH is now about half an hour a week for both men and women. The difference between the OLS and the fixed-effects results indicates that men using WfH work systematically longer hours. We do not observe this type of positive selection for women. Actual hours are a mixed of contractual hours and overtime hours. In columns (3) and (4), we explore whether the increase in actual hours comes from an increase in contractual hours or in overtime hours. Column (3) shows that there is no significant association between WfH and contractual hours for men. For women however, WfH is associated with a reduction in contractual hours by 0.76 hours a week on average. But this reduction in contractual hours for women is more than compensated by an increase in overtime hours of 1.3 hours on average. Men also increase their overtime hours when using WfH by 0.5 additional overtime hours per week and this explains the increase in overall hours shown in column (2).

How do those different impacts of WfH on contractual and overtime hours translate into wages for men and women? Column (5) shows the effect of WfH on hourly wages calculated as the monthly pay divided by actual hours while column (6) shows the results for monthly wages. Women, who on average increase their overtime hours but decrease their contractual hours, experience a reduction in both hourly and monthly wages. This result indicate that overtime is largely uncompensated for women. Men however have an increase in their monthly wage when starting working from home which indicates that they obtain some monetary compensation for the additional hours they do.

Table 3: Effect of WfH on worked hours and wages, all employees

	Actual hours		Contracted hours	Overtime hours	Hourly wage	Monthly wage
	OLS (1)	FE (2)	FE (3)	FE (4)	FE (5)	FE (6)
WfH	2.602*** (0.317)	0.499* (0.288)	-0.032 (0.160)	0.531** (0.264)	0.017 (0.012)	0.028** (0.012)
WfH \times Female	-1.181** (0.555)	0.010 (0.530)	-0.734* (0.401)	0.744* (0.397)	-0.048** (0.021)	-0.054** (0.023)
Occupation FE	Yes	Yes	Yes	Yes	Yes	Yes
Occupational status	Yes	Yes	Yes	Yes	Yes	Yes
Observations	22326	22326	22326	22326	22326	22326
R-squared	0.491	0.152	0.188	0.047	0.154	0.190

Note: Standard errors in parentheses, $*p < 0.10$, $**p < 0.05$, $***p < 0.01$. Control variables included are gender-specific year fixed effects, gender-specific demographic controls (age, age squared, migration background, marital status, children for three age-groups), gender-specific human capital controls (highest degree and actual work experience), job characteristics (tenure, tenure squared, public sector dummy, firm size), macro-regions, urban area, gender-specific 1-digit industry dummies, gender-specific occupation fixed effects (95 occupation dummies), gender-specific occupational status fixed effects (15 occupation dummies) and a and gender-specific job change dummy.

Results on the overall sample may hide heterogeneous results for different worker groups. In particular, the descriptive statistics seem to indicate that some women may combine WfH arrangements with part-time work while others may combine WfH with an increase in working hours. The large share of women working part-time and the heterogeneous use of WfH by women may blur the results for this group. In what follows, we focus on the sample of full-time workers. Table 4 shows the effect of WfH on contractual and overtime hours for the sample of employees working more than 30 hours a week. Again, the OLS estimate shows that FT employees using WfH work longer hours than those who do not work from home. Controlling for individual fixed-effects in column (2), we still find that

Table 4: Effect of WfH on actual, contracted and overtime hours, full-time employees

	Actual hours			Contracted hours		Overtime hours	
	OLS (1)	FE (2)	FE (3)	FE (4)	FE (5)	FE (6)	FE (7)
WfH	2.701*** (0.293)	0.902*** (0.281)	0.621** (0.273)	0.211** (0.095)	0.172* (0.094)	0.692*** (0.268)	0.449* (0.264)
WfH \times Female	-0.251 (0.476)	0.621 (0.535)	0.859* (0.512)	-0.159 (0.197)	-0.081 (0.193)	0.780 (0.509)	0.939* (0.494)
Occupation FE	Yes	No	Yes	No	Yes	No	Yes
Occupational status	Yes	No	Yes	No	Yes	No	Yes
Observations	17684	17684	17684	17684	17684	17684	17684
R-squared	0.223	0.015	0.054	0.029	0.054	0.013	0.047

Note: Standard errors in parentheses, $*p < 0.10$, $**p < 0.05$, $***p < 0.01$. Control variables included are gender-specific year fixed effects, gender-specific demographic controls (age, age squared, migration background, marital status, children), gender-specific human capital controls (highest degree and actual work experience), job characteristics (tenure, tenure squared, public sector dummy, firm size), macro-regions, urban area, gender-specific 1-digit industry dummies, gender-specific occupation fixed effects (95 occupation dummies), gender-specific occupational status fixed effects (15 occupation dummies) and a and gender-specific job change dummy.

individuals starting working from home increase their actual hours by 0.9 hour a week. The interaction with the female dummy is positive but not significant here. In column (3) we control for occupation and occupational status dummies. The increase in actual hours with WfH is slightly smaller for men and now differs significantly across gender. Women increase their actual hours by 1.5 hours a week compared to 0.6 hour a week for their male counterpart working in similar occupations. Decomposing the effect into contractual and overtime hours changes, we find that both FT men and women increase slightly their contractual hours with WfH (columns (4) and (5)). We find a bigger effect of home-based work on overtime hours and a substantial difference between men's and women's responses when controlling for occupations. The results in column (7) show that on average men increase their overtime hours by 0.5 hour per week with HBW take-up, and women do so by 1.4 hours.

Summing up the results for full-time employees, within occupations, women use HBW arrangements to increase their total hours worked and do so by a larger amount than men. The gender difference comes from differential increase in overtime hours. The stronger increase in actual hours among women in the sample of FT employees contrasts with the results found on the sample of both PT and FT employees. In the overall sample, the effect of WfH on actual hours is smaller for women than for men, although not significantly so, because of a significant reduction in contractual hours among women. This indicate that women working part-time use WfH arrangements differently than women working full-time

and/or that some women working full-time have simultaneously switch to a part-time contract and starting working from home.

Table 5: Effect of WfH on hourly and monthly wages, full-time employees

	Hourly wage			Monthly wage		
	OLS (1)	FE (2)	FE (3)	OLS (4)	FE (5)	FE (6)
WfH	0.019 (0.013)	0.027** (0.012)	0.023* (0.012)	0.076*** (0.012)	0.046*** (0.012)	0.037*** (0.012)
WfH \times Female	0.000 (0.026)	-0.043* (0.023)	-0.052** (0.024)	-0.002 (0.025)	-0.031 (0.022)	-0.035 (0.022)
Occupation FE	Yes	No	Yes	Yes	No	Yes
Occupational status	Yes	No	Yes	Yes	No	Yes
Observations	17708	17708	17708	17708	17708	17708
R-squared	0.599	0.161	0.192	0.635	0.176	0.211

Note: Standard errors in parentheses, $*p < 0.10$, $**p < 0.05$, $***p < 0.01$. Control variables included are gender-specific year fixed effects, gender-specific demographic controls (age, age squared, migration background, marital status, children), gender-specific human capital controls (highest degree and actual work experience), job characteristics (tenure, tenure squared, public sector dummy, firm size), macro-regions, urban area, gender-specific occupation fixed effects (95 occupation dummies) and gender-specific occupational status fixed effects (15 occupation dummies).

Table 4 indicates that WfH helps reduce the average gender gap in working hours among full-time workers by about 0.85 hour a week. A recent strand of literature on the gender pay gap using data for the U.S. shows that there is a penalty to working shorter hours in certain occupations and that a small hour gap explains a significant part of the gender gap in hourly wages (Goldin, 2014; Cortes and Pan, 2016). An increase in women’s worked hours relative to men’s could increase female hourly wages relative to male wages by signaling a stronger job attachment and/or the ability to take up new responsibilities. We look here if working from home also translates into higher hourly wages for women and men. We use a reduced form wage equation as specified in equation (1). Table 5 displays the estimated effect of working from home on hourly wages for full-time workers in columns (1) to (3). Hourly wages are calculated as the monthly gross income divided by *actual* monthly working hours (contractual plus overtime hours). With individual fixed-effects, we find that men experience an increase in hourly wages by 2% with taking up WfH arrangements. Women however experience a reduction in their hourly wage by 3%. Not only the longer hours done from home do not increase women’s hourly wages on average but they even contribute to a widening of the hourly pay gap (based on actual hours). This can be explained first by a slightly stronger increase in contractual hours for men (although the gender difference is not significant, cf. Table 4 columns (4) and (5)),

second by an increase in overtime hours done at home that are mostly unpaid for women but are compensated for men. We also check whether the additional hours translate into higher monthly wages in columns (3) and (4). The OLS estimates show that WfH is positively correlated with monthly wages. Individuals working sometimes from home earn on average 7% more. However, the FE estimates show that this WfH premium is reduced when we control for individual time-invariant unobservable characteristics. Men experience an increase in monthly earnings by about 4% with HBW take-up. The coefficient of the interaction between WfH and the female dummy is negative but not statistically different from zero in all regressions. While women increase actual working hours more than men with home-based work take-up, this is not reflected in a significantly higher increase in monthly wages in the short to medium run (1-7 years).

Table 12 in the appendix shows results on the subsample of FT employees who always do overtime hours. The gender difference in the effect of WfH on wages is even larger in magnitude. Women starting working from home face a wage penalty for WfH in both hourly and monthly wages while men see their monthly earnings increase with WfH. This confirms the finding that the gender difference in the effect of WfH is due to compensated vs. uncompensated overtime.

5.2 Addressing potential selection biases

In this section, we investigate whether our estimates suffer from selection bias due to unobserved shocks to individuals' decision to work. Indeed, if the population that participates to the labour market is not representative of the overall population, the estimated effect of working from home might be biased. For instance, if women who are working are also willing to work longer hours and to use flexible working arrangements to do so, compared to what women outside of the labour market would do, the effect of working from home on hours worked is overestimated. Note that exploiting the panel data dimension, we control for individual characteristics and preferences that remain constant over time. By doing so we already address an important aspect of this issue. However, if preferences and other determinants of working status evolve over time, for example with the occurrence of events like partner's unemployment, the selection bias is not corrected by controlling for individual fixed-effects. We suggest two ways to tackle the potential remaining selection bias.

First, we replicate the results on a sample of men and women highly attached to the labour market. Table 13 in the appendix shows results for the sample of full-time employees without children under 12 years old, a sample with high labour force attachment and for which we do not expect strong differences in selection across men and women. The

results tend to confirm the benchmark findings although not all coefficients are statistically significant. In particular, for full-time women without children under 12 WfH leads to an increase the number of actual hours worked, as well as overtime hours, without an increase in hourly or monthly wages. However, the results for men appear to be slightly smaller compared to the baseline and not statistically significant. As a result, the interaction term turns out to be insignificant in the wage equations meaning that WfH appears not to have a differential impact on wages for men and women.

Second, we directly control for selection bias due to time-varying unobservable characteristics using a control function approach adapted to the panel data setting as in [Wooldridge \(1995\)](#). We present the econometrical model in [Appendix C](#). Basically, we estimate the effect of working from home on hours and wages using our benchmark equation but adding a control function computed in a first stage to correct for a potential selection bias (see [equation \(4\)](#) in the appendix).³ The results on the overall sample, including both part-time and full-time workers, are reported in [Table 16](#). The sample size is smaller in this section compared to the previous section because we drop individuals with missing information on the excluded variables used in the first step.

In both tables, column 1 displays the results of [equation \(1\)](#) estimated with the within-estimator. Column 2 displays the results of [equation \(1\)](#) estimated with the Chamberlain’s approach to individual fixed-effects to show that the results are identical regardless of the estimator (see also [Wooldridge \(2010\)](#)). Column 3 displays the results of [equation \(4\)](#) estimated with the Chamberlain’s approach augmented with a control function to correct for the selection bias. We allow the effect of the control function to vary by gender and time. Comparing column 2 and 3 in [Table 16](#), the effect of WfH on overtime hours is marginally bigger for men when we correct for the selection bias, but it does not affect the results on hours for women. The estimated coefficients of WfH on wages are marginally more negative for women but the change is very small. We have replicated this analysis on the sample of full-time workers only and find similar results. Overall, we conclude that individual fixed-effects and the vector of individual characteristics included in [equation \(1\)](#) control well for characteristics that may simultaneously determine labour supply decision, wages and WfH so that the WfH estimates are not affected by selection biases.

5.3 Explaining the effects of working from home on hours worked and wages

Overall, we find that both men and women increase weekly working hours by doing HBW. While men benefit from an increase in monthly pay, women do not despite a bigger

³This approach has been applied by [Dustmann and Rochina-Barrachina \(2007\)](#) to the estimation of the returns to experience on wages for women.

increase in hours compared to men. Why are women not compensated for the additional hours they work when starting working from home? In the next table we investigate potential channels that might explain the results. First, employers changes or promotion within the firm may lead to changes in both work arrangements and wages. For example, one can may move to a more innovative and productive firm and get a higher wage and access to WfH arrangements. As men tend to change job more often than women, this could explain the male monthly wage premium associated with WfH. Similarly, a promotion within the firm might be associated with a change in tasks or responsibilities coming along with a higher probability to work from home, an increase in working hours and wages. Note that we already control for job change and the occupational status in all regressions to avoid this type of endogeneity issues. To explore further this issue we replicate the analysis interacting the WfH dummy with a job change dummy and with a dummy denoting a promotion (i.e. an increase in the occupational status). Table 14 in the appendix shows the results for actual hours worked, hourly wages and monthly wages by gender. The increase in actual working hours is not driven by job movers or promotion. Women (men) starting WfH while staying in the same job increase their actual working hours by 1.2 (0.7) hours per week (columns (1) and (4)). Even if promotion is associated with an increase in actual hours worked, the interaction term with WfH is not statistically significant in the regressions. The table also shows that job changes and promotion do not drive the positive effect of WfH on monthly wages for men (column (6)). However, job changes and promotion might explain part of the gender differences in the effect of WfH on hourly wages. Specifically, the effect of WfH on hourly wages for men staying in the same job is smaller and not statistically significant (column(5)).

Second, it is possible to get overtime hours compensated with time off instead of money. Column (1) and (2) in Table 6 shows the results of a conditional logit regression with the dependent variable equal to 1 if at least some overtime hours are converted into vacation, which is often referred to as compensatory time. In column (1), without occupation dummies, we see that male employees are more likely to convert overtime hours into time-off with HBW take-up. However, this effect because insignificant in column (2) where we control for occupations and occupational status. In both columns, there is no gender difference in the use of compensatory time when starting HBW. In columns (3) and (4), we replicate the hourly and monthly wage regressions controlling for the use of time-off to compensate overtime. The main results remain unchanged. Compensation of overtime with days off does not explain the negative effect of WfH on women’s actual hourly wage.

Third, compensating wage differentials for alternative work arrangements may explain part of the gender differences in how WfH affect wages if men and women value the ability to work from home in different ways. [Mas and Pallais \(2017\)](#) find that in the U.S. women have a higher willingness to pay for working from home compared to men. As a results,

Table 6: Effect of WfH on overtime compensation, full-time employees

	Compensatory time		Hourly wage	Monthly wage
	Conditional Logit (1)	Conditional Logit (2)	FE (3)	FE (4)
WfH	0.281*	0.258	0.02	0.035***
	(0.157)	(0.160)	(0.013)	(0.012)
WfH \times Female	-0.229	-0.236	-0.049**	-0.033
	(0.286)	(0.290)	(0.024)	(0.023)
Compensatory time			-0.019***	0.008*
			(0.005)	(0.005)
Comp time \times female			0.001	0.005
			(0.008)	(0.008)
Occupation FE	No	Yes	Yes	Yes
Occupational status	No	Yes	Yes	Yes
Observations	8377	8377	17458	17458
R-squared			0.194	0.213

Note: Standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Control variables included are gender-specific year fixed effects, gender-specific demographic controls (age, age squared, migration background, marital status, children), gender-specific human capital controls (highest degree and actual work experience), job characteristics (tenure, tenure squared, public sector dummy, firm size), macro-regions, urban area, gender-specific occupation fixed effects (95 occupation dummies) and gender-specific occupational status fixed effects (15 occupation dummies).

women might be willing accept lower wages than men when they use HBW arrangements. Using German data, we are not able to look at valuation of HBW arrangements. However, we have information on job and life satisfaction and we can estimate the effect of HBW take-up on self-reported satisfaction. If WfH is a mean to improve work-life balance, we expect an improvement in job and life satisfaction with HBW take-up. Table 7 provides the estimated effect of WfH on job and life satisfaction of full-time employees. The OLS results show that men working sometimes from home are more satisfied with their job but this is not the case among women. Controlling for individual fixed-effects, we find that job satisfaction increases significantly with HBW take-up for both men and women and more so for men although the gender difference is not significant. However, the effect on life satisfaction is positive only for men. The interaction with the female dummy is large and negative, although not significant, which implies much weaker evidence that WfH has a positive impact on women’s life satisfaction.

Table 7: Effect of WfH on job and life satisfaction, full-time employees

	Job satisfaction			Life satisfaction		
	OLS (1)	FE (2)	FE (3)	OLS (4)	FE (5)	FE (6)
WfH	0.201** (0.080)	0.197** (0.093)	0.179* (0.092)	0.023 (0.066)	0.147** (0.070)	0.136* (0.069)
WfH × Female	-0.277* (0.160)	-0.087 (0.192)	-0.068 (0.191)	0.100 (0.130)	-0.160 (0.145)	-0.149 (0.146)
Monthly wage			0.483*** (0.102)			0.311*** (0.075)
Observations	17630	17630	17630	17684	17684	17684
R-squared	0.054	0.058	0.061	0.077	0.044	0.046

Note: Standard errors in parentheses, $*p < 0.10$, $**p < 0.05$, $***p < 0.01$. Control variables included are gender-specific year fixed effects, gender-specific demographic controls (age, age squared, migration background, marital status, children), gender-specific human capital controls (highest degree and actual work experience), job characteristics (tenure, tenure squared, public sector dummy, firm size), macro-regions, urban area, gender-specific occupation fixed effects (95 occupation dummies) and gender-specific occupational status fixed effects (15 occupation dummies).

5.4 Effect of home-based work for parents

Working from home might represent a chance for women with children to better combine family life and work. It is often argued that flexible work arrangements may improve women’s labour force attachment. Home-based work is one of the main work arrangements that enable individuals to be more flexible in their work-schedule, by for instance shifting

part of the work hours usually done during the day to the evening. If the lack of flexibility is an important barrier for mothers to supply labour, the positive effect of WfH on hours should be especially strong among mothers. Given that the labor supply response to having a child is very different between men and women, we investigate the differential effect of WfH by parenthood looking at women only. We thus estimate the fixed effects regression model for women including an interaction term between WfH and the parenthood status distinguishing between children smaller than 6 and children between 6 and 11 years old. 8

Table 8: Effect of WfH by parenthood, only women

	Actual hours (1)	Contracted hours (2)	Overtime hours (3)	Hourly wage (4)	Monthly wage (5)	Job satisfaction (6)	Life satisfaction (7)
<i>Panel A: All women</i>							
WfH	1.281** (0.511)	-0.412 (0.399)	1.692*** (0.354)	-0.048** (0.020)	-0.022 (0.021)	0.077 (0.130)	-0.021 (0.097)
Child aged 0-5	-11.118*** (0.684)	-9.882*** (0.623)	-1.236*** (0.283)	0.061*** (0.021)	-0.313*** (0.030)	0.248 (0.161)	0.010 (0.118)
WfH × Child aged 0-5	-3.691*** (1.298)	-2.121* (1.125)	-1.570** (0.679)	0.068 (0.049)	-0.026 (0.063)	0.022 (0.279)	0.204 (0.199)
Child aged 6-11	-9.444*** (0.697)	-8.351*** (0.632)	-1.094*** (0.291)	0.036 (0.023)	-0.269*** (0.031)	0.344** (0.173)	-0.092 (0.119)
WfH × Child aged 6-11	-1.003 (0.882)	0.288 (0.699)	-1.290** (0.563)	0.052 (0.034)	0.025 (0.038)	-0.005 (0.233)	0.244 (0.179)
Observations	10437	10437	10437	10437	10437	10379	10427
R-squared	0.222	0.240	0.048	0.134	0.190	0.045	0.038
<i>Panel B: Full-time women</i>							
WfH	1.593*** (0.467)	0.087 (0.177)	1.507*** (0.451)	-0.039* (0.021)	-0.005 (0.020)	0.090 (0.184)	-0.058 (0.136)
Child aged 0-5	-1.901*** (0.466)	-1.283*** (0.358)	-0.618 (0.381)	0.014 (0.028)	-0.035 (0.028)	0.325 (0.257)	-0.093 (0.201)
WfH × Child aged 0-5	-2.540 (1.549)	-0.756 (0.614)	-1.783 (1.418)	0.116 (0.081)	0.063 (0.076)	0.687* (0.392)	0.176 (0.410)
Child aged 6-11	-2.214*** (0.466)	-1.720*** (0.338)	-0.494 (0.377)	0.007 (0.031)	-0.050 (0.032)	0.302 (0.258)	-0.061 (0.186)
WfH × Child aged 6-11	-0.092 (0.856)	0.567 (0.355)	-0.659 (0.878)	0.037 (0.057)	0.038 (0.054)	-0.310 (0.431)	0.353 (0.373)
Observations	6687	6687	6687	6687	6687	6654	6680
R-squared	0.070	0.086	0.054	0.222	0.230	0.065	0.040

Note: Standard errors in parentheses, $*p < 0.10$, $**p < 0.05$, $***p < 0.01$. Control variables included are gender-specific year fixed effects, gender-specific demographic controls (age, age squared, migration background, marital status, children), gender-specific human capital controls (highest degree and actual work experience), job characteristics (tenure, tenure squared, public sector dummy, firm size), macro-regions, urban area, gender-specific occupation fixed effects (95 occupation dummies) and gender-specific occupational status fixed effects (15 occupation dummies).

6 Concluding remarks

In the last decades, working arrangements have become more flexible extending workers' options regarding when and where they work. Flexible working has been presented as a way to better combine family and career in some cases, and to increase productivity in others. It is not clear however if it can promote both at the same time. There is remarkably little research on how WfH affects the careers and on how it depends on workers' characteristics. We investigate here how flexible-work arrangements through working from home affect men's and women's career in terms of working hours and labour earnings. By doing so we are able to tell whether working from home allow women to strengthen their labour market attachment by increasing their hours worked relative to men, and whether the change in working arrangement pays off in terms of labour earnings equally for both gender. Controlling for workers' observed and unobserved heterogeneity, we find that WfH does not affect contractual hours in the short to medium run either for women or for men. But we do find that full-time women use WfH arrangements to increase overtime hours, and more so than full-time men. However, women keep on working fewer hours than men overall. We also investigate whether the increase in working hours among individuals doing WfH translates into higher wages. For men, actual hourly wages increase as they start working from home. By contrast, additional overtime hours do not seem to pay off for women. Hence, women's hourly wages based on actual hours even decrease significantly. Consistent with this latter results, we also find that WfH increases job satisfaction among men but not among women.

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A Descriptive statistics

Table 9: Change in home-based work status by year and gender

	WfH		No WfH		Total
	Take-up	no change	Drop-out	no change	
<i>Sample of Women</i>					
1999	33	37	29	1524	1623
2002	23	29	39	1436	1527
2009	88	56	34	1663	1841
2014	66	94	48	1463	1671
Total	210	216	150	6086	6662
<i>Sample of Men</i>					
1999	48	45	57	1938	2088
2002	41	39	63	1751	1894
2009	93	58	49	1763	1963
2014	73	68	65	1361	1567
Total	255	210	234	6813	7512

Source: GSOEP. Sample of full-time and part-time employees.

Table 10: Time-use data by home-based work status and gender

	HBW	no HBW	difference	(t-stat.)
<i>Sample of FT Women (N: 3847)</i>				
Commuting distance (in km)	22.05	19.01	3.04	(1.08)
Weekday hours for housework	2.49	2.98	-0.49***	(-3.99)
Weekday hours for leisure	1.36	1.54	-0.17*	(-1.79)
<i>Sample of PT Women (N: 2519)</i>				
Commuting distance (in km)	18.27	11.43	6.84***	(4.97)
Weekday hours for housework	3.86	4.41	-0.54***	(-3.78)
Weekday hours for leisure	1.47	1.66	-0.18*	(-1.75)
<i>Sample of Women with a partner (N: 5044)</i>				
Commuting distance (in km)	21.02	15.48	5.54***	(3.17)
Weekday hours for housework	3.36	3.74	-0.38***	(-3.38)
Weekday hours for leisure	1.37	1.50	-0.13*	(-1.66)
<i>Sample of Mothers (N: 5265)</i>				
Commuting distance (in km)	20.01	14.98	5.02***	(2.92)
Weekday hours for housework	3.38	3.73	-0.35***	(-3.18)
Weekday hours for childcare	2.24	1.62	0.61***	(3.20)
Weekday hours for leisure	1.41	1.53	-0.12	(-1.58)
<i>Sample of Men (N: 7243)</i>				
Commuting distance (in km)	34.35	26.79	7.55**	(2.45)
Weekday hours for housework	1.85	2.18	-0.34***	(-4.29)
Weekday hours for leisure	1.39	1.61	-0.22***	(-3.15)
<i>Sample of Men with a partner (N: 5870)</i>				
Commuting distance (in km)	34.94	26.60	8.34***	(2.58)
Weekday hours for housework	1.78	2.17	-0.39***	(-4.62)
Weekday hours for leisure	1.32	1.50	-0.18**	(-2.44)
<i>Sample of Fathers (N: 5896)</i>				
Commuting distance (in km)	35.67	27.08	8.59**	(2.50)
Weekday hours for housework	1.81	2.18	-0.37***	(-4.21)
Weekday hours for childcare	0.73	0.79	-0.06	(-0.72)
Weekday hours for leisure	1.31	1.53	-0.21***	(-2.86)

Source: GSOEP. Sample of full-time and part-time employees with non-missing time-use information. Housework includes running errands and repairs.

Table 11: Descriptive stat by home-based work intensity and gender

	Monthly HBW	Weekly HBW	difference	(t-stat.)
<i>Sample of Women</i>				
Actual working hours	38.39	34.69	3.69***	(3.34)
Contracted working hours per week	33.56	29.28	4.27***	(4.64)
Overtime hours per week	4.83	5.41	-0.58	(-1.07)
Works less than 30 hrs	0.31	0.55	-0.24***	(-5.09)
Hours worked, fulltime	44.84	43.94	0.90	(1.25)
gross hourly real wages	20.89	21.28	-0.40	(-0.48)
gross wage real	3142.88	2812.85	330.03**	(2.55)
migration background	0.15	0.13	0.03	(0.80)
Married or with partne	0.84	0.82	0.02	(0.61)
age	42.91	45.83	-2.92***	(-3.50)
agesq	1920.48	2177.31	-256.84***	(-3.43)
Children under age 3	0.04	0.05	-0.00	(-0.17)
Child aged between 3 and 6	0.08	0.08	0.00	(0.05)
Children between 6 and 16	0.55	0.68	-0.13***	(-2.88)
Civil servant	0.39	0.67	-0.28***	(-6.12)
firm 200+ employees	0.63	0.42	0.21***	(4.42)
firm 20- employees	0.17	0.22	-0.04	(-1.09)
Firm tenure	11.21	14.23	-3.01***	(-3.21)
Firm tenure squared	214.63	303.30	-88.67***	(-2.65)
Urban	0.71	0.68	0.03	(0.66)
	Monthly HBW	Weekly HBW	difference	(t-stat.)
<i>Sample of Men</i>				
Actual working hours	45.64	46.33	-0.69	(-1.17)
Contracted working hours	38.72	38.11	0.60*	(1.66)
Overtime hours	6.92	8.22	-1.29***	(-2.79)
Works less than 30 hrs	0.04	0.10	-0.06***	(-2.92)
Hours worked, fulltime	46.25	47.73	-1.49***	(-2.95)
gross hourly real wages	25.36	24.35	1.01	(1.48)
gross wage real	4436.21	4186.42	249.79**	(2.16)
migration	0.11	0.13	-0.01	(-0.47)
Married or with partner	0.87	0.89	-0.02	(-0.98)
age	43.46	45.36	-1.89***	(-2.69)
agesq	1965.00	2145.39	-180.39***	(-2.86)
Children under age 3	0.07	0.09	-0.02	(-0.72)
Child aged between 3 and 6	0.07	0.10	-0.03	(-1.19)
Children between 6 and 16	0.48	0.54	-0.05	(-1.41)
Civil servant	0.24	0.45	-0.21***	(-5.83)
firm 200+ employees	0.62	0.60	0.03	(0.71)
firm 20- employees	0.13	0.09	0.04	(1.53)
Firm tenure	12.05	13.53	-1.48*	(-1.94)
Firm tenure squared	241.68	281.61	-39.93	(-1.53)
Urban	0.82	0.70	0.12***	(3.62)

Source: GSOEP. Sample of full-time and part-time employees working from home.

B Additional results

Table 12: Effect of WfH on hourly and monthly wages, full-time employees who always do overtime hours

	Hourly wages		Monthly wages	
	FE (1)	FE (2)	FE (3)	FE (4)
WfH	0.034 (0.034)	0.036 (0.036)	0.065* (0.034)	0.060* (0.036)
WfH × Female	-0.081 (0.064)	-0.108* (0.063)	-0.134** (0.060)	-0.148** (0.059)
Occupation FE	No	Yes	No	Yes
Occupational status	No	Yes	No	Yes
Observations	4183	4183	4183	4183
R-squared	0.110	0.195	0.121	0.214

Note: Standard errors in parentheses, $*p < 0.10$, $**p < 0.05$, $***p < 0.01$. Control variables included are gender-specific year fixed effects, gender-specific demographic controls (age, age squared, migration background, marital status, children), gender-specific human capital controls (highest degree and actual work experience), job characteristics (tenure, tenure squared, public sector dummy, firm size), macro-regions, urban area, gender-specific occupation fixed effects (95 occupation dummies) and gender-specific occupational status fixed effects (15 occupation dummies).

Table 13: Effect of WfH on hours and wages, full-time employees without children under 12

	Actual	Contractual	Overtime	Hourly	Monthly
	hours FE (1)	hours FE (2)	hours FE (3)	wage FE (4)	wage FE (5)
WfH	0.589 (0.368)	0.199 (0.133)	0.390 (0.363)	0.004 (0.017)	0.019 (0.016)
WfH × Female	1.146* (0.626)	-0.153 (0.227)	1.298** (0.614)	-0.041 (0.027)	-0.018 (0.026)
Observations	13736	13736	13736	13736	13736
R-squared	0.059	0.053	0.054	0.180	0.202

Note: Standard errors in parentheses, $*p < 0.10$, $**p < 0.05$, $***p < 0.01$. Control variables included are gender-specific year fixed effects, gender-specific demographic controls (age, age squared, migration background, marital status, children), gender-specific human capital controls (highest degree and actual work experience), job characteristics (tenure, tenure squared, public sector dummy, firm size), macro-regions, urban area, gender-specific occupation fixed effects (95 occupation dummies) and gender-specific occupational status fixed effects (15 occupation dummies).

Table 14: Effect of WfH on hours and wages with job changes and promotions, full-time employees

	Women			Men		
	Contractual hours (1)	Hourly wages (2)	Monthly wages (3)	Contractual hours (4)	Hourly wages (5)	Monthly wages (6)
WfH	1.228** (0.477)	-0.007 (0.020)	0.021 (0.019)	0.689** (0.312)	0.013 (0.014)	0.029** (0.013)
Job change	-0.078 (0.186)	0.001 (0.009)	-0.000 (0.009)	-0.233 (0.161)	-0.001 (0.007)	-0.006 (0.007)
WfH × job change	0.319 (0.756)	-0.064 (0.041)	-0.059 (0.039)	0.375 (0.512)	0.006 (0.024)	0.013 (0.024)
Promotion	0.406** (0.202)	0.016* (0.009)	0.026*** (0.010)	0.731*** (0.170)	0.010 (0.008)	0.025*** (0.007)
WfH × promotion	1.025 (0.944)	0.000 (0.052)	0.021 (0.055)	-0.879 (0.638)	0.080*** (0.028)	0.062** (0.029)
Occupation FE	Yes	Yes	Yes	Yes	Yes	Yes
Occupational status	No	No	No	No	No	No
Observations	6189	6189	6189	11519	11519	11519
R-squared	0.064	0.212	0.215	0.041	0.176	0.197

Note: Standard errors in parentheses, $*p < 0.10$, $**p < 0.05$, $***p < 0.01$. Control variables included are gender-specific year fixed effects, gender-specific demographic controls (age, age squared, migration background, marital status, children), gender-specific human capital controls (highest degree and actual work experience), job characteristics (tenure, tenure squared, public sector dummy, firm size), macro-regions, urban area, gender-specific occupation fixed effects (95 occupation dummies) and gender-specific occupational status fixed effects (15 occupation dummies).

C Model with correlated individual effects and correction for selection into work

We follow here [Wooldridge \(1995\)](#) and present a model that accounts for correlated individual effects and deals with potential selection bias due to shocks to individuals' decision to work.

The model is composed of an outcome equation and a selection equation.

$$y_{it} = \mathbf{x}_{1it}\boldsymbol{\beta}_1 + \mathbf{x}_{2it}\boldsymbol{\beta}_2 + \theta_t + \alpha_i + u_{it} \quad t = 1, \dots, T \quad (2)$$

$$h_{it}^* = \mathbf{x}_{1it}\boldsymbol{\gamma}_1 + \mathbf{z}_{it}\boldsymbol{\gamma}_2 + \eta_i + v_{it} \text{ and } s_{it} = \mathbb{1}[h_{it}^* > 0] \quad (3)$$

where y_{it} is the outcome of individual i at time t , h_{it}^* is the hours worked by individual i in year t . Because h_{it}^* is unobserved for people who are not working in year t , we use an indicator variable s_{it} which is equal to one if individual i is working (i.e. has a strictly positive number of worked hours at time t) and to zero if individual i is not working. The vector \mathbf{x}_1 includes variables that appear in both the outcome and the selection equation while the vector \mathbf{x}_2 appears only in the outcome equation. \mathbf{z} is the vector of excluded variables that appear only in the selection equation. θ_t is a set of time fixed effects. In both equations we account for time invariant individual unobserved characteristics, α_i in equation (2) and η_i in equation (3).

We use Chamberlain's approach to panel data models to control for individual unobservable characteristics and at the same time deal with self-selection into the work force. In this setting we make the following assumptions. First, following Chamberlain (1984), [Wooldridge \(1995\)](#) and [Wooldridge \(2010\)](#), the conditional expectation of the individual effects in the outcome equation and in the selection equation are linear functions of the mean of the observable variables :

$$\eta_i = \bar{\mathbf{x}}_{1i}\boldsymbol{\delta}_1 + \bar{\mathbf{z}}_i\boldsymbol{\delta}_2 + e_i,$$

$$E(\alpha_i|\mathbf{x}_i, \mathbf{z}_i, \varepsilon_{it}) = \bar{\mathbf{x}}_{1i}\tilde{\boldsymbol{\phi}}_1 + \bar{\mathbf{x}}_{2i}\tilde{\boldsymbol{\phi}}_2 + e_i.$$

Second, the errors in the selection equation (3) $\varepsilon_{it} = e_i + v_{it}$ are independent of \mathbf{z}_i .

Third, the errors in the outcome equation (2) u_{it} are mean independent of $(\mathbf{x}_i, \mathbf{z}_i)$ conditional on the errors in the selection equation (3) ε_{it} ; and the conditional expectations of u_{it} is linear in ε_{it} :

$$E(u_{it}|\mathbf{x}_i, \mathbf{z}_i, \varepsilon_{it}) = E(u_{it}|\varepsilon_{it}) = \rho_t\varepsilon_{it}.$$

As we do not observe h_{it}^* but only s_{it} , we use the selection indicator and transform the last expression into : $E(u_{it}|\mathbf{x}_i, \mathbf{z}_i, s_{it=1}) = \rho_t E(\varepsilon_{it}|\mathbf{x}_i, \mathbf{z}_i, s_{it=1})$.

Under the previous assumptions, we obtain:

$$\begin{aligned} E(\alpha_i + u_{it}) &= E(c_i|\mathbf{x}_i, \mathbf{z}_i, s_{it=1}) + E(u_{it}|\mathbf{x}_i, \mathbf{z}_i, s_{it=1}) \\ &= \bar{\mathbf{x}}_i\psi + \rho_t E(\varepsilon_{it}|\mathbf{x}_i, \mathbf{z}_i, s_{it=1}). \end{aligned}$$

We thus estimate the following model:

$$y_{it} = \mathbf{x}_{1it}\beta_1 + \mathbf{x}_{2it}\beta_2 + \bar{\mathbf{x}}_i\psi + \rho_t\lambda(s_{it}) + \theta_t + \mu_{it} \quad (4)$$

where $\lambda(s_{it}) = E(\varepsilon_{it}|\mathbf{x}_i, \mathbf{z}_i, s_{it=1})$. The vector \mathbf{x}_1 includes the educational degree, demographics characteristics namely the age and its square, the marital status, the migration background, the number of children in three age groups. The vector \mathbf{x}_2 appears only in the outcome equation and includes job characteristics namely whether the individual works in the public sector, the size of the firm, tenure in the firm and its square, full-time and part-time experience in years as well as gender-specific occupation and occupational status fixed-effects.

To get estimates of $\lambda(s_{it})$ we run in a first step the following probit model on s_{it} for each time period t and separately for men and for women :

$$P(s_{it} = 1|\mathbf{x}_{1i}, \mathbf{z}_i, \eta_i) = \Phi(\mathbf{x}_{1it}\gamma_1 + \mathbf{z}_{it}\gamma_2 + \bar{\mathbf{x}}_{1i}\delta_1 + \bar{\mathbf{z}}_i\delta_2) \quad (5)$$

where \mathbf{x}_1 is defined as above and the vector of excluded variables \mathbf{z} includes the marital status interacted with the number of children in three age categories, the partner employment status and its interaction with the number of children in the three age categories as well as cohort fixed-effects. We then compute $\lambda(s_{it}) = \frac{\phi(s_{it})}{\Phi(s_{it})}$ where ϕ is the standard density function and Φ is the standard cumulative distribution function.

The results of this first step on the pooled sample of years are reported in Table 15.⁴ Column 1 reports the results on the female probability to work, either part-time or full-time, while column 2 reports the results on the female probability to work full-time. Columns 3 and 4 report the results for men. The female probability to work decreases significantly with the number of children, especially if the children are young (columns 1 and 2). The impact of children on the male probability to work is much smaller (columns 3 and 4). For women, the negative effect of young children on the probability to work is stronger if they are married or living with a partner, and even stronger if the partner is himself working;

⁴Results by year are available upon request.

while the interactions between having children and the partner’s employment barely affect men’s probability to work. Women have also a lower probability to work if their partner is working and if their partner has a vocational or tertiary degree, while for men partner’s employment and educational attainment increase their probability to work. Having a direct or indirect migration background reduces the probability to work for both men and women, although the effect is stronger among men. On the contrary, having a vocational or tertiary degree increases the likelihood of working especially among women.

In a second step, we estimate equation 4 adding the control function $\lambda(s_{it})$ previously estimated. The results on the overall sample, including both part-time and full-time workers, are reported in Table 16. The results on the sample of full-time workers are reported in Table ???. The sample size is smaller in this section compared to the previous section because we drop individuals with missing information on the excluded variables used in the first step. Similarly to our main specification the regressors include demographics characteristics, job characteristics, as well as gender-specific industry, occupation and occupational status fixed-effects. It is now augmented with a control function to correct for the selection bias. We allow the effect of the control function to vary by gender and time.

Table 15: Probability to work, by gender

	Women		Men	
	All employees (1)	Full-time employees (2)	All employees (3)	Full-time employees (4)
Number of children	-0.146*** (0.019)	-0.117*** (0.018)	-0.044* (0.025)	-0.050** (0.024)
Number of children aged 1-3	-0.912*** (0.058)	-0.692*** (0.058)	0.050 (0.089)	0.024 (0.077)
Number of children aged 3-5	-0.415*** (0.059)	-0.255*** (0.059)	-0.112 (0.075)	-0.067 (0.070)
Married or living with partner	0.035 (0.025)	0.003 (0.023)	-0.018 (0.027)	-0.055** (0.024)
Married×number of children	-0.033 (0.024)	-0.016 (0.023)	0.024 (0.028)	0.034 (0.027)
Married×number of children aged 1-3	-0.152** (0.067)	-0.165** (0.066)	-0.114 (0.093)	-0.075 (0.081)
Married×number of children aged 3-5	0.113 (0.072)	0.002 (0.071)	0.100 (0.081)	0.030 (0.074)
Partner in employment	-0.063** (0.032)	-0.030 (0.030)	0.168*** (0.037)	0.169*** (0.033)
Partner in employment× number of children	-0.005 (0.017)	-0.015 (0.017)	-0.042** (0.018)	-0.039** (0.016)
Partner in employment× number of children aged 1-3	0.025 (0.040)	-0.035 (0.039)	-0.064 (0.047)	-0.042 (0.040)
Partner in employment× number of children aged 3-5	-0.127*** (0.045)	-0.113*** (0.044)	0.043 (0.049)	0.043 (0.041)
Partner with vocational education degree	-0.299*** (0.018)	-0.282*** (0.018)	0.137*** (0.019)	0.182*** (0.017)
Partner with tertiary education degree	-0.300*** (0.028)	-0.150*** (0.027)	-0.100*** (0.038)	-0.049 (0.033)
Partner in employment× tertiary education degree	0.154*** (0.039)	0.119*** (0.037)	0.007 (0.056)	-0.031 (0.047)
Partner in employment× vocational degree	0.148*** (0.031)	0.142*** (0.030)	-0.096*** (0.037)	-0.139*** (0.033)
Direct or indirect migration background	-0.119*** (0.011)	-0.109*** (0.010)	-0.221*** (0.013)	-0.193*** (0.012)
Tertiary education degree	0.379*** (0.072)	0.215*** (0.066)	0.149* (0.082)	-0.011 (0.069)
Vocational degree	0.113*** (0.031)	0.072** (0.030)	0.102*** (0.037)	0.046 (0.034)
Age	0.090*** (0.006)	0.080*** (0.006)	0.163*** (0.007)	0.141*** (0.006)
Age ²	-0.001*** (0.000)	-0.001*** (0.000)	-0.002*** (0.000)	-0.002*** (0.000)
Observations	117827	116799	108035	107028

Note: Standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Additional control variables included are cohort fixed effects, macro-regions and urban area. We also control for individual effects using Chamberlain approach and add the time average of all explanatory variables .

Table 16: Effect of home-based work controlling for selection, all employees

	Overtime hours			Hourly wages		
	FE (1)	CRE (2)	CRE (3)	FE (4)	CRE (5)	CRE (6)
WfH	0.562** (0.268)	0.562** (0.269)	0.571** (0.270)	0.019 (0.013)	0.019 (0.013)	0.019 (0.013)
Female	0.000 (.)	-3.565 (2.698)	-1.113 (3.421)	0.000 (.)	-0.343** (0.155)	-0.644*** (0.208)
WfH*Female	0.819** (0.407)	0.819** (0.409)	0.811** (0.410)	-0.050** (0.022)	-0.050** (0.022)	-0.052** (0.022)
Correction for selection	No	No	Yes	No	No	Yes
Observations	21829	21829	21829	21829	21829	21829

Note: Standard errors in parentheses, $*p < 0.10$, $**p < 0.05$, $***p < 0.01$. Control variables included are gender-specific year fixed effects, gender-specific demographic controls (age, age squared, migration background, marital status, children), gender-specific human capital controls (highest degree and actual work experience), job characteristics (tenure, tenure squared, public sector dummy, firm size), macro-regions, urban area, gender-specific occupation fixed effects (95 occupation dummies) and gender-specific occupational status fixed effects (15 occupation dummies).