

Women, Fertility and Informality*

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Abstract

A large literature documents differences in women's and men's labor market outcomes, particularly after childbirth. In this paper, we investigate how these choices differ in a context with widespread informality. We analyze labor market and insurance choices by exploring an event study analysis around the birth of the first child, using data from a longitudinal survey in Chile. We document that women are more likely to work as self-employed after the first child's birth. This effect is larger for highly educated women, who are also more likely to report working remotely with no differences in work hours. In contrast, women with less education reduce their supplied hours. These switches are associated with less cognitive-intensive occupations, which may explain the observed fall in wages. Finally, we explore the effects of the 2008 Chilean pension system reform on formal work decisions. We observe that women who had children after 2008 are less likely to leave formal employment compared to women who had children before the reform was implemented.

Keywords: Chile, Informality, Insurance, Gender Gaps, Child Penalty

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1. INTRODUCTION

Recent empirical literature provides solid evidence on the relationship between female labor market outcomes, gender norms and fertility decisions. Women are more likely to drop out of the labor force after the birth of the first child, work part-time, and move to self-employment (Blau & Kahn (2007), Lim (2017), Kuziemko, Pan, Shen & Washington (2018), Kleven, Landais, Posch, Steinhauer & Zweimüller (2019), Kleven, Landais & Søgaard (2019), Berniell, Berniell, De la Mata, Edo & Marchionni (2020)). In addition, the event of childbirth is also highly correlated with the widening of the gender wage gap (Goldin 2014).

Much of the evidence comes from developed and high income countries, but less is known about the relationship between fertility and labor market outcomes in developing countries (Cruces & Galiani (2007), Aguero & Marks (2008), Berniell, Berniell, De la Mata, Edo & Marchionni (2020)).

The labor markets in Latin American countries differ greatly from high income countries. First, the formal sector is much more rigid, allowing for less flexibility in working arrangements, such as hours and place of work. Second, informality is widespread. According to Maloney (2004), between 30% and 70% of the urban work force in Latin American countries is informal. The definition of informality varies among existing studies, but it usually subsumes wage earners without a labor contract and other workers with low social security contributions, such as the self-employed. Informal workers are considerably more exposed to risk not only because they are in sectors with higher earnings volatility and turnover, but also due to the lack of access to social insurance programs such as unemployment benefits, disability insurance, pensions, and maternity leave in the case of women. We use Chile as a case study, because the availability of its rich data sets allows us to employ panel data and perform event studies as our empirical strategy. Even though informality rates in Chile are lower than in other Latin American countries, our results could be informative for developing countries with similar labor market characteristics. Finally, formal childcare is still largely unavailable (Mateo Díaz & Rodriguez-Chamussy 2016), so the presence of children can be expected to have a strong effect on the labor supply of women in the household.

In this paper, we distinguish three sectors of employment: formal, informal and self-employment. We define a formal worker as one that has a defined labor contract. A written labor contract protects against unexpected events like unemployment and ensures benefits such as social security and labor union participation rights. An informal worker, however, is not in possession of such a contract and a self-employed individual works independently. We show that these sectors differ in hours of work, workplace flexibility, wages, firm size, and occupation composition.

We begin our event studies analysis by documenting well-known facts, such as the fall in labor force participation and wages of women after the birth of the first child, in comparison to men (Kuziemko, Pan, Shen & Washington (2018), Kleven, Landais, Posch, Steinhauer & Zweimüller (2019), Kleven, Landais & Søgaard (2019), Berniell, Berniell, De la Mata, Edo & Marchionni (2020)). We evaluate

whether occupational sorting is behind the fall in wages of women after childbirth. We find that there is a positive association between cognitive skill requirements and wages and that there is a fall in the cognitive skill requirements of the occupations in which women are employed after childbirth.¹ We also analyze the choice of sector of employment. As in previous literature, we find that there is a fall in formal work.² We bring insights into the choice of informal work and self-employment. We find that there are no significant changes in the share workers in the informal sector after childbirth for both men and women. In addition, we find that women are more likely to switch into self-employment after childbirth and that the effect is larger for highly educated women (those that have more than high school education). Overall, we observe a decrease in formal work, no changes in informal work and an increase in self-employment, all conditional on employment. These results are exactly aligned with the degree of flexibility of these sectors, where formal work and self-employment are at the opposite ends of the spectrum. We also observe that flexible arrangements differ by education level: while highly educated women are more likely to work remotely and keep their hours of work unchanged after childbirth, lower educated women remain working at the firm and reduce their hours of work.

In addition, we analyze insurance decisions of men and women regarding pension contributions and type of health coverage. We observe a fall in female contributions to the pension system relative to men, where married women experience the largest fall. This different behavior by marital status may have long-run welfare implications in the case of divorce. In relation to health coverage, we find that women are less likely to keep private insurance after childbirth, while men experience no effects. This may be related to poorer economic conditions, as women are more likely to leave the labor force after childbirth.

In a final exercise, we explore the effects of the 2008 Chilean pension system reform, which aimed to decrease the gender gap in pensions in two ways: (i) through government coverage of women's pension contribution for each child born alive (an amount of 10% of 18 minimum wages) and (ii) in case of divorce, a judge can determine that a spouse keeps up to 50% of the other spouse's pension funds accumulated during marriage. We study the impact of the reform on formal employment and observe that women who had children after the reform are less likely to leave formal employment, in comparison to those who had children before 2008.

This paper is structured as follows. In Section 2 we summarize the main findings in the literature and our main contribution. In Section 3 we introduce the data sets and display important descriptive statistics of the sample. In Section 4 we introduce our empirical strategy. In Section 5 we present our results. In the final section we conclude.

¹Cognitive skill requirements are measured as required cognitive tasks at the occupational level. More details in Section 3.

²Our definition of informal employment considers workers who do not have a labor contract and differs from other definitions in the literature. More concretely, Berniell, Berniell, De la Mata, Edo & Marchionni (2020) consider workers who share at least one of these characteristics: do not contribute to social security, do not have a labor contract, are self-employed and low-educated, and have temporary jobs.

2. RELATED LITERATURE AND CONTRIBUTION

This paper contributes to three strands of the literature: (i) research on gender gaps in the labor market and their determinants, (ii) studies on informality and choice of sectors of employment, and (iii) work that explores the effects of the 2008 Chilean pension system reform.

Several studies have documented that the gender wage gap in developed countries has decreased over the period 1970-1990, but its closing has had a slower rate in the last three decades (Goldin (2006), Blau & Kahn (2006), Blau & Kahn (2007), Blau & Kahn (2017)). The narrowing of the gap has been mainly driven by an increase in human capital accumulation and labor market attachment among females, as well as by a decrease in occupational segregation by gender (Blau & Kahn 2017). As children remain the primary reason for women to change career plans and are a major driver of the gender wage gap (Goldin (2006), Correll, Benard & Paik (2007), Bertrand, Goldin & Katz (2010)), our paper studies gender gaps in labor market outcomes and insurance decisions around the time of childbirth focusing on a developing context.

Like previous related literature (Kuziemko, Pan, Shen & Washington (2018), Kleven, Landais, Posch, Steinhauer & Zweimüller (2019), Kleven, Landais & Søgaard (2019), Berniell, Berniell, De la Mata, Edo & Marchionni (2020)), we use an event study approach to study the gender gaps around the time of childbirth.³ These papers find that there is an increase in the gender gap in earnings, a decrease in labor force participation and wages of mothers relative to fathers, and that many of these effects are persistent. We investigate if the wage decrease after childbirth is related to different occupational choices. More concretely, we study the cognitive content of occupations in which women are employed before and after childbirth.

This paper also relates to studies that analyze how workers choose sectors of employment, especially in developing countries (Dix-Carneiro & Kovak (2019), Dix-Carneiro, Goldberg, Meghir & Ulyssea (2019), Berniell, Berniell, De la Mata, Edo & Marchionni (2020), Ponczek & Ulyssea (2017)). Our paper distinguishes multiple characteristics of each job and classifies individuals as formally employed, informally employed, or self-employed — three coexisting types of employment typically found in developing countries. We define formal workers as individuals in possession of a defined labor contract. A written labor contract protects against unexpected events such as lay-offs on short notice and ensures entitlement to benefits such as social security and labor union participation rights. Informal workers, in contrast, are not in possession of such a labor contract. Self-employed individuals work independently. In the context of developing countries, accounting for self-employment is important since a nontrivial fraction of the working population has neither a formal nor an informal employer. Jobs in these three sectors of employment also differ in characteristics, such as hours and place of work, ‘firm’ size, wages, cognitive skill requirements and the share

³In reference to methodology, our paper addresses the issues of non-convex weighting when using two-way fixed effect estimators in event studies with varying treatment timing, typically not addressed in the literature, by following the method implemented in Sun & Abraham (2020).

of people that contributes to the pension system. The percentage of individuals that contribute to the pension system is above 98% in the formal sector, around 20% in the informal sector and 16% for those in self-employment. Contrary to other approaches in the existing literature, we acknowledge that workers could contribute to the pension system while being self-employed or working without a labor contract.

As we measure different characteristics of jobs, which include hours of work and work location, we contribute to the literature on child penalties and the search of flexible work arrangements (Golden (2001), Golden (2008), Goldin & Katz (2011), Edwards (2012), Goldin (2014)). While there is significant literature studying the choice of part-time work, we bring a less explored dimension, which is workplace flexibility. In the Chilean context, the formal sector is the most rigid, where more than 80% of women work at the establishment. The informal sector is still very inflexible in place of work, as around 40% of women work at the firm. In self-employment, however, less than 20% of workers work at the firm site.

While clearly related in spirit, the recent paper by Berniell, Berniell, De la Mata, Edo & Marchionni (2020) differs from ours in several ways. First, their definition of informality differs from ours, subsuming workers in at least one of the following categories: not contributing to social security, low-skilled in self-employment, working with no labor contract and having a temporary job.⁴ Second, we consider self-employment as a different sector of employment, as it is characterized, for example, by different work arrangements and wage distribution. Third, we study occupational sorting, workplace flexibility, health insurance, the effects of the pension reform, among other outcomes, not addressed in their paper.⁵

We further analyze gender gaps in health and social security insurance after the birth of the first child. While there is some evidence that women are less likely to contribute to the pension system after the event of childbirth (de Previsión Social (2015), Amarante, Colacce & Manzi (2017), Berniell, Berniell, De la Mata, Edo & Marchionni (2020)), we additionally explore differences by marital status, providing insights on the source of the pension gender gap. On the health dimension, we study whether women differently change their health insurance rates and association with a private health care provider after childbirth.

Finally, we study the implications of the 2008 pension system reform on labor force participation and formal employment of men and women in Chile. We perform event studies on men and women who gave birth before and after 2008 to study the effects of the reform, complementing the existing literature exploring the effects of the reform on pension wealth, formal employment, pension contributions, among other outcomes (Attanasio, Meghir & Otero (2011), Behrman, Calderon, Mitchell,

⁴In a previous version of their paper, they considered an informal worker an individual who did not contribute to the social security system.

⁵Their paper differs from ours as well in methodology and sample selection, as ours considers individuals who became parents between 1981 and 2016 and theirs between 2002 and 2015.

Vasquez & Bravo (2011), Todd & Joubert (2013)).

3. DATA AND INSTITUTIONAL SETTING

Our main dataset is a longitudinal survey from Chile, “*Encuesta de Protección Social*” (EPS).⁶ The survey has six waves (2002, 2004, 2006, 2009, 2012 and 2015) and contains, among others, information on demographics, family structure, health, earnings, employment, and wealth, where almost 35,000 individuals are interviewed.⁷ Labor market spells are characterized by information on the contractual relationship, firm size, hours of work, occupation and industry. Historical information dating back to 1980 is obtained in the first interview. In each survey wave, labor market information and changes in the family structure since the last interview are recorded. Information on other variables, such as wealth, is available only for the years in which individuals were surveyed. Wages are available for all spells from the year 2002 onward and detailed labor market trajectories can be reconstructed for the majority of the workers. The resulting 35-year panel allows us to analyze the allocation of the labor force in different sectors of employment and its relation to a child arrival, conditional on various socio-demographic characteristics. Since this data can be linked to the administrative data on the Pension System in Chile, “*Historia Previsional de Afiliados*” (HPA), on some occasions, we use the administrative records to minimize measurement error.

In addition to the above data sets, we use the Occupation and Information Network data set (O*NET) to build a measure of cognitive skill requirement of occupations.⁸ This data set contains information on a wide array of requirements at the occupational level, such as abilities, knowledge, skills, and work styles. We use 18 descriptors of core cognitive tasks, perform principal component analysis and keep the first principal component as a measure of cognitive skill requirements at the occupational level. We normalize the score to be in the interval [0,1].

3.1 Sample

For the purpose of this study, we consider the time period 1981-2016 and individuals born between 1945 and 1995, aged between 16 and 59.⁹ As we are interested in the way in which a child arrival shapes individuals’ careers, we focus on individuals who become parents at some point during the observation period. Table 1 below presents key descriptive statistics of our sample of interest, which contains 6,729 mothers and 6,045 fathers. We observe that around two thirds of women have a high school degree at most, while the remaining third has a higher education level (some college, college degree or more). In the case of men, around 30% have higher education. We also explore family related statistics, and report that 75.6% of women and 86.3% of men were married at childbirth. The average age at first birth is around 23 and 25 for women and men, respectively. Individuals

⁶Ministry of Labor and Social Protection, Survey EPS.

⁷Since the second wave, the EPS is a nationally representative survey of the Chilean population.

⁸This data set is developed under the sponsorship of the U.S. Department of Labor/Employment and Training Administration.

⁹We limited the maximum age to 59 because 60 is the legal retirement age for women in Chile.

can be observed for around 25 years on average.

Table 1: Descriptive Statistics

Statistic	N	Mean	St. Dev.
Panel A — Women			
Cohort	6,729	1974	11.892
Less than high school	6,729	0.140	0.347
High school degree	6,729	0.526	0.499
More than high school	6,729	0.334	0.472
Marital status	6,729	0.756	0.429
Age at birth of first child	6,729	23.801	5.081
Years observed	6,729	24.859	10.078
Panel B — Men			
Cohort	6,045	1 971	11.775
Less than high school	6,045	0.178	0.382
High school degree	6,045	0.534	0.499
More than high school	6,045	0.289	0.453
Marital status	6,045	0.863	0.344
Age at birth of first child	6,045	25.541	5.285
Years observed	6,045	26.860	9.449

Note: Data from EPS. Cohorts born between 1945 and 1995, individuals ages 16 and 59. Columns report *Number of Observations* (N), *Mean* and *Standard Deviation* (St.Dev.). Panel A presents the statistics for Women and Panel B for Men.

3.2 Labor Market Characteristics

In Table 2 we present a summary of the information related to the labor market. We converted the spell information to a monthly panel given that this is the most desegregated information from the spell reporting.¹⁰ We report working hours and wages after removing the highest and lowest 2% of observations. We observe that men work more hours than women, 48.4 weekly hours versus 45, respectively. Wage information is reported as the logarithm of monthly wages in Chilean UFs, which corresponds to, approximately, 40 USD. Wages for men in the sample are higher than wages for women. On average, the wage measure for women is 2.38, while the male average stands at 2.61.

Table 2 further summarizes the rates of labor force participation, employment in different sectors as well as ratios of employment by type of working arrangement. Average labor force participation is 57% for women and 88.8% for men. Unemployment rates are higher among females: only 4.5% of

¹⁰As we discuss in section 4, the event studies will use monthly data but the event dummies are coded annually.

men are unemployed while 8% of women are unemployed. Employed individuals work in four main sectors: the public sector, the formal sector, the informal sector, and self-employment. Informal workers are those that work for private firms but report that they do not have a signed labor contract. Self-employed individuals are those that declare to work independently (*cuenta propia*). Following these definitions, participation of men in the formal sector conditional on participation is 59%, in the informal sector is 8% and in self-employment is 16%. Among women the corresponding statistics are 48%, 12%, and 9%, respectively.¹¹

Conditioning on labor force participation, 70% of women and 64% of men work at the firm. Finally, we observe that both women and men contribute to the pension system at low rates, 31% and 53%, respectively.

3.3 Sectors of Employment

To complete the presentation of the data, we highlight important differences across sectors of employment. In Figure 1 we show characteristics of the formal, informal, and self-employment sectors: firm size, place of work, pension contributions, cognitive requirements, weekly hours and hourly wages. With the exception of pension contributions, all figures are generated based on data for women only.

The first panel shows the firm size distribution by sector. Around 60% of women working in the formal sector are employed in firms with more than 20 employees. In the informal sector this share falls to approximately 20%, and the typical firm has less than 10 employees. Self-employment is entirely characterized by small firms, where more than 70% of self-employed women work in a one-person venture. The second panel displays the proportion of women by workplace. The majority of women in the formal sector work at the firm, while only 40% of informal workers and less than 20% of the self-employed do so.

In the third panel we show that around 20% of individuals in the informal sector and in self-employment contribute to the pension system. In panel four, we summarize the mean cognitive requirements of occupations associated with each employment scenario and find that the demand for cognitive requirements is highest in the formal sector. In terms of working hours, the formal sector has typical contracts of 45 or 48 hours, and other working arrangements are much less common. For the informal and self-employment sectors there is higher dispersion, especially for self-employment. The last panel shows the wage distributions (cumulative density functions) across sectors. Around 40% of self-employed and informally employed women are earning less than the minimum wage.¹² The formal sector cumulative distribution function stochastically dominates the

¹¹In Table 2, there is an omitted sector ‘other’, such that when we sum this category and the share of individuals unemployed, in the formal, informal and self-employment sectors, we obtain the share of individuals who are participating in the labor force.

¹²The minimum wage increased in Chile from 100 US dollars at its introduction in the 70s to almost 400 US dollars in recent years.

Table 2: Labor Market Information

Statistic	N	Mean	St. Dev.
Panel A — Women			
Pension contribution indicator	1,993,227	0.316	0.465
Working hours	728,189	44.984	10.094
Log monthly wage	356,597	2.386	0.633
Labor force participation	1,575,946	0.570	0.495
Unemployed	1,575,946	0.080	0.271
Formal sector	1,575,946	0.277	0.448
Informal sector	1,575,946	0.067	0.249
Self-employed	1,575,946	0.050	0.218
Public sector	1,575,946	0.079	0.270
Working at the firm facility	637,059	0.699	0.459
Cognitive measure	204,857	0.479	0.228
Panel B — Men			
Pension contribution indicator	1,943,062	0.530	0.499
Working hours	1,249,947	48.437	8.730
Log monthly wage	533,201	2.609	0.596
Labor force participation	1,563,162	0.888	0.315
Unemployed	1,563,162	0.046	0.209
Formal sector	1,563,162	0.524	0.499
Informal sector	1,563,162	0.080	0.271
Self-employed	1,563,162	0.146	0.353
Public sector	1,563,162	0.053	0.224
Working at the firm facility	1,139,399	0.636	0.481
Cognitive measure	294,468	0.497	0.162

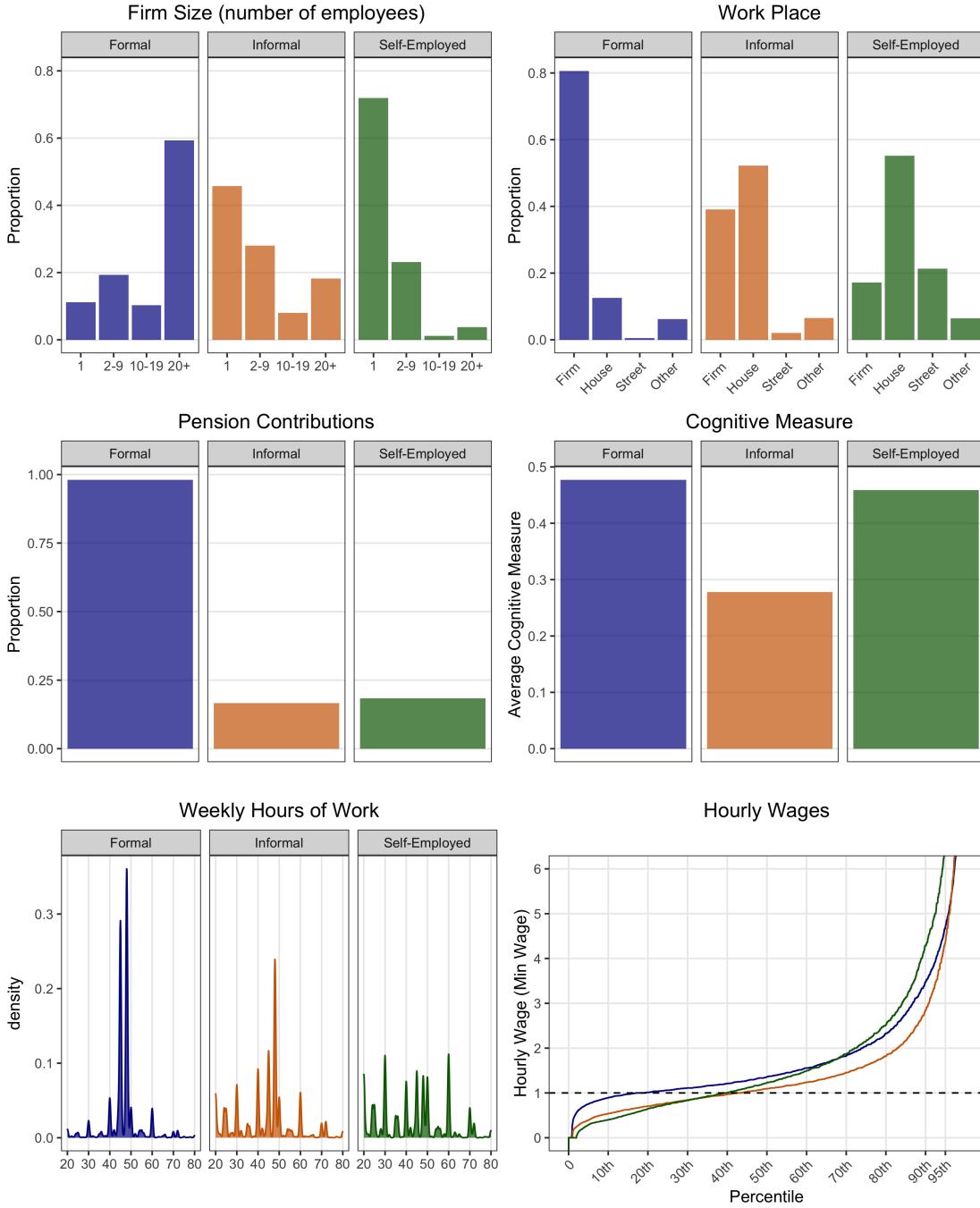
Note: Data from EPS and O*NET. Cohorts born between 1945 and 1995. For the labor market outcomes observations are restricted to individuals between 16 and 59 years old and for years between 1981 and 2016.

other two, except at the top wages. The findings from Figure 1 let us conclude that informality and self-employment are associated with lower levels of social security contributions and higher levels of labor market risk compared to the formal sector.

3.4 Pension System Reform in 2008

In the final part of our analysis we refer to a reform of the pension system that took place in Chile in 2008. This reform aimed to reduce poverty at older ages and the number of individuals with low pensions at retirement. The new pension ends the requirement of a minimum of 20 years of contribution for eligibility to a minimum pension level, and increases the generosity of pensions through a raise in the minimal pension level and through the introduction of a bonus with an implicit tax rate of 30%.

Figure 1: Characteristics of Sectors of Employment



Note: Data from EPS 2002-2015. All individuals born between 1945 and 1995, ages between 16 and 59. With the exception of the third panel, all graphs restrict to the sample of women only. The first panel shows the proportion of women by firm size and the second panel by workplace across sectors of employment. The third panel displays the proportion of individuals contributing to the pension system. The fourth panel shows the average cognitive requirements, the fifth panel the distribution of weekly hours and the sixth panel the flipped CDF for hourly wage in terms of the minimum wage, in all cases across sectors of employment.

Other changes of the reform affect women in particular: 1) the government covers a woman's pension contribution for each child born alive with an amount that represents 10% of 18 minimum wages, and 2) at the moment of divorce, a judge can determine that a spouse keeps up to 50% of the other spouse's pension funds. The goal of these changes is to reduce the gender gap in pensions received at the time of retirement. It is not clear, however, which could be the effect of this reform on women's incentives to work and to remain in the formal sector. On the one hand, the coverage of pension contributions by the government increases the pension savings, so the household needs to work less in the formal sector to obtain the same pension amount. At the same time, married women who do not work have an increase in insurance in the case of divorce, potentially receiving up to half of the husband's pension funds. This also motivates a decrease in labor supply. On the other hand, given that women have pension coverage for one and a half years for each child born, they may have incentives to remain attached to the formal sector and reap a higher contribution at an older age.

4. EMPIRICAL STRATEGY

Our empirical strategy follows an event study approach similar to [Kuziemko, Pan, Shen & Washington \(2018\)](#) and [Kleven, Landais & Søgaard \(2019\)](#), exploring time of birth of the first child. The basic model is given by:

$$Y_{imt} = \sum_{\tau=-5}^8 \beta_\tau \mathbb{1}\{EV_{imt} = \tau\} + \sum_{a=16}^{59} \gamma_a \mathbb{1}\{\text{age}_{imt} = a\} + \nu_i + \varepsilon_{imt}, \quad (1)$$

where i indexes individuals, m calendar-month, and t indexes the calendar year. Individuals have their first child at calendar year e_i , so we construct the event time as the distance, in years, relative to the birth of the first child, given by:

$$EV_{imt} = \begin{cases} -5, & \text{if } t - e_i < -5 \\ t - e_i, & \text{if } -5 \leq t - e_i \leq 8 \\ 8, & \text{if } t - e_i > 8 \end{cases}, \quad (2)$$

We cap the extreme points, 5 years before and 8 years after the first birth, as in [Kuziemko, Pan, Shen & Washington \(2018\)](#). In our specification we include as controls age and individual fixed effects. We estimate the regressions separately for men and women, using always event year -2 as the comparison level, which is omitted from Equation 1. The choice of the annual level stems from data constraints — for a high fraction of women in our sample we can only identify the year of first birth, but not the exact month.¹³

Recent research by [Goodman-Bacon \(2018\)](#), [Callaway & Sant'Anna \(2019\)](#) and [Sun & Abraham](#)

¹³ Additionally, the computational burden of the estimator of [Sun & Abraham \(2020\)](#) is substantially higher with the monthly specification.

(2020) discusses the issues with non-convex weighting when using two-way fixed effect estimators in event studies, where there is variation in treatment timing across units and dynamic treatment effects. We follow [Sun & Abraham \(2020\)](#) and estimate the parameters of interest, β_τ , without the contamination effects from other periods. As we show in our results section, our estimates point in the direction of dynamic treatment effects for several outcomes, which may pose challenges for papers using two-way fixed effects in the context of childbirth event studies. The estimator, however, constraints the treatment effect to be homogeneous across different cohorts, a hypothesis that it is strong in our setting.¹⁴

We restrict our sample to individuals that have at least one child — therefore, we do not explore selection into becoming a parent. Our identification hypothesis is that the *pre-birth* outcomes are exogenous to the birth of the first child. Our approach allows for some anticipatory behavior, requiring only that for a non empty set of *pre-birth* years this anticipatory behavior is non-existent. We do confirm this intuition showing that pre-birth estimates are centered around zero for both men and women.

The outcome variable varies in each exercise, including indicator variables for labor force participation, employment in specific sectors (formal, informal and self-employment) and place of work, among others. The coefficient β_τ captures the difference of average Y_{it} , τ years apart from the birth of the first child in comparison with two years before the event, conditional on age, and individual fixed effects. Our identification strategy explores, therefore, individual level variation in the timing of births — estimating within-individual evolution of outcomes. In most of our graphs we show the coefficient of interest β_τ from Equation 1 as a percentage of the counterfactual outcome, when we exclude the contribution of the event dummies as in [Kleven, Landais & Søgaard \(2019\)](#).

5. RESULTS

5.1 Labor Supply, Wages and Occupations

We begin our analysis by showing the evolution of labor supply choices and wages before and after the event of the birth of the first child. Figure 2 shows the event study coefficients from Equation 1 as a percentage of the counterfactual outcome. Two years before the birth of the first child ($\tau = -2$), 54% of women and 82% of men are working. The labor force participation (LFP) rates of men and women diverge further two years after the birth: there is a reduction in labor force participation of approximately 40% for women, but there are no effects for men with respect to $\tau = -2$. This initial decline experienced by women is persistent over time. We also report results for low and highly educated individuals, and observe that low educated women are more likely to leave the labor force than highly educated women (a year after the first birth, there is an approximate decrease of over 40% and around 20% with respect to $\tau = -2$, respectively). Our estimates mirror

¹⁴We define a “cohort” as a group of women that have their first birth in a particular age.

the results from the existing literature, being close to US and UK estimates, but larger than the ones from Scandinavian countries (Kuziemko, Pan, Shen & Washington (2018), Kleven, Landais, Posch, Steinhauer & Zweimüller (2019), Kleven, Landais & Søgaard (2019), Berniell, Berniell, De la Mata, Edo & Marchionni (2020)).¹⁵ In addition, we show heterogeneity by marital status, previously unexplored in related event studies. We find that married women experience an approximate decline of 40% in LFP and single women around 25% a year after the birth, relative to $\tau = -2$. The difference by marital status may arise due to social norms, insurance, or due to the fact that the income of the partner contributes to joint family resources in such a way that employment in the presence of a child and a husband becomes less desirable.

Regarding hourly wages, Figure 3 shows there is an initial 5% fall for women a year after the birth, with respect to $\tau = -2$, but this drop becomes more pronounced over time representing a 20% fall by the sixth year. There are heterogeneous results by education level, where we observe a fall in hourly wages for highly educated women but not for low educated women in Panels (b) and (c). The fall in wages for women with high education may be driven by slower rates of human capital accumulation, or different commitment to the job in the presence of children. It could further be driven by the fact that these women switch to lower paying and less demanding jobs. The stable wage level of low educated women, on the other hand, could be due to selection: those who remain at work are the most productive, preventing a decrease in hourly wages.

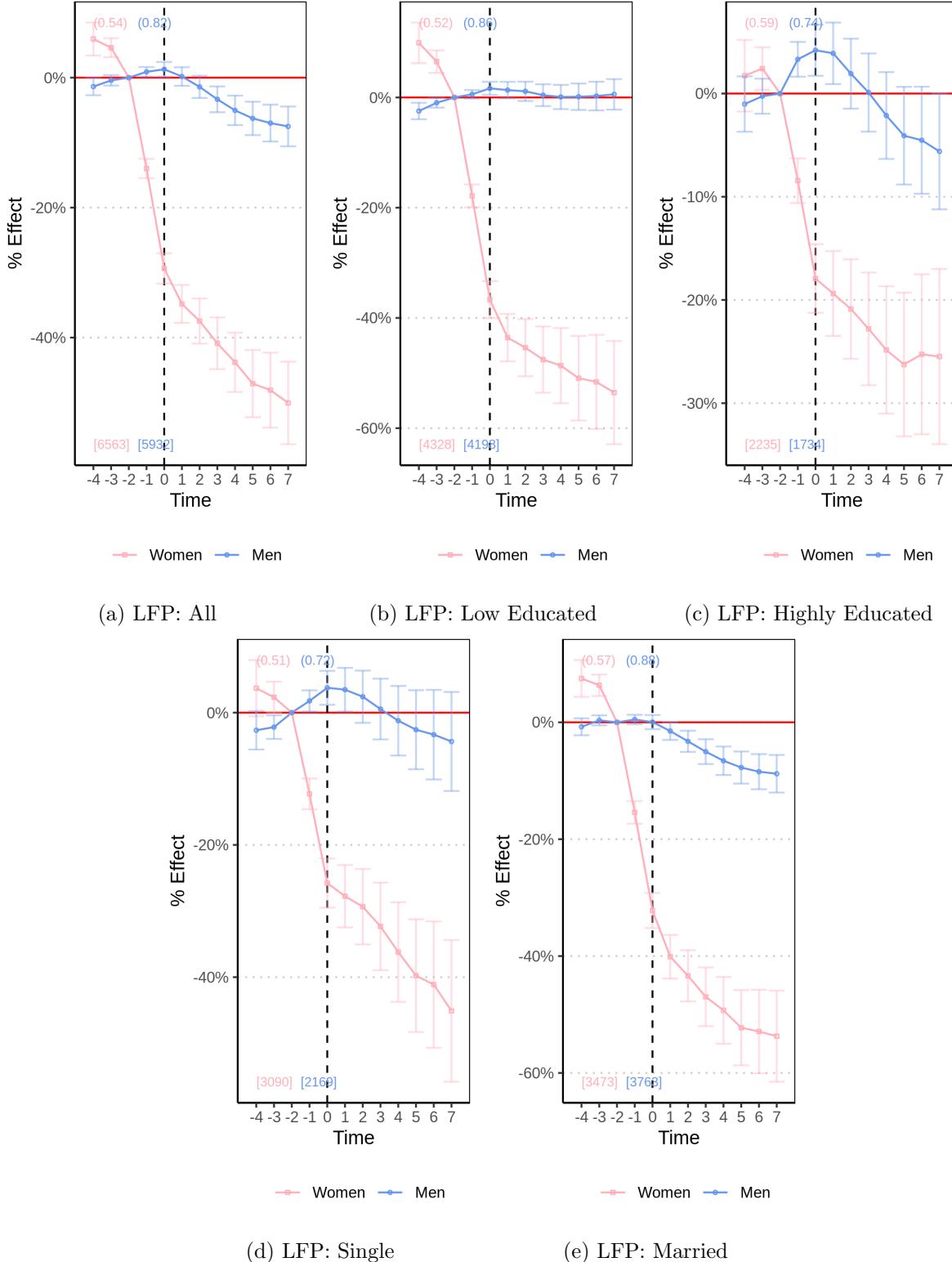
To better understand the reason for the fall in wages after childbirth we perform an event study where we analyze if women move towards occupations that have lower wages. We proceed in two steps. First, we show that women move towards occupations with lower cognitive content. Second, we report a positive correlation between wages and cognitive content at the occupational level. In the first step, we classify occupations by their cognitive task requirements, where we consider core math, analytical and verbal skills. We sort the occupations on a unit interval [0,1], where 1 represents the occupation with the highest cognitive content. Figure 4 shows that there is about a 10% decrease in cognitive tasks performed at the job a year after the event of motherhood and a decrease of almost 30% by the sixth year, with respect to $\tau = -2$. In the second step, we compute the mean wages at the occupational level. With information on cognitive skill requirements for 207 occupations, we graph the relation between wages and cognitive skill requirements in Figure 5, where we report a positive relation. This suggests that as women move towards less cognitive occupations after birth, they are more likely to move towards jobs with lower wages.

5.2 Sector of Employment

We also study the effects of parenthood on sector of employment, distinguishing between three sectors: formal, informal and self-employment. These sectors differ in the degree of flexibility, as

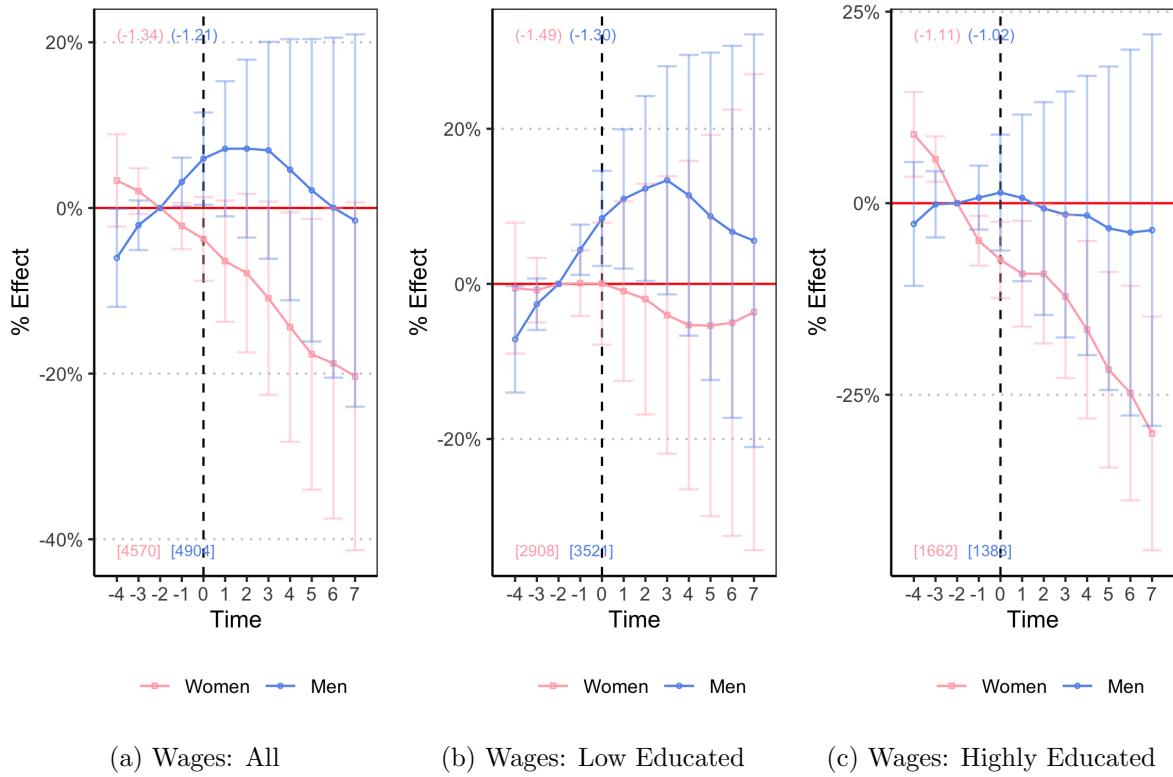
¹⁵We find that our estimates are larger than in Berniell, Berniell, De la Mata, Edo & Marchionni (2020) that find a decrease in LFP of 15% after childbirth. This may be due to different sample selection and empirical strategy.

Figure 2: Labor Supply



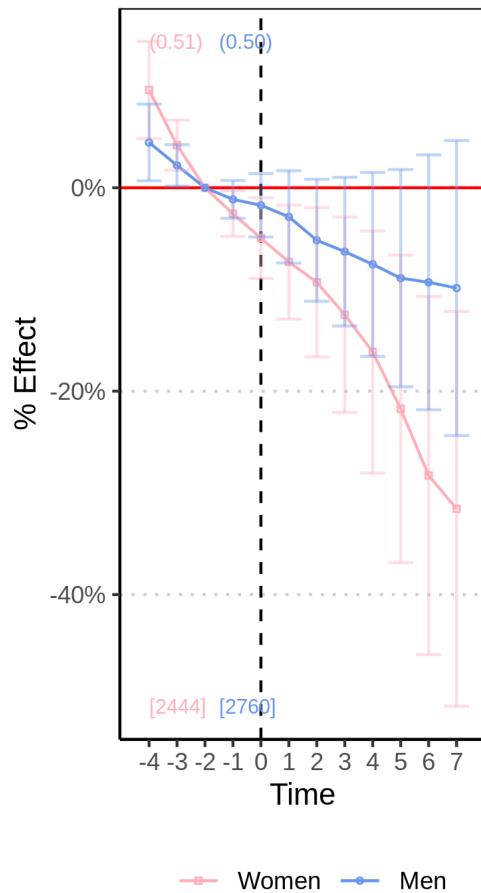
Note: Each graph plots the β_t coefficients from Equation 1 as a percentage of the counterfactual outcome, together with 95% confidence intervals. The baseline coefficient is set at period -2. Numbers in parenthesis display the outcome variable level in the reference period and numbers in brackets the number of individuals in each analysis. The outcome variable is a binary variable which equals 1 when the individual is in the labor force. Panel (a) uses the full samples, while panels (b)-(e) use sub-samples, respectively: low educated (high school or less), highly educated (some college or more), single and married.

Figure 3: Hourly Wages



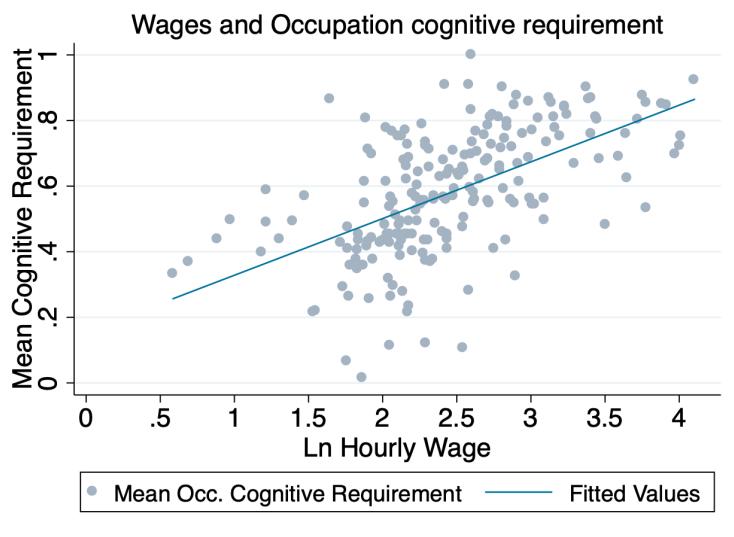
Note: Each graph plots the β_τ coefficients from Equation 1 together with the 95% confidence intervals. The baseline coefficient is set at period -2. Numbers in parenthesis display the outcome variable level in the reference period and numbers in brackets the number of individuals in each analysis. The outcome variable is the hourly wages. Panel (a) uses the full samples, while panels (b)-(c) for sub-samples, respectively: low educated (high school or less) and highly educated (some college or more). Results by marital status are available upon request.

Figure 4: Occupation Cognitive Requirements



Note: The graph plots the β_τ coefficients from Equation 1 as a percentage of the counterfactual outcome, together with 95% confidence intervals. The baseline coefficient is set at period -2. Numbers in parenthesis display the outcome variable level in the reference period and numbers in brackets the number of individuals in each analysis. The outcome variable is the average cognitive measure of the occupation.

Figure 5: Correlation Wages and Cognitive Skill Requirements at Occupational level



Note: Data from EPS and O*NET. The sample includes 207 occupations. The cognitive skill requirement is obtained performing principal component analysis on 18 descriptors of cognitive task requirements. We keep the first principal component and normalize the measure on the interval [0,1].

depicted in Figure 1. The formal sector is the most rigid, where the majority of employees typically work 48 hours and the usual place of work is the firm. The informal sector is more flexible than the formal sector in the hours dimension, but still very inflexible on the workplace dimension as around 40% of the employees work at the firm. Self-employment offers the most flexible work arrangements, as is evident from the histogram of hours worked - which is very smooth over the range of working hours - and from the fact that over 50% of individuals who are self-employed work from home.

We start the analysis with formal employment. We observe in panel (a) of Figure 6 that, conditional on working, women decrease employment in the formal sector after the birth of the first child. A year after the birth, there is a 13% decrease in formal employment for women, with respect to $\tau = -2$. In contrast, men increase their participation in formal employment by 3% in the first year after birth. Figure A.1 reports the results unconditional on working, where we observe a decrease in employment for women in the formal sector of 50% a year after the first birth with respect to $\tau = -2$. This strong decline in formal employment may be driving the fall in labor force participation. We report heterogeneous results by education level on panels (b) and (c) of Figure 6. Low educated women decrease formal work by 17% and highly educated women by 8%. Figure A.1 in Section ?? shows that the fall in formal employment (unconditional on working) for low educated women is above 70% while for highly educated women above 30% in the years after childbirth. This large difference may explain the larger fall in labor force participation of low educated women shown in Figure 2. Panels (d) and (e) show that the formal employment response of single and married women is very similar.

We now turn to the results on informal work. Our study distinguishes formal from informal work by the existence of a formal contract of employment. We understand that a labor contract for a determined time period, establishing rights and obligations of the worker, determines a working formal relation. This contract protects the worker from unexpected events such as unemployment, and provides with benefits such as social security and labor union participation (Díaz & Gálvez 2015). We observe that for those individuals who are working under a formal contract in our sample, 98% of them are contributing to the pension system. For informal workers, we find that only 23% are contributing to the pension system.¹⁶ Therefore, workers can be under an informal contract in the private sector and still contribute to the pension system. We observe in panel (a) of Figure 7 that there are no significant changes in informal work for men and women after the birth of the first child. There are also no significant changes for low and highly educated women (panels (b) and (c)) nor for single or married women (panels (d) and (e)). If we analyze the results unconditional on employment, we observe in panels (b) and (c) of Figure A.2 in Section ?? that there is a fall of 40% in informal employment a year after the birth of the first child for both low and highly educated women. However, low educated women experience a persistent effect that lasts many years after the birth. This fall is consistent with a larger fall in labor force participation among low educated women that is persistent after childbirth. Our results on informal employment differ from Berniell, Berniell, De la Mata, Edo & Marchionni (2020) because we consider a different definition of informality, as described on Section 2, and employ different samples and methodology.

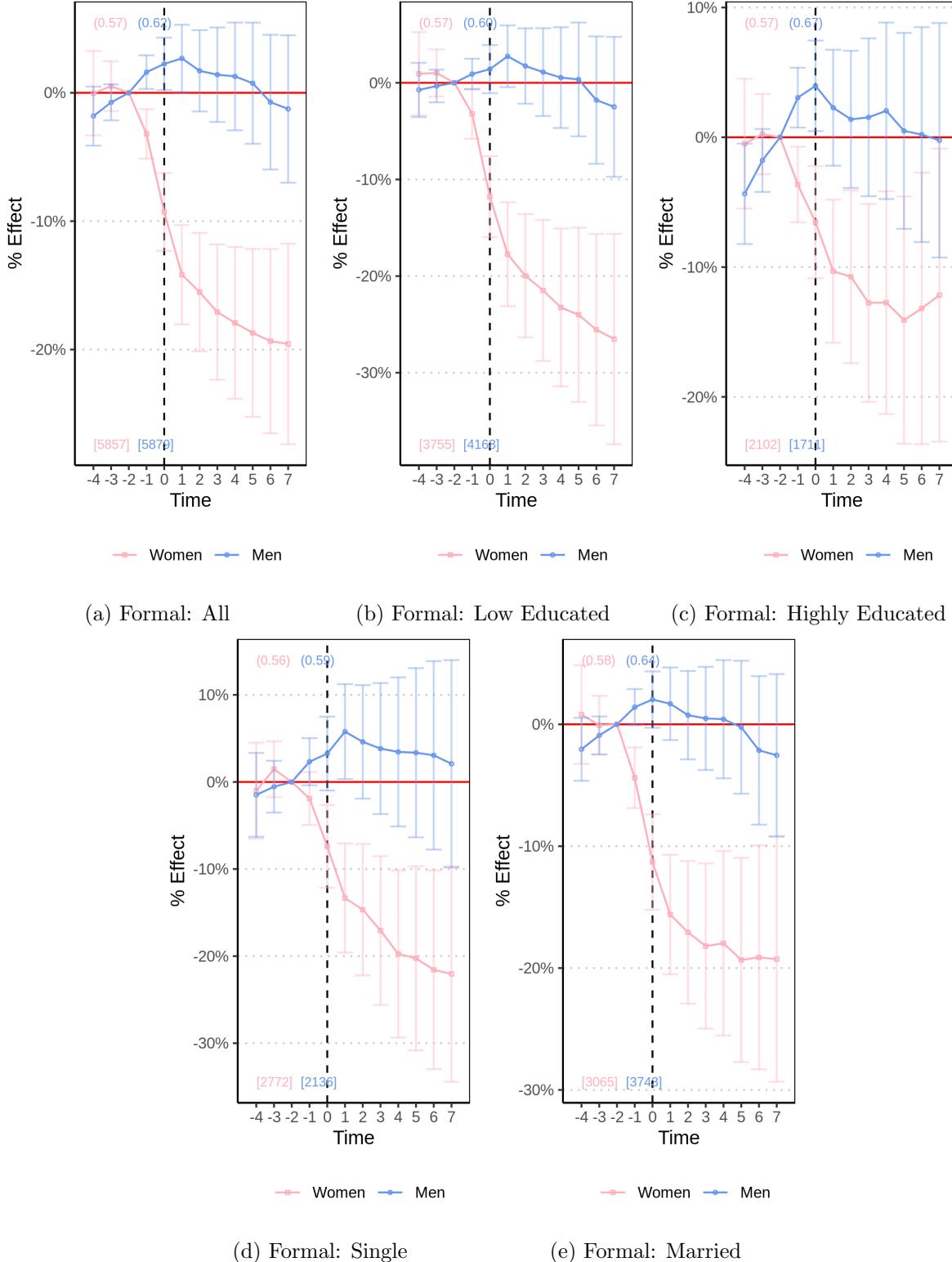
Finally, we report results on self-employment conditional on employment in Figure 8. In panel (a) we observe that there is an increase of above 60%, with respect to $\tau = -2$, on the probability of being self-employed for women while there are no effects for men. This effect is persistent and increasing, reaching a 100% by the 6th year after the birth of the first child. We also show results by education level on panels (b) and (c). A year after the birth, low educated women increase self-employment by around 60% while highly educated women by a 100%. Appendix Figure A.3 shows that, unconditional on employment, the increase in self-employment after childbirth is driven almost entirely by highly educated women.

5.3 Flexible work arrangements

The results from the previous section are very consistent with the fact that women may try to find work arrangements that are flexible after childbirth. We observe that the decrease in formal work, the lack of significant changes in informal work and the increase in self-employment, all conditional on employment, are aligned with the degree of flexibility of these sectors, where formal and self-employment are at the opposite ends of the spectrum. We now provide results on how parents choose hours and place of work after the event of childbirth. While the results on hours of work (panels (a)-(c) of Figure 9) are consistent with findings in related literature (Kleven, Landais & Søgaard (2019), Berniell, Berniell, De la Mata, Edo & Marchionni (2020)), we bring new insights

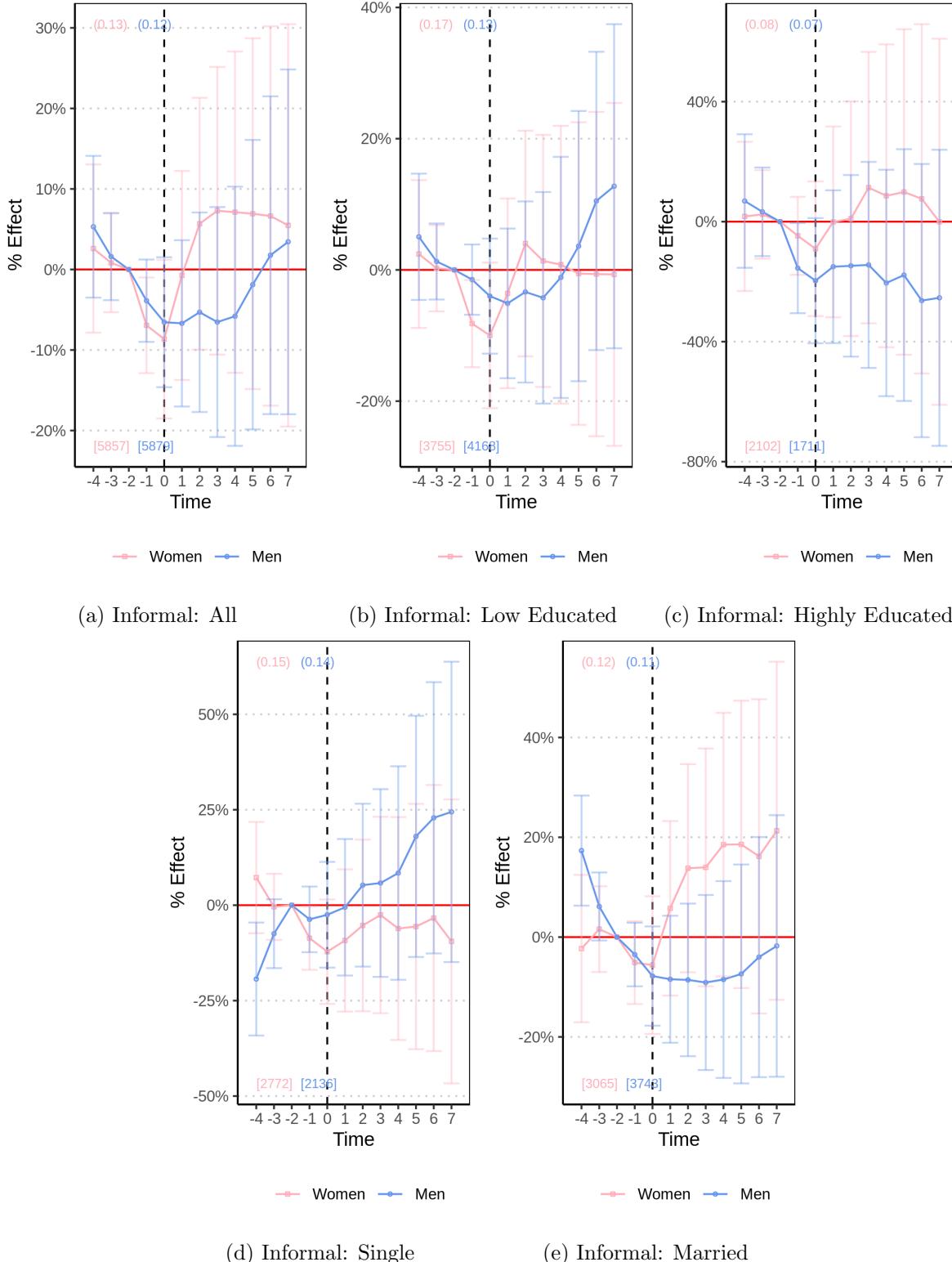
¹⁶Own calculations based on self-reported pension contributions from EPS data.

Figure 6: Formal Employment - Conditional on Working



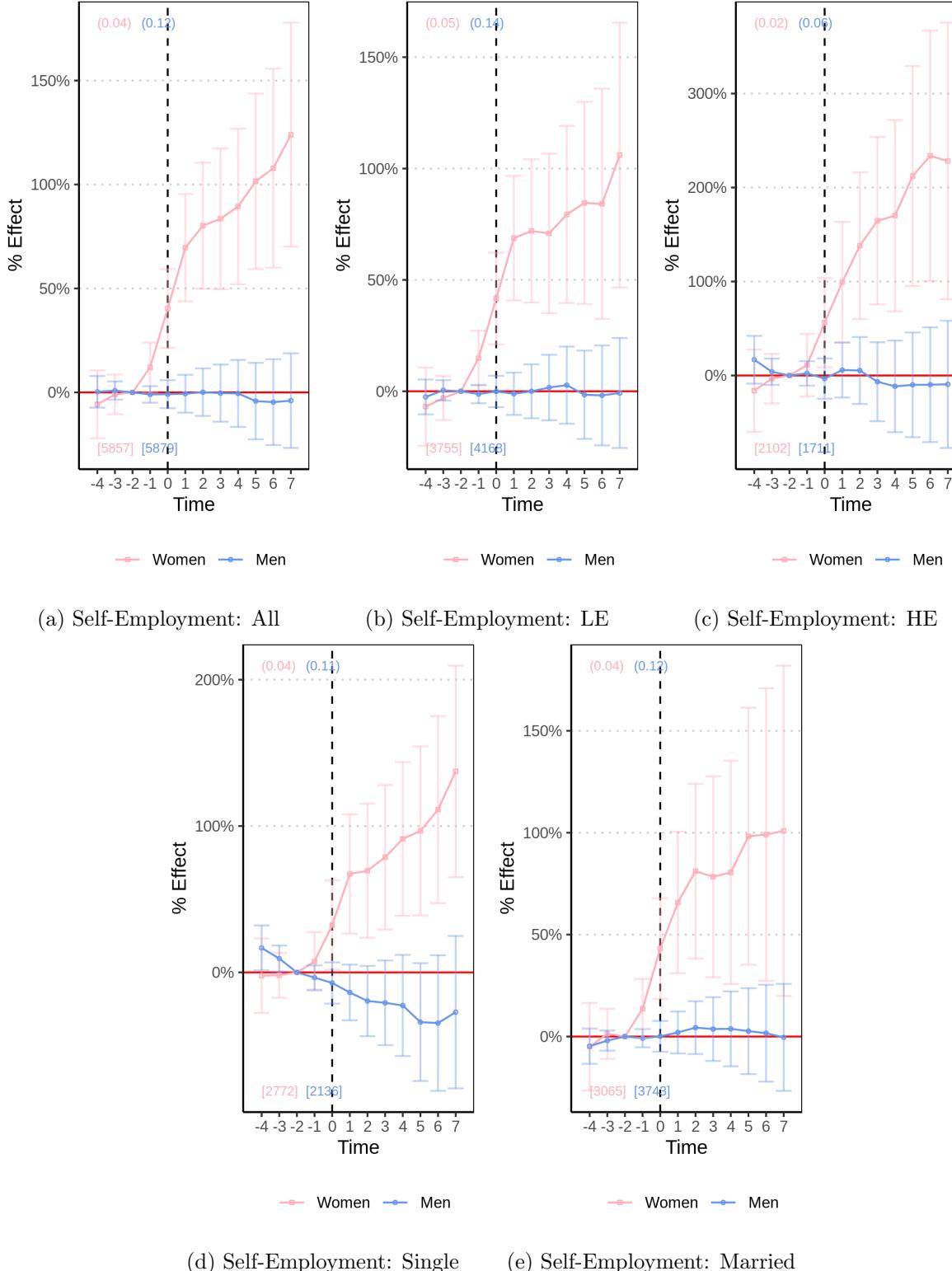
Note: Each graph plots the β_τ coefficients from Equation 1 as a percentage of the counterfactual outcome, together with 95% confidence intervals. The baseline coefficient is set at period -2. Numbers in parenthesis display the outcome variable level in the reference period and numbers in brackets the number of individuals in each analysis. The outcome variable is a dummy variable for formal employment. Panel (a) uses the full samples, while panels (b)-(e) for sub-samples, respectively: low educated (high school or less), highly educated (some college or more), single and married.

Figure 7: Informal Employment - Conditional on Working



Note: Each graph plots the β_t coefficients from Equation 1 as a percentage of the counterfactual outcome, together with 95% confidence intervals. The baseline coefficient is set at period -2. Numbers in parenthesis display the outcome variable level in the reference period and numbers in brackets the number of individuals in each analysis. The outcome variable is a dummy variable for informal employment. Panel (a) uses the full samples, while panels (b)-(e) for sub-samples, respectively: low educated (high school or less), highly educated (some college or more), single and married.

Figure 8: Self-Employment - Conditional on Working



Note: Each graph plots the β_τ coefficients from Equation 1 as a percentage of the counterfactual outcome, together with 95% confidence intervals. The baseline coefficient is set at period -2. Numbers in parenthesis display the outcome variable level in the reference period and numbers in brackets the number of individuals in each analysis. LE stands for Low Educated and HE for Highly Educated. The outcome variable is a dummy variable for self-employment. Panel (a) uses the full samples, while panels (b)-(e) for sub-samples, respectively: low educated (high school or less), highly educated (some college or more), single and married.²¹

into a different dimension of job flexibility: the place of work. Panel (d) shows that after childbirth women are less likely to work at the firm while men experience no effects. We observe heterogeneous effects by education level on the hours and workplace dimensions, as highly educated women are less likely to work at the firm and experience no change in hours of work after childbirth. In contrast, low educated women decrease their hours of work and remain working at the firm. This is potentially related to job flexibility available for low and highly educated women in self-employment. We observe in the data that 54% of low educated women (high school or less) do not work at the firm, but the share increases to 71% for those with more than high school education.¹⁷

5.4 Insurance

One of the objectives of this paper, apart from studying men and women's labor market behavior, is to study their insurance decisions, which include pension contributions and health coverage. For individuals in the formal sector, contributions to social security are part of the formal labor contract. However, there may be voluntary contributions from individuals in the informal and self-employment sectors. In our sample, 23% and 22% of informal and self-employed workers, respectively, contribute to the pension system. In Panel (a) of Figure 10, we report that there is a decrease in pension contributions above 5% for women in the first year after childbirth, with respect to $\tau = -2$, while there are no significant changes for men. This is a persistent fall for women, reaching over 10% by the sixth year after the first birth. Panels (b) and (c) evidence that the behavior is consistent across education levels.¹⁸ Interestingly, we observe in Panels (d) and (e) that it is married women who, by the second year after childbirth, experience a decrease of almost 10% in pension contributions with respect to $\tau = -2$. In the case of single women, the decrease is of 5% by the same year. Given that married women are more likely to leave the labor force after childbirth, we explore pension contributions unconditional on working. Appendix Figure A.4 shows that married women decrease their contributions by over 40% and single women by 25% a year after childbirth, with respect to $\tau = -2$. In both cases, pension contributions continuously decrease many years after childbirth. This different behavior by marital status may have implications in the long run in the case of divorce, where married women who did not contribute to the pension system could be adversely affected, especially when married to an individual without pension funds.¹⁹

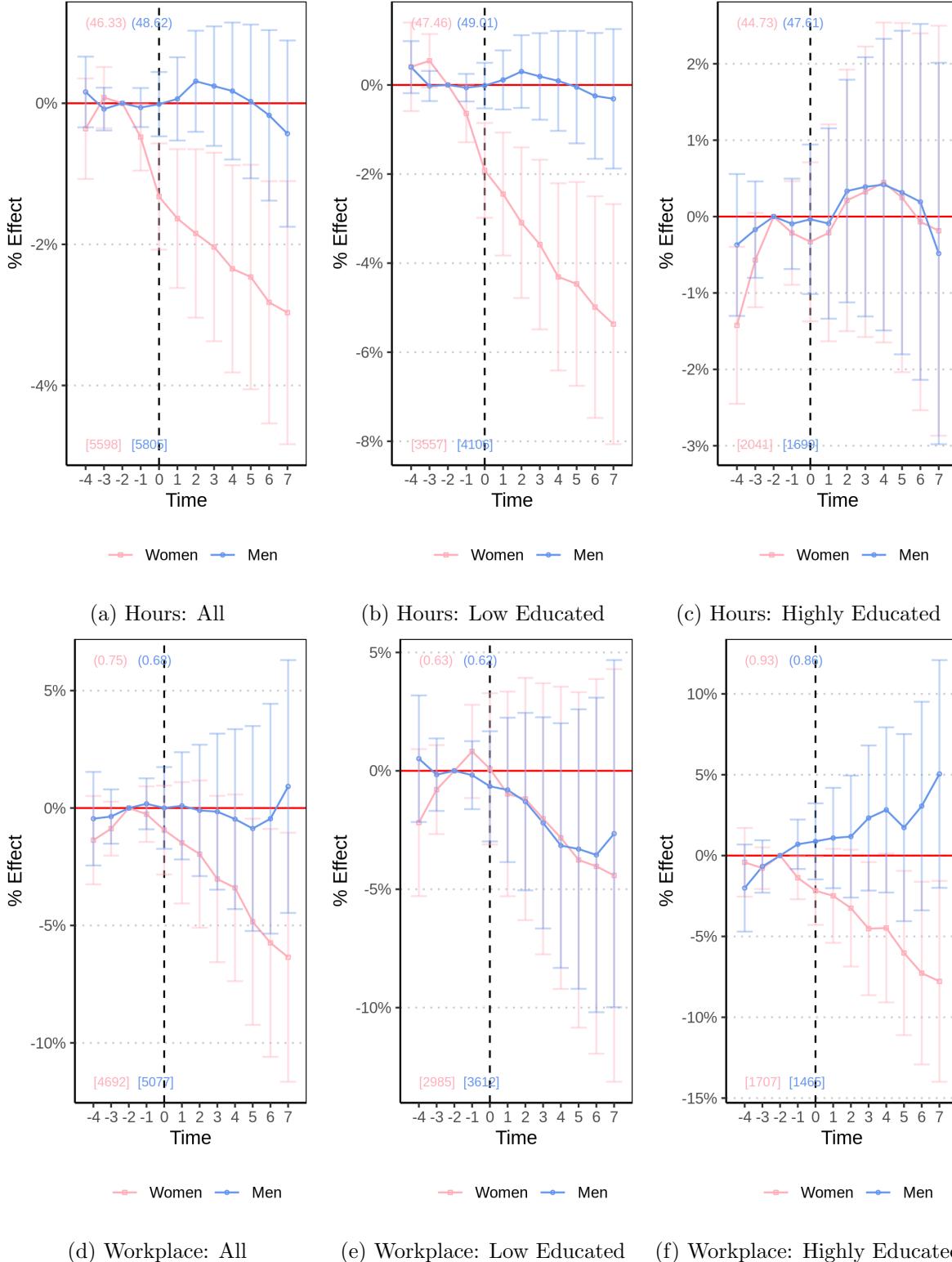
In relation to health insurance, before childbirth 93% of women and 90% of men report having health insurance in Chile. Panel (a) in Figure 11 reports the effects of childbirth on access to health coverage, where we observe no significant changes for neither men and women. In this case, the

¹⁷The differences in workplace flexibility in self-employment are also evident for men. The share of low educated men not working at the firm is 58%, while it is 79% for the highly educated.

¹⁸We also perform this analysis using administrative records of pension contributions instead of self-reported data. We also find that highly educated women decrease their pension contributions conditional on working. Results are available upon request.

¹⁹Since 2008, new legislation contemplates the transfer of part of the pension funds to the spouse that was economically affected during marriage (it is ruled by a judge). It should not exceed 50% of the accumulated funds during marriage of the spouse that has to contribute.

Figure 9: Flexible Work Arrangements



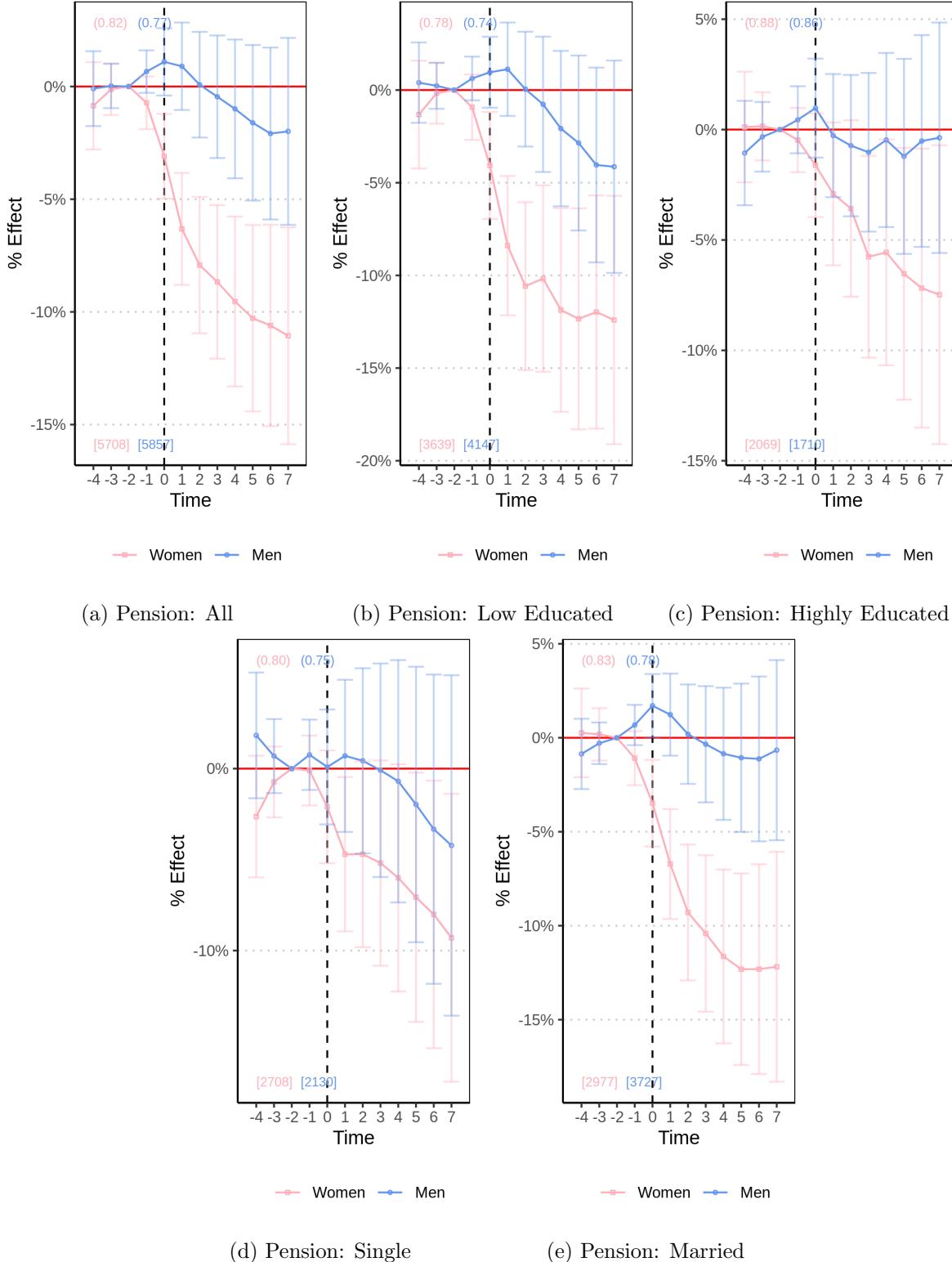
Note: Each graph plots the β_t coefficients from Equation 1 as a percentage of the counterfactual outcome, together with 95% confidence intervals. The baseline coefficient is set at period -2. Numbers in parenthesis display the outcome variable level in the reference period and numbers in brackets the number of individuals in each analysis. The outcome variable for panels (a)-(c) are hours of work and for panels (d)-(f) is a dummy for workplace at the firm site. Panels (a) and (d) use the full sample, panels (b) and (e) the sub-sample of low educated individuals (high school or less), and panels (c) and (f) highly educated individuals (some college or more). Results by marital status are available upon request.

available data does not allow to follow the same person monthly before and after birth, as the question about health insurance is not retrospective in the surveys. Hence, our event studies rely on cross-sectional data where there is substantial variation in the date of birth of the first child. In addition, we explore the effects of childbirth on the quality of their health insurance, given by whether it is public or private. We find that there is a fall of almost a 100% in the share of women with private health coverage a year after childbirth, while there are no significant effects for men. This may be related to women's lower economic conditions, as they are more likely to leave the labor force and experience lower wages after childbirth.

5.5 Pension System Reform in 2008

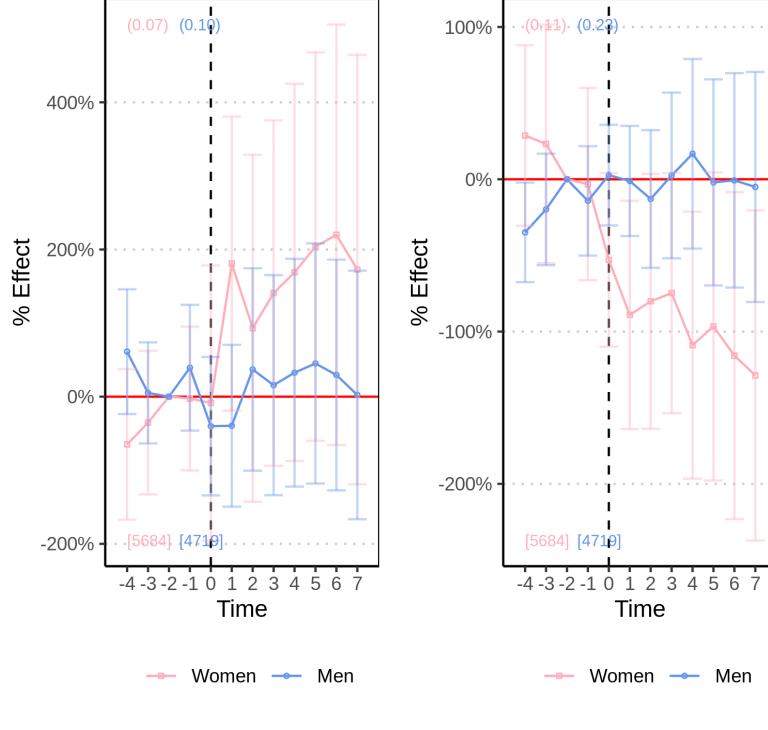
In this section we analyze the effects of the pension system reform in 2008 in formal employment and labor supply decisions. We proceed by evaluating the responses of men and women before and after this reform was implemented. In particular, we perform event studies for those who had children before and after 2008, while keeping individuals from the same cohorts in each analysis. In Panel (a) of Figure 12, we report the labor supply responses of individuals who had a child before 2008. In Panel (b), we report the same outcome for individuals who gave birth after 2008. We observe that there are no differences in labor supply responses between those groups. However, Figure 13 shows a different picture. We document the responses in formal work, conditional on employment, for individuals that had children before 2008 (Panel (a)) and after 2008 (Panel (b)). We observe that women who had children after the reform are more likely to remain in the formal sector after the birth of the first child, suggesting that the policy encourages formal labor market attachment.

Figure 10: Pension Contribution



Note: Each graph plots the β_τ coefficients from Equation 1 as a percentage of the counterfactual outcome, together with 95% confidence intervals. The baseline coefficient is set at period -2. Numbers in parenthesis display the outcome variable level in the reference period and numbers in brackets the number of individuals in each analysis. The outcome variable is a dummy variable for pension contribution (self-reported). Panel (a) uses the full samples, while panels (b)-(e) for sub-samples, respectively: low educated (high school or less), highly educated (some college or more), single and married.

Figure 11: Health Insurance



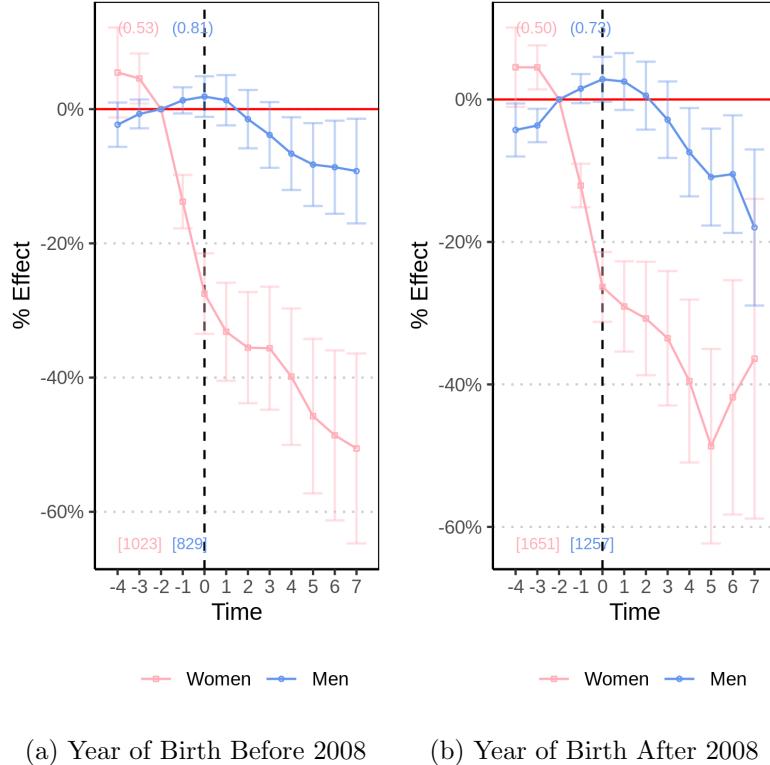
Note: Each graph plots the β_τ coefficients from Equation 1 as a percentage of the counterfactual outcome, together with 95% confidence intervals. The baseline coefficient is set at period -2. Numbers in parenthesis display the outcome variable level in the reference period and numbers in brackets the number of individuals in each analysis. The outcome variables are dummy variables for no health insurance (panel a) and private health insurance (panel b).

6. CONCLUSION

In this paper we analyze the labor market and insurance decisions of men and women around the time of childbirth in Chile. This is a market with three distinct sectors: formal, informal and self-employment. A formal worker has a clear labor contract that protects against unexpected events such as unemployment, and ensures benefits such as social security and labor union participation rights. An informal worker does not have such contract and a self-employed individual works independently. These sectors also differ in hours and place of work, firm size, cognitive tasks, among other characteristics.

Using an event studies approach, we find that the fall in women's wages after childbirth is associated with their switch into less cognitive occupations, which have lower wages. In addition, we find that there is a decrease in formal work, no significant changes in informal work and an increase in self-employment for women after childbirth. These results are aligned with the degree of flexibility of these sectors, where formal and self-employment are at opposite ends of the spectrum. Moreover, women with high education are more likely to work remotely after childbirth, while low educated women experience no changes on work location. Regarding insurance choices, we observe a fall in

Figure 12: Labor Supply - Pension Reform 2008

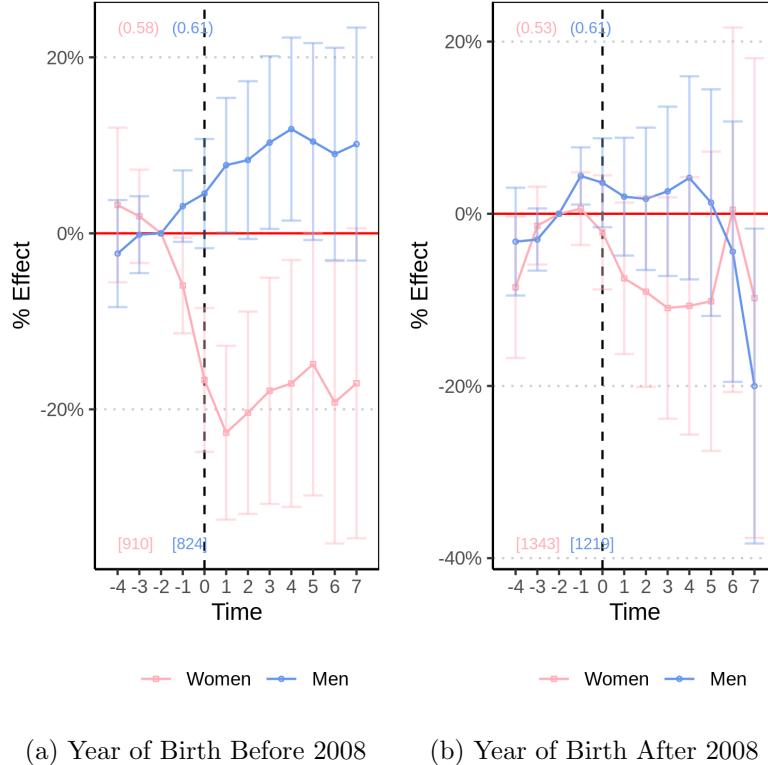


Note: Each graph plots the β_τ coefficients from Equation 1 as a percentage of the counterfactual outcome, together with 95% confidence intervals. The baseline coefficient is set at period -2. Numbers in parenthesis display the outcome variable level in the reference period and numbers in brackets the number of individuals in each analysis. The outcome variable is a dummy variable for labor force participation. Panel (a) estimates for the sub-sample of individuals who gave birth to children before 2008 and panel (b) after 2008.

female pension contributions, which is larger for married women, and a fall in female private health insurance after childbirth, while men experience no effects. In a final exercise, we explore the effects of the 2008 pension system reform in Chile, which aimed to decrease the gender gap in pensions. We observe that women who had children after the reform are less likely to leave formal employment, in comparison to women who had children before 2008.

We expect that our work informs policy makers on the costs associated with labor market behavior and insurance decisions after childbirth in a country with widespread informality. Gender gaps, not only in wages and labor market attachment, but also in occupational sorting, sectors of employment and insurance, may have long-run welfare implications. Further work should study the effects of policies that aim to reduce such gaps in the context of developing countries, taking into account the role of children as a major driver for differential gender behavior.

Figure 13: Formal Employment Conditional on Working - Pension Reform 2008



Note: Each graph plots the β_τ coefficients from Equation 1 as a percentage of the counterfactual outcome, together with 95% confidence intervals. The baseline coefficient is set at period -2. Numbers in parenthesis display the outcome variable level in the reference period and numbers in brackets the number of individuals in each analysis. The outcome variable is a dummy variable for formal employment, conditional on working. Panel (a) estimates for the sub-sample of individuals who gave birth to children before 2008 and panel (b) after 2008.

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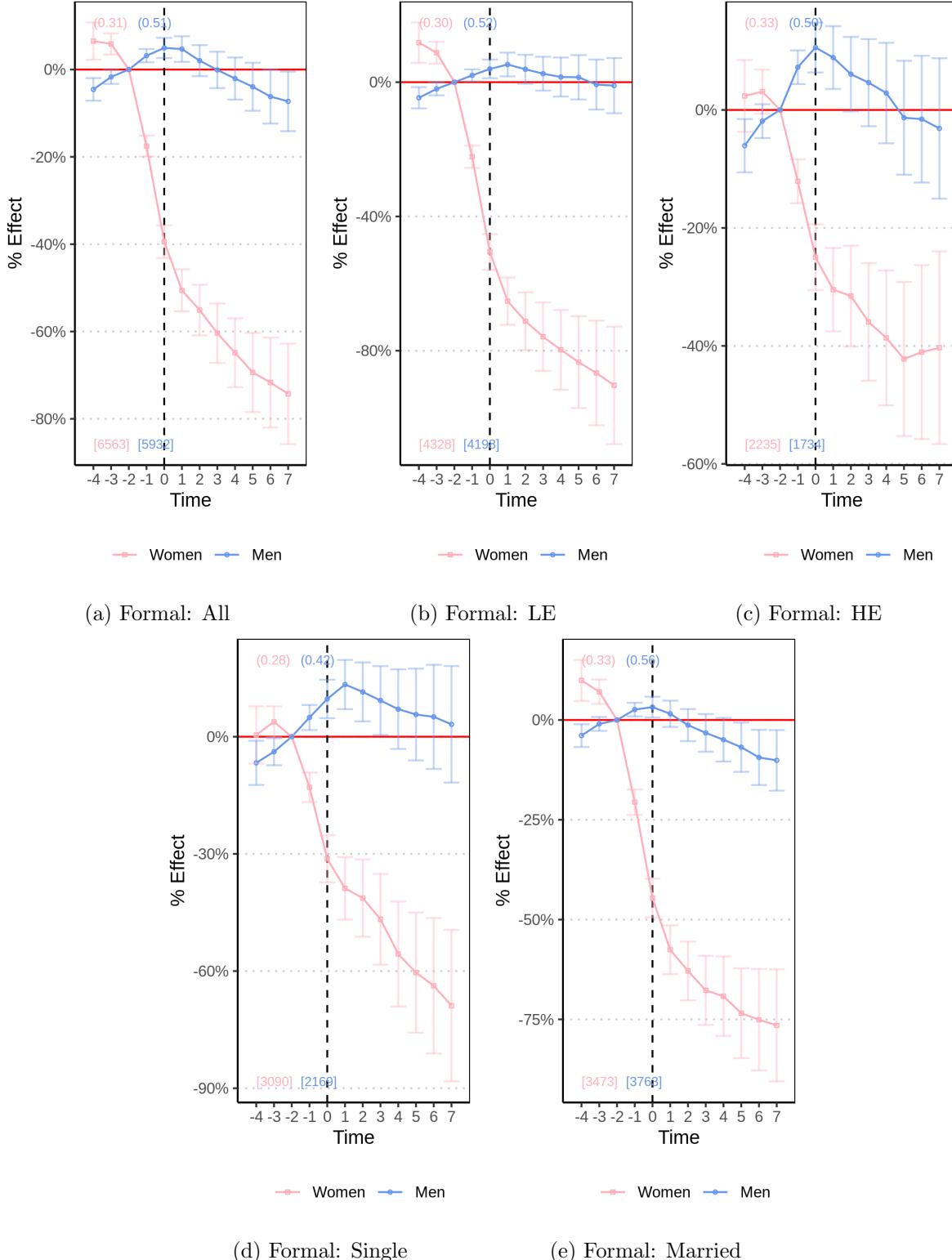
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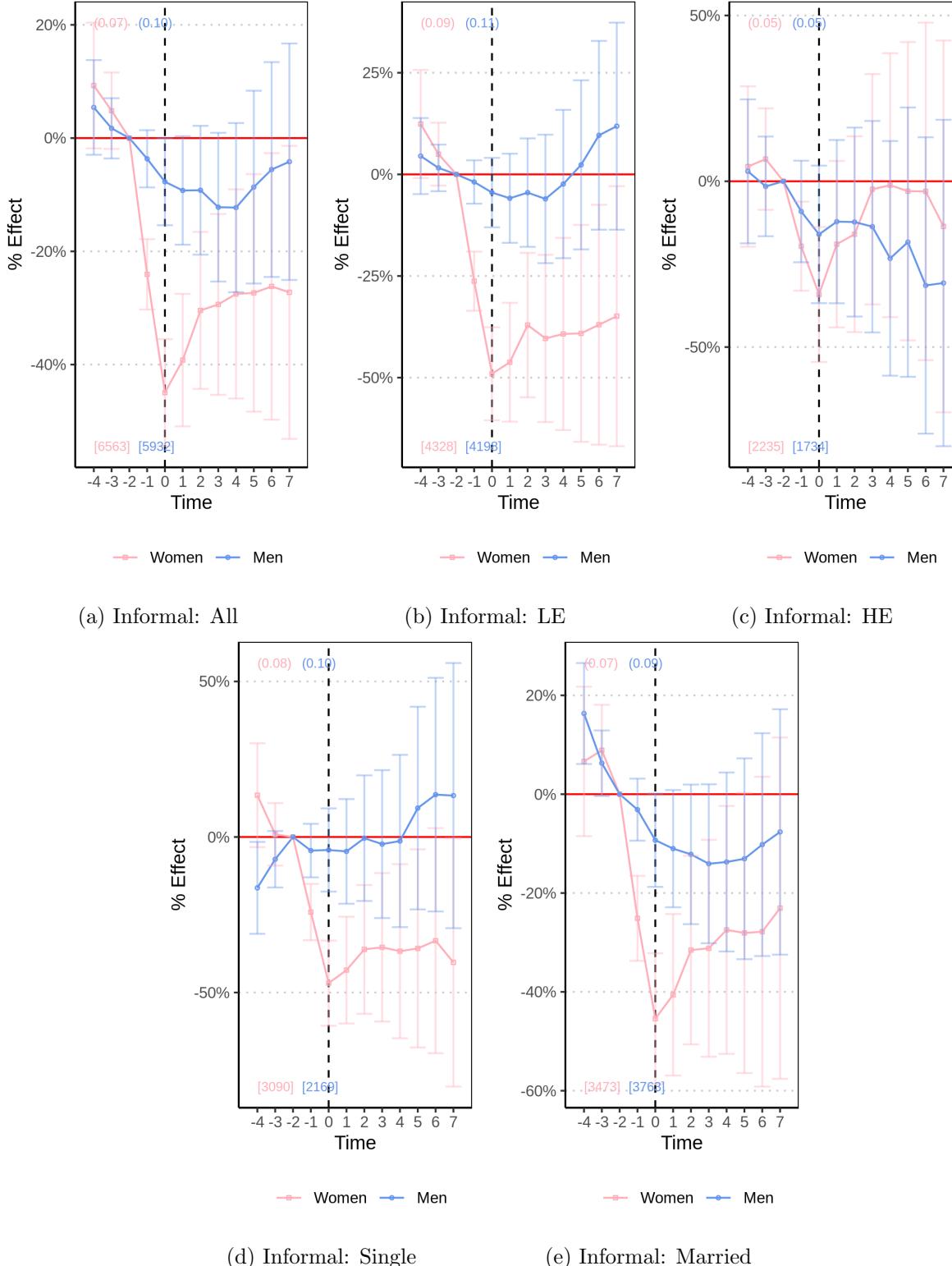
APPENDIX

Figure A.1: Formal Employment - Unconditional on Working



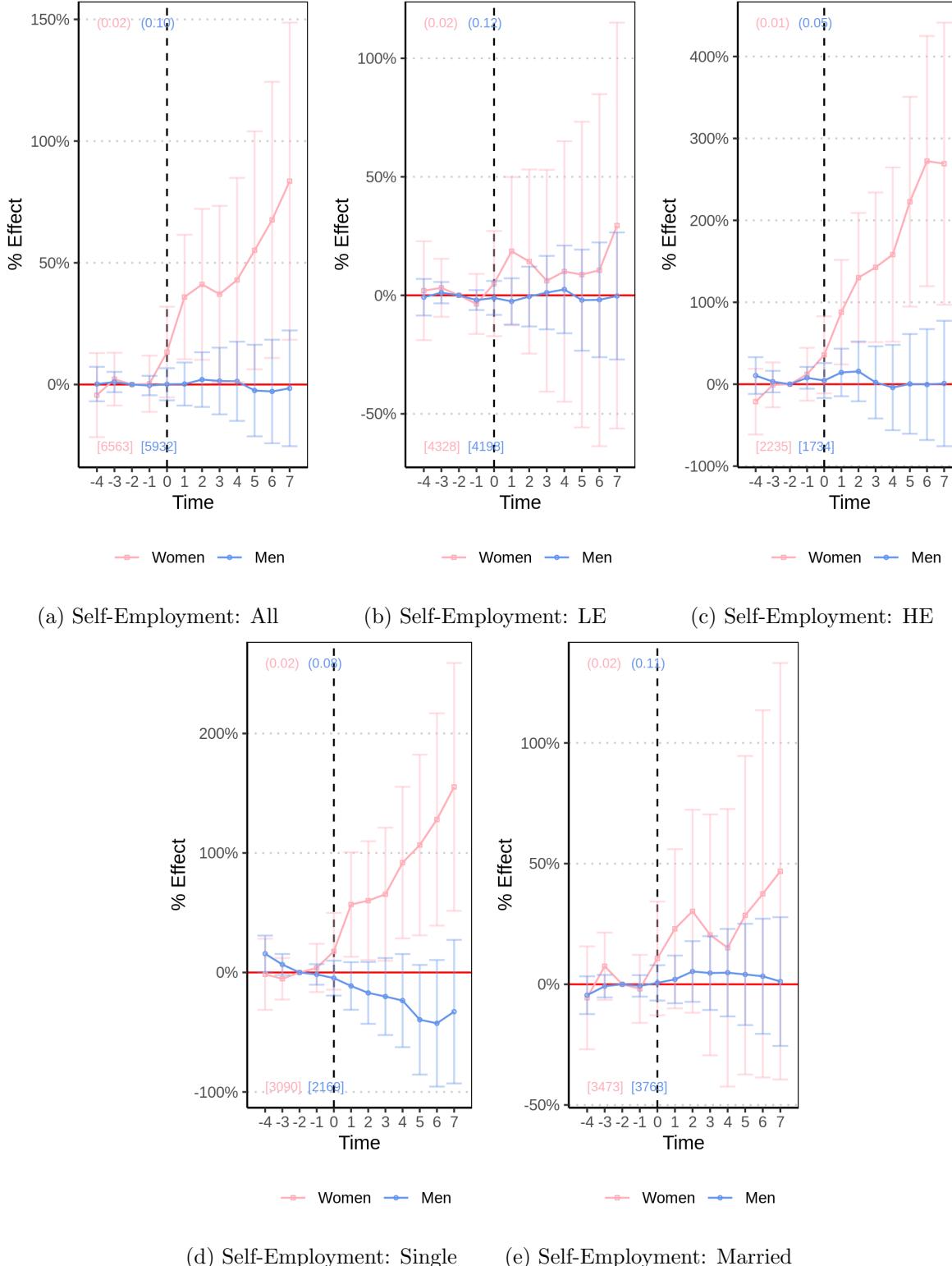
Note: Each graph plots the β_τ coefficients from Equation 1 as a percentage of the counterfactual outcome, together with 95% confidence intervals. The baseline coefficient is set at period -2. Numbers in parenthesis display the outcome variable level in the reference period and numbers in brackets the number of individuals in each analysis. LE stands for Low Educated and HE for highly educated. The outcome variable is a dummy variable for formal employment. Panel (a) uses the full samples, while panels (b)-(e) for sub-samples, respectively: low educated (high school or less), highly educated (some college or more), single and married.³²

Figure A.2: Informal Employment - Unconditional on Working



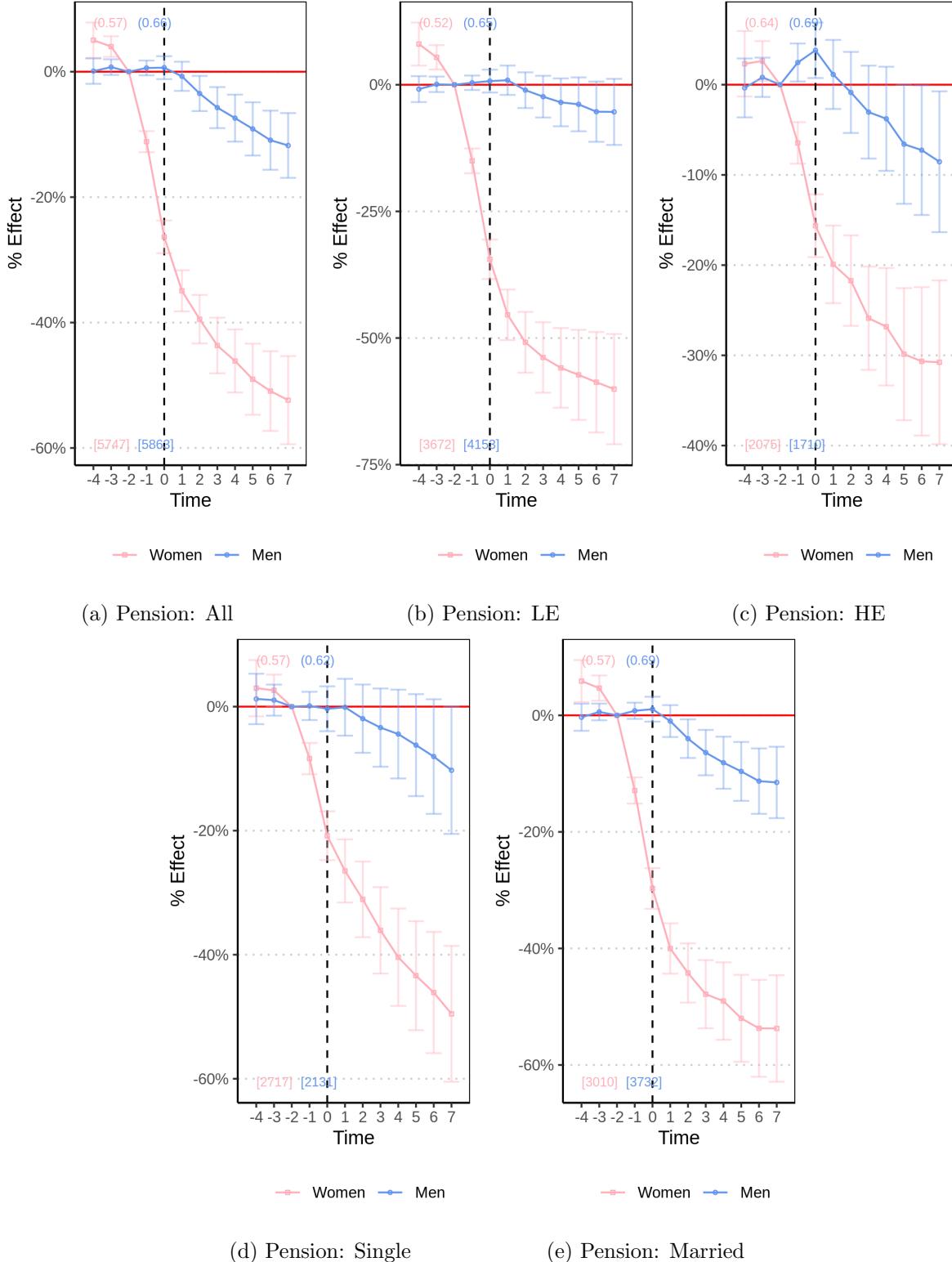
Note: Each graph plots the β_τ coefficients from Equation 1 as a percentage of the counterfactual outcome, together with 95% confidence intervals. The baseline coefficient is set at period -2. Numbers in parenthesis display the outcome variable level in the reference period and numbers in brackets the number of individuals in each analysis. LE stands for Low Educated and HE for highly educated. The outcome variable is a dummy variable for informal employment. Panel (a) uses the full samples, while panels (b)-(e) for sub-samples, respectively: low educated (high school or less), highly educated (some college or more), single and married.³³

Figure A.3: Self-Employment - Unconditional on Working



Note: Each graph plots the β_τ coefficients from Equation 1 as a percentage of the counterfactual outcome, together with 95% confidence intervals. The baseline coefficient is set at period -2. Numbers in parenthesis display the outcome variable level in the reference period and numbers in brackets the number of individuals in each analysis. LE stands for Low Educated and HE for highly educated. The outcome variable is a dummy variable for self-employment. Panel (a) uses the full samples, while panels (b)-(e) for sub-samples, respectively: low educated (high school or less), highly educated (some college or more), single and married.

Figure A.4: Pension Contribution - Unconditional on working



Note: Each graph plots the β_τ coefficients from Equation 1 as a percentage of the counterfactual outcome, together with 95% confidence intervals. The baseline coefficient is set at period -2. Numbers in parenthesis display the outcome variable level in the reference period and numbers in brackets the number of individuals in each analysis. LE stands for Low Educated and HE for Highly Educated. The outcome variable is a dummy variable for pension contribution (self-reported). Panel (a) uses the full samples, while panels (b)-(e) for sub-samples, respectively: low educated (high school or less), highly educated (some college or more), single and married.