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Gender Gaps in Labor Informality: The Motherhood Effect

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We estimate the short- and long-run labor market impacts of parenthood in a developing country, Chile, based on an event-study approach around the birth of the first child. We find that becoming a mother implies a sharp decline in employment, working hours, and labor earnings, while fathers' outcomes remain unaffected. Importantly, the birth of the first child also produces a strong increase in labor informality among working mothers (38%). All these impacts are milder for highly educated women. We assess mechanisms behind these effects based on a model economy and find that: (i) informal jobs' flexible working hours prevent some women from leaving the labor market upon motherhood, (ii) improving the quality of social protection of formal jobs tempers this increase in informality. Our results suggest that mothers find in informal jobs the flexibility needed for family-work balance, although it comes at the cost of deteriorating their labor market prospects.

KEYWORDS

Gender gap, child penalty, developing countries, labor informality, Chile, Latin America

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Brechas de género en informalidad laboral: El efecto de la maternidad

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Estimamos los impactos de la paternidad en el mercado laboral a corto y largo plazo en un país en desarrollo, Chile, basándonos en un enfoque de estudio de eventos en torno al nacimiento del primer hijo. Encontramos que convertirse en madre implica una fuerte disminución en el empleo, las horas de trabajo y los ingresos laborales, mientras que los resultados de los padres no se ven afectados. Es importante destacar que el nacimiento del primer hijo también produce un fuerte aumento de la informalidad laboral entre las madres trabajadoras (38%). Todos estos impactos son más leves en el caso de las mujeres con un alto nivel de educación. Evaluamos los mecanismos detrás de estos efectos basados en un modelo y encontramos que: i) la existencia de empleos informales con horarios flexibles estimula a algunas mujeres a no abandonar el mercado laboral al momento de la maternidad, ii) la mejora de la calidad de la protección social de los empleos formales modera este aumento de la informalidad. Nuestros resultados sugieren que las madres encuentran en los empleos informales la flexibilidad necesaria para encontrar un balance entre familia y trabajo, aunque esto se produce a costa de deteriorar sus perspectivas en el mercado laboral.

KEYWORDS

Brecha de género, penalidad por maternidad, países en desarrollo, informalidad laboral, Chile, América Latina

1 | INTRODUCTION

Informality is a pervasive and gendered characteristic of labor markets in developing countries. For instance, more than half of total employment in Latin America is informal, and informality rates are higher for women than for men (SEDLAC, 2020).[1] Informal workers have weaker social protection, lower wages, and worse prospects for career mobility, while work arrangements tend to be more flexible in informal jobs and working hours are usually shorter.[2] Thus, informal employment offers some attractive characteristics—flexible working hours—along with many other undesirable ones. Given that mothers are by and large primarily responsible for the care of children, informal jobs may be attractive in the search for flexibility in the workplace, especially when alternatives remain scarce.

Recent literature for developed countries shows that it is difficult to reconcile full-time jobs with raising children, since both time and material resources are key inputs for children's development (Del Boca et al., 2014). This literature shows that in their labor market decisions, parents take into account the trade-off between working hours and financial resources offered by many full-time and long-hours jobs, with the usual result being that mothers—not fathers—choose to reduce working hours or even opt out of the labor force in order to devote more time to raising children (Goldin, 2014; Kuziemko et al., 2018; Kleven et al., 2019b). In addition, parents take into account the available bundle of child-related benefits tied to their labor market decisions (Guner et al., 2020). In developing countries, children whose parents are informal workers are entitled to social protection that is of a similar quality to that of non-working parents but certainly lower than that of parents with formal jobs.[3] Therefore, the trade-off behind labor market and child investments is related not only to the tension between working long-hours——and receiving higher wages—and having time available to invest in children, but also to the quality of social protection that children are entitled to.

The aim of this paper is to explore the role of informal job opportunities in labor market decisions at the onset of parenthood in a developing country: Chile. The informality rate among prime-age workers in Chile was 40% on average between 1996 and 2016.[4] This measure of informality comprises unregistered workers without access to social security benefits, workers with no explicit written contracts of employment, workers in temporary jobs, and low-skilled self-employment, in line with the International Labour Organization's guidelines on measuring informality (ILO, 2013). Moreover, the gender gap in informality is large for some of these subcategories: 15.7% of working Chilean females are in jobs that do not grant them access to a pension, and 14.8% do not have a written contract, while the corresponding percentages among male workers are 4.9 and 4.3 percentage points lower, respectively.

Using data from the Social Protection Survey carried out by the Chilean Ministry of Labor and Social Protection and an event study approach around the birth of the first child (Angelov et al., 2016; Kleven et al., 2019b), we show that motherhood explains a large part of the informality levels among working women in Chile and, therefore, a large part of the gender gap in the informality rate. The analysis begins with the estimation of the short- and long-term impacts of parenthood on mothers' and fathers' labor market trajectories. We find

[1] Other developing regions, such as Sub-Saharan Africa, offer a similar pattern (Otobe, 2017).

[2] For a detailed characterization and analysis of labor informality in Latin America, see Perry et al. (2007) and Gasparini and Tornarolli (2009).

[3] In developing countries inactive individuals and informal workers are usually entitled to the same type of social protection (non-contributory) while formal workers are covered by contributory schemes. See for instance Levy and Schady (2013).

[4] Own calculations based on the Chilean National Socioeconomic Characterization Survey (CASEN for its acronym in Spanish).

that the birth of the first child has strong and long-lasting effects on labor market outcomes of Chilean mothers, while fathers remain unaffected. Becoming a mother implies a sharp decline in women's labor supply, both in the extensive and intensive margins, and labor earnings. Importantly, these effects persist even 10 years after the birth of the first child. On average, women's employment declines by 22%, hours worked fall by 4%, and monthly labor earnings decrease by 28% over the first decade of motherhood.[5]

Importantly, we also assess whether there is a change in women's occupational structure toward informal jobs after the first child is born. We find that the fall in female employment is mainly explained by a decline in formal employment, leading to a 38% increase in the informality rate among working women. We then analyze whether these effects differ across education groups and find that the negative effects of motherhood on labor market outcomes are smaller for mothers with higher education attainment.

The empirical approach we use allows for comparisons with similar studies focused on more developed countries. Interestingly, our results indicate that the motherhood effect on employment in Chile (-22%) is much lower than in countries like the US and the UK (around -40%; Kleven et al. 2019a; Kuziemko et al. 2018), and also smaller than the average effect found by Berniell et al. (2020) for 29 developed—mostly European—economies (-25%). We hypothesize that the magnitude of the motherhood effect we obtain for Chile is very much associated with the existence and characteristics of informal job opportunities.

To further explore the connection between motherhood and labor market outcomes in Chile, we build a quantitative model economy and perform two exercises to study the effects of informal job opportunities in the labor market decisions of women who become mothers. The economy is a simple occupational choice model with individuals who are heterogeneous in their labor productivity levels. Upon becoming mothers, women have to choose between working or opting out of employment and dedicate more time to raising their children. Importantly, the model includes the possibility of both formal and informal employment, with the latter being characterized by more flexible working hours, lower wages, and weaker social protection. The model also features a technology to raise children that combines time, material resources, and the quality of social protection services. The first exercise indicates that the drop in mothers' employment (22%) would have been larger (30%) if the economy did not offer informal employment opportunities. The possibility of taking informal jobs allows some mothers——those with intermediate levels of labor productivity—to choose to earn some income by working short hours in the informal sector rather than directly leaving the labor force, a decision that they would have had to make if formal jobs—with fixed- and longer-hours schedules—were the only occupational choice available. The second exercise aims at assessing the role of the quality of the social protection services offered by formal and informal jobs. We conclude that rendering the former more attractive than the latter in terms of the quality of social protection provided would considerably reduce the impact of motherhood on labor informality. For instance, an improvement in health coverage derived from formal employment benefits or more generous parental leaves would reduce the negative impact of motherhood on formal employment.

Our work is related to and contributes to three strands of literature. First, we add to the literature that quantifies the effects of children on maternal labor outcomes, which has mainly concentrated on developed countries. Within this literature, our paper is closely related to those studies that focus on the impact of the first child, which generally find large and persistent effects on labor market outcomes of mothers (Cristia, 2008; Fernández-Kranz et al., 2013; Angelov et al., 2016; Lundborg et al., 2017; Kleven et al., 2019a,b; Kuziemko

[5] Although the literature generally refers to the impact of the birth of the first child on mothers' labor outcomes as *child penalty*, we prefer the more neutral *motherhood effect*.

et al., 2018).[6] Second, we contribute to the literature that studies gender differences in the demand for flexibility in the workplace, which shows that mothers place family amenities before pecuniary rewards, as they tend to choose more family-friendly and part-time jobs (Fernández-Kranz et al., 2013; Kleven et al., 2019b; Bertrand et al., 2010; Goldin, 2014; Goldin and Katz, 2016).[7] Third, we also contribute to the literature analyzing the interplay between fertility and mothers' labor market outcomes in developing countries (Cruces and Galiani, 2007; Agüero and Marks, 2011; Cáceres-Delpiano, 2012; Tortarolo, 2014; De Jong et al., 2017; Agüero et al., 2020).[8]

Additionally, and to the best of our knowledge, we are the first to establish a clear link between motherhood and female labor informality. Our results indicate that motherhood greatly contributes to the high informality rates among working women and thus to the gender gap in labor informality. Informal labor market opportunities allow for more flexible work arrangements in terms of working hours and work schedules, acting as a buffer that prevents some women from leaving the labor market after becoming mothers. However, settling for informal jobs implies resigning contributory social protection as well as possibly suffering a depreciation—or lack of accumulation—of some skills that are valuable in the labor market. These costs may in part explain the persistence of poor labor market outcomes of mothers even long after having their first child.

The rest of the paper is organized as follows. Section 2 describes the data set and the empirical strategy. Section 3 shows the main results, while Section 4 presents the model and its parameterization. Section 5 concludes.

2 | DATA AND EMPIRICAL STRATEGY

2.1 | Data

We use longitudinal data from the Social Protection Survey of Chile that is carried out by the Ministry of Labor and Social Protection. Since 2004, the survey has followed a sample of around 16,000 individuals ages 18 years and older who are representative of the Chilean population. This survey includes demographic and socioeconomic information at the individual and household levels. More importantly for our purposes, every wave has a labor history module in which respondents are asked to recall their labor market episodes during a reference period, typically between the current and last survey waves.[9]. This survey also includes information on the exact dates of children's births, which allows for studying the dynamics of labor outcomes for individuals who became parents between 2002 and 2015.

[6] One exception that finds no effects is Nix and Andresen (2019) for same-sex couples. Other studies look at the effect of family size or second and third child on labor market outcomes of mothers and generally find only short term and smaller effects (Agüero and Marks, 2011; Angrist and Evans, 1998; Bronars and Grogger, 1994; Cruces and Galiani, 2007; De Jong et al., 2017; Jacobsen et al., 1999; Rosenzweig and Wolpin, 1980; Tortarolo, 2014).

[7] Related works, like Mas and Pallais (2017) and Wiswall and Zafar (2017), find that women value flexibility or shorter working hours more than men.

[8] Among these works, the closest to ours is Cáceres-Delpiano (2012), which analyzes the effect of additional children (the intensive margin of fertility) using demography and health surveys' cross-sections for 40 countries from different developing regions (e.g., Sub Saharan Africa and Latin America, among others). He finds that the greatest drop in female employment as a consequence of a fertility shock (multiple births) occurs in jobs with a higher degree of informality, such as unpaid and occasional jobs, while he finds no effect on low-skilled self-employment.

[9] Given that the same individuals are contacted several times between 2002 and 2016, recall bias is mitigated in the Social Protection Survey. Around two thirds of our sample come from a report close to the interview (1 to 3 years)

Our goal is to estimate the effect of parenthood on labor outcomes based on an event study approach around the birth of the first child. We thus adopt sample restrictions to that aim. Our sample includes only those individuals we observe at least once before and once after becoming parents. We also define an age range that likely covers all fertile years, thus restricting the sample to mothers whose age at the birth of the first child is between 18 and 50 years old and fathers whose age at the birth of the first child is between 18 and 60 years old. These sample restrictions result in an unbalanced panel of 2,445 women and 1,924 men.

We define the event as the year (the 12-month period) that ends when the first child is born. Let τ represent the number of years relative to the event, then $\tau = 0$ covers the exact month of birth and the previous 11 months. Notice that although the event includes the year of conception, pregnancy, and birth, we refer to the event as the first child's year of birth, in line with the literature (Kleven et al., 2019b; Kuziemko et al., 2018). A negative (positive) value of τ refers to the pre-child (post-child) years. In our sample, τ runs from -4 (4 years before the event) to +10 (10 years after it).

We build a monthly panel with information on employment status, informal employment, hours worked per week, hourly wages, and monthly labor earnings for each individual in the sample.[10] Monthly labor earnings take the value 0 when the individual is not working in a given month. Informal employment is defined as those jobs in at least one of the following categories: unregistered jobs (i.e., jobs without social security contributions), jobs with no written employment contract, low-skilled (nonprofessional) self-employment, and temporary jobs. This measure follows the International Labour Organization guidelines (ILO, 2013).[11,12] Our sample covers labor market outcomes for the period 1997–2016. Appendix A provides more details about the construction of labor market trajectories based on the Social Protection Survey labor history modules and the exact definitions of the outcome variables.

The use of survey data has the advantage of allowing informal employment to be identified, which is the main interest of the paper. Given its nature, informal employment is not regularly captured in administrative labor registries, and surveys are the only source to study it, through the reported job attributes. However, the use of survey data comes at the cost of small sample sizes and lower quality in the measurement of other labor outcomes, in particular wages and hours worked.

[10] Hours worked, wages, and whether employment is informal refer to the main job.

[11] According to the 17th International Conference of Labour Statisticians, informal employment comprises "all remunerative work (i.e., both self-employment and wage employment) that is not registered, regulated or protected by existing legal or regulatory frameworks, as well as non-remunerative work undertaken in an income-producing enterprise. Informal workers do not have secure employment contracts, workers' benefits, social protection or workers' representation.

[12] Unpaid—mostly family—workers are considered informal workers and included in our data in the non contract category.

TABLE 1 Summary Statistics at $\tau = -1$

	Mothers	Fathers
Complete sample		
Year of birth	1987	1984
	(6.12)	(7.40)
Age at first child	23.15	25.09
	(4.71)	(5.79)
With some college education	0.38	0.35
	(0.49)	(0.48)
In the labor force	0.48	0.76
	(0.48)	(0.41)
Employed	0.42	0.71
	(0.46)	(0.42)
Monthly labor earnings (2015 Chilean pesos)	102774	221197
	(163181)	(216602)
Sample of workers		
Hours worked per week	42.01	46.20
	(11.44)	(9.71)
Hourly wage (2015 Chilean pesos)	1547	1781
	(1145)	(1339)
Informal worker	0.38	0.39
	(0.48)	(0.47)
Unregistered worker	0.22	0.20
	(0.40)	(0.39)
Temporary job	0.26	0.25
	(0.43)	(0.42)
No contract	0.19	0.15
	(0.38)	(0.35)
Non-professional self-employed	0.04	0.09
	(0.20)	(0.28)
No. of individuals in complete sample	2,455	1,924

Notes: The table shows the mean and the standard deviation (in parentheses) of sociodemographic and labor market variables for both mothers and fathers a one year before the first childbirth ($\tau = -1$). Monthly labor earnings take the value 0 when the individual is not working in a given month. See Appendix A for more details on the definition of each variable. The sample includes parents observed at least once before and at least once after childbirth. The sample is restricted to mothers whose age at first childbirth is between 18 and 50 years old and fathers whose age at first childbirth is between 18 and 60 years old. Calculations based on the Social Protection Survey.

Table 1 presents descriptive statistics of mothers and fathers in our sample in the year before they become parents.[13] Before the child is born, fathers are older than mothers, on average, but less likely to have at least some college education. Women have an employment rate 29 points lower than men's, work 4 hours less per week, and earn 13% less per hour.[14] Interestingly, labor informality is about 39% and does not differ by gender one year before the birth of the first child.

2.2 | Methodology

We estimate the impact of children on mothers' and fathers' labor outcomes based on an event study approach around the birth of the first child, as in Kleven et al. (2019b). The event study methodology allows overcoming the problem of endogeneity of fertility with the key identification assumption that the timing of the first child's birth is not correlated with labor outcomes, conditional on a child being born during the observation period and the included controls.[15] Kleven et al. (2019b) show that the event study approach we use performs well in identifying both short- and long-run effects of children compared to widely used alternative approaches, such as instrumental variables and differences-in-differences, that also tackle the problem of endogeneity of fertility.

Consider a panel of $i = 1, ...N$ individuals observed monthly for all or some $t = 1, ...T$ calendar years. We model outcome Y for individual i in calendar year t and month m, and at event time τ as

$$Y_{itm\tau} = \sum_{k \neq -1} \beta_k I(k = \tau) + \sum_j \gamma_j I(j = age_{itm\tau}) + \sum_y \alpha_y I(y = t) + \sum_s \alpha_s I(s = m) + \epsilon_{itm\tau}. \quad (1)$$

The first term of the equation consists of a set of event time dummies. The event time coefficients β_τ for $\tau \geqslant 0$ capture the post-child dynamic effects, i.e., the effects of parenthood on outcome Y for each event year τ after the birth of the first child.[16] Since the omitted category corresponds to $\tau = -1$, the coefficients measure the impact of children relative to the year before they are born. Coefficients β_τ for $\tau < 0$ capture pretrends, i.e., trends on outcomes prior to the birth of the child. Note that even though our outcomes are measured on a monthly basis, the event time is a yearly measure to allow for comparisons with the existing literature. The remaining terms in equation (1) include a full set of age-in-years dummies (second term), calendar year dummies (third term), and month dummies (fourth term). The full set of age dummies allows us to control nonparametrically for underlying life cycle trends, the year dummies to control nonparametrically for time trends such as the business cycle, and the month dummies to control nonparametrically for seasonality within the calendar year. We estimate this model for the sample of mothers and fathers separately.

As in Kleven et al. (2019b), we scale $\hat{\beta}_\tau$ to present our results as the percentage effect relative to the counterfactual outcome absent children implied by our estimated model.

[13] Table B.1 in Appendix B describes the post-child period.

[14] These gender gaps are similar to those found in other studies using a representative sample of the prime-age population. For example, Marchionni et al. (2019) show that labor force participation in Chile in 2015 was 26 percentage points lower for women than for men aged 25--54, while the hourly wage gap ($\frac{women}{men}$ -1) after controlling for individual characteristics was 16%.

[15] For a formal discussion about the identifying assumptions in an event study see Borusyak and Jaravel (2018) and Sun and Abraham (2020).

[16] Long-term effects also capture the impact of children born after the first child.

Formally, the percentage effect for each event time τ is given by $P_\tau = \frac{\hat{\beta}_\tau}{E[\tilde{Y}_{itm\tau}|\tau]}$, where $\tilde{Y}_{itm\tau}$ is the predicted outcome at event time τ from the equation (1) when subtracting the event time terms.[17] We estimate bootstrapped standard errors for the percentage effects, clustering at the individual level.

There are potential threats to our identification strategy. First, a discontinuity observed at event time $\tau = 0$—which we will interpret as the causal effect of children—could be, instead, the consequence of labor outcomes contemporaneously affecting fertility. For instance, a shock that negatively affects employment prospects may also make women decide to have a child. This would be a concern for identification only if women had perfect control over the timing of birth. However, this seems implausible in our setting. First, it is impossible to perfectly control the timing of conception—even for women who are planning their pregnancy. Second, a sizable number of pregnancies in our sample are not even likely to be the result of planning, given that 50% of births and 62% of pregnancies in South American countries are not intentional (Sedgh et al., 2014).[18]

A second threat has to do with the validity of the stronger assumptions required for identifying the long-run effects. While the identification of short-run effects relies on a smoothness assumption common to all event studies, the identification of long-run effects with an event study requires to assume that—after controlling for age and calendar year effects—the outcome variable in the counterfactual situation absent children does not follow any trend. The absence of pretrends would lend support to the latter. In our case, the estimated event study coefficients prior to the event year are generally close to zero (see the next section). This suggests that our long-term estimates are not simply a continuation of preexisting trends. Moreover, in those cases when there is a slight pretrend, the sign is the opposite to that of the corresponding after-child coefficients, which, if anything, would bias our estimates downward. Furthermore, if unobservable trends in the absence of children are still a concern, we can implicitly rely on fathers as a control group to provide further credibility for our estimated long-run effects as long as their labor outcomes are not affected by the arrival of children—which is the case, as we will show later on.

Another possible concern for our identification strategy is the use of an unbalanced panel, i.e., the fact that we do not observe the same individuals in each of the 15 event time periods. To rule out having our results driven by changes in the composition of the sample, we provide evidence that predetermined characteristics of mothers and fathers—for instance, childhood socioeconomic status and parents' education—do not change across the event time periods. We show that although the panel is unbalanced, the predetermined characteristics: 1) are smooth around the event, 2) are very stable across event time, and 3) have distributions that are very similar for fathers and mothers. The first finding is relevant for identifying the short-run effects, while the second and third findings are relevant for long-run impacts. We show this analysis in Appendix C.[19]

Finally, for the analysis of child-impacts on hourly wages, hours worked, and informal employment, we restrict the sample to employed individuals. A potential concern is that the estimates may also capture selection effects in the case that motherhood affects mothers'

[17] Specifically, we define $\tilde{Y}_{itm\tau} = \sum_j \hat{\gamma}_j I(j = age_{itm\tau}) + \sum_y \hat{\alpha}_y I(y = t) + \sum_s \hat{\alpha}_s I(s = m)$. To compute $E[\tilde{Y}_{itm\tau}|\tau]$ we average $\tilde{Y}_{itm\tau}$ across individuals, conditional on τ.

[18] On top of that, even if the timing of the birth of the child were perfectly manipulable, previous literature for developing countries (Chatterjee and Vogl, 2018) shows that fertility is procyclical in the short run, i.e., that women tend to have children when employment prospects are better. Hence, because we find negative child effects on mother's employment (see the next section), our estimates would be a lower bound of the true effect of children. For developed countries see for instance Lindo (2010), Black et al. (2013), Lovenheim and Mumford (2013) and Schaller (2016).

[19] We thank an anonymous reviewer for this suggestion.

employment. However, given that the existing evidence supports a positive selection into employment (for a review of the literature see Blau and Kahn (2017)), our estimates would represent a lower bound of the true impact of the first child on these labor market outcomes.

3 | THE MOTHERHOOD EFFECTS ON LABOR MARKET OUTCOMES IN CHILE

This section presents the results from separately estimating Equation (1) for mothers and fathers. For simplicity, we use figures to summarize the results but report the point estimates for the event time coefficients ($\hat{\beta}_\tau$) in Tables B.2 and B.3 in Appendix B. The figures in this section show the estimates of P_τ, i.e., the scaled event time coefficients explained in Section 2.2. We first focus on discussing the impact of the birth of the first child on employment, working hours, and labor earnings. Then, we investigate how parenthood impacts labor informality. Finally, we study whether these impacts vary with education.

Figure 1 shows the separate trajectories of employment (1a), weekly hours worked (1b), hourly wages (1c), and monthly labor earnings (1d) across event time for fathers and mothers. A first aspect to highlight is that labor trajectories of mothers, but not of fathers, change drastically with the birth of the first child, opening a large gap between women and men that, importantly, persists in the long term. For most of these outcomes, the evolution for mothers and fathers is similar in the pre-child period, but mothers' trajectories start diverging around the time of conception—i.e., in $\tau = 0$ and up to one year after childbirth—and then remain relatively stable.[20]

[20] The literature on motherhood effects using event studies usually finds that the adjustments begin some months before birth, around the time of conception (Kleven et al., 2019b and Kuziemko et al., 2018). In fact, in an alternative specification in which we define the event time on a monthly basis, where $\tau = 0$ is the exact month of birth of the first child, we find that the adjustment in labor outcomes trajectories starts around conception. Defining the event time as a yearly measure, as we do in equation (1), this adjustment is captured by event time zero.

(a) Employment Rates

(b) Hours Worked

(c) Hourly Wages

(d) Labor Earnings

FIGURE 1 Impacts on Labor Supply and Labor Earnings. *Notes:* These figures show, for men and women separately, the estimated impacts of children on employment rates (Figure 1a), hours worked per week (Figure 1b), hourly wages (Figure 1c), and monthly labor earnings (Figure 1d). The effects on hours worked and hourly wages are estimated conditional on being employed. The figures report the scaled coefficients P_τ as explained in Section 2.2. Since the omitted category is $\tau = -1$, the scaled coefficients measure the impact of children as a percentage of the counterfactual outcome relative to the year before the first childbirth. Controls include year, month, and age-in-years fixed effects. Data cover the period 1997--2016, and the sample includes parents observed at least once before and at least once after childbirth. The sample is restricted to mothers whose age at first childbirth is between 18 and 50 years old and fathers whose age at first childbirth is between 18 and 60 years old. The figures also show the bootstrapped 90% confidence intervals for the scaled results using 500 replications and clustering at the individual level. Calculations based on the Social Protection Survey.

Taking the average effect from event time $\tau = 1$ to $\tau = 10$, mothers' employment declines by 22%, hours worked fall by 4%, and labor earnings decrease by 28%.[21,22] While the effects on employment and working hours are large and statistically significant, the effect on women's hourly wage is mild and not significant.[23] Therefore, the main force behind the

[21] Although employment trajectories exhibit positive pretrends, the estimated coefficients are not statistically significant for mothers before $\tau = 0$. In any case, pretrends of men and women are parallel, and while the positive trend for men continues for a couple of years after becoming fathers, for women there is a drastic break that coincides with the year of birth of the first child. As discussed in Section 2.2, this suggests that if we were willing to think of fathers as the control group for mothers, our results underestimate the impact of motherhood on women's employment.

[22] Women's labor force participation follows a similar trajectory to that of employment, falling 15% after the birth of the first child. See Figure B.1 in Appendix B.

[23] As discussed in Section 2.2, there is strong evidence of positive selection into employment upon motherhood.

sharp and persistent drop in women's monthly labor earnings is the strong negative effect of motherhood on labor supply, in both the extensive and intensive margins.

We can compare our results for Chile with those of more developed economies. Using the same methodology and retrospective data from SHARELIFE (The Survey of Health, Ageing and Retirement in Europe), Berniell et al. (2020) find that the average negative effect of motherhood on mothers' employment across 29 developed—mostly European—countries is 25%, larger than the 22% reduction in mothers' employment that we find in Chile. Furthermore, the negative impact of motherhood on women's employment in Chile is similar to that in Northern Europe (Denmark, Finland, and Sweden), lower than the 29% effect in southern countries (Cyprus, Greece, Israel, Italy, Portugal, and Spain), and much lower than the 39% effect in Western Europe (Austria, Belgium, France, Germany, Ireland, Luxembourg, The Netherlands, and Switzerland). Clearly, Chile differs from these more developed countries in several dimensions, including the relevance of informal employment as well as the quality of its social protection system.[24] In the next subsection and in Section 4, we explore whether the magnitude of the motherhood effect on employment that we obtain for Chile is related to them.

3.1 | The Motherhood Effect on Labor Informality

There is a growing body of evidence showing that women value job characteristics that favor work-life balance (Bertrand et al., 2010; Goldin, 2014; Goldin and Katz, 2016; Mas and Pallais, 2017; Wiswall and Zafar, 2017). This literature focuses on developed countries, where family-friendly occupations are found in specific sectors, such as the public sector, or flexibility can be achieved through part-time work arrangements (Kleven et al., 2019b).[25] We claim that in less developed countries, on the other hand, the informal labor market provides other ways to achieve flexibility. Indeed, the existence of a large informal labor market is a key way in which Chile differs from more developed countries. Considering that informal jobs include non-registered jobs, jobs with no written contract of employment (including unpaid jobs), low-skilled self-employment, and temporary jobs, 40% of prime-age Chilean workers are informal in our period of analysis. The incidence of the phenomenon

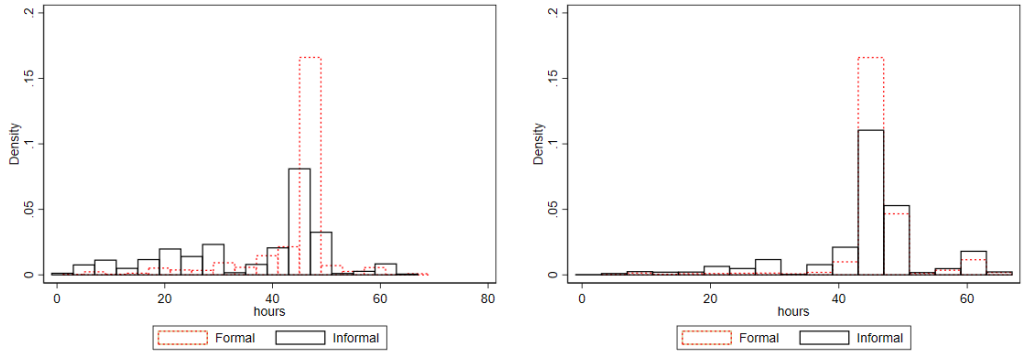
This type of selection may be behind the small and not significant effect of motherhood on hourly wages in Figure 1c, a channel that we will analyze further in Section 3.2 and Section 4. Additionally, attenuation bias due to measurement error could also explain the nonsignificance of our results. Like in most studies using survey data, hourly wages very likely suffer from measurement error given that both earnings and hours worked may be imperfectly captured, as discussed by Fernández-Kranz et al. (2013). In our case, the Social Protection Survey collects a single measure of average earnings and hours for the entire employment spell, from which we calculate hourly wages as the ratio between the former and the latter, as explained in Appendix A.

[24] For instance, the effect of motherhood on employment for Chile is similar to that of Denmark (Kleven et al., 2019b; Berniell et al., 2020), while family policies—job-protected leave and public provision of child care—are much more generous in the latter. Since 2002, Danish parents have been offered 18 weeks of maternity leave and 32 weeks of shared parental leave combined with publicly subsidized universal child care services. In contrast, maternity leave in Chile was extended from 12 to 24 weeks only in 2011, in a context where the main alternative to maternal care is informal child care arrangements, since formal child care services cover only a small fraction (18%) of children between 0 and 2 years old. Regarding this relatively recent expansion of the maternity leave in Chile, Albagli and Rau (2018) find that it caused an increase in the probability that mothers remain employed after maternity leave. In fact, when we replicate our analysis restricting the sample to women who became mothers after the expansion of benefits (2012 onward), the estimated motherhood effects fall. Results available upon request.

[25] The negative effect of motherhood on hours worked that we find in Chile captures switches to part-time jobs, which are important for women with children. If we define part-time employment as working less than 30 hours a week, the share of employed women working in part-time jobs increases by 23% after the first child is born.

is somewhat higher among women (41% of female workers are informal), but the gender gap ($\frac{women}{men} - 1$) widens considerably for some of the informality subcategories that we consider. For instance, 15.7% of Chilean female workers have non-registered jobs, and 14.8% do not have a written employment contract, while the corresponding percentages among male workers are 4.9 and 4.3 percentage points lower, respectively (i.e., gender gaps of 45% and 41%, respectively).[26]

As we argued before, informal jobs may offer more flexible arrangements in terms of working hours, which could help balance family life and work. For instance, the Chilean formal labor market basically offers only full-time jobs, as part-time jobs are very rare (Montero and Rau, 2015). Figure 2 shows that, in our sample, the distribution of hours worked per week before the birth of the first child is bunched around 45 hours for men and women in formal jobs, while informal jobs seem to offer more opportunities for adjusting working hours, as the distribution of hours per week is more disperse, especially for women.



(a) Women (b) Men

FIGURE 2 Distribution of Hours Worked per Week Before First Childbirth, Formal and Informal Workers by Gender. *Source:* Own calculations based on the Social Protection Survey.

Next, we study how the informality rate, i.e., the share of informal jobs in total employment, changes with the birth of the first child. Figure 3 shows the gender-specific impact of the birth of the first child on labor informality. Conditional on being employed, after the first child is born, the probability of having an informal job increases for mothers and not fathers. Taking the average effect from event time $\tau = 1$ to $\tau = 5$, the informality rate among working women increases 24% upon motherhood. The average effect over the whole post-child period is 38%, although estimates become less precise for the last event periods. This novel result indicates that motherhood notably contributes to the high levels of labor informality among working women and thus to the gender gap in labor informality.

[26] Own calculations based on the CASEN for the 1996–2016 period.

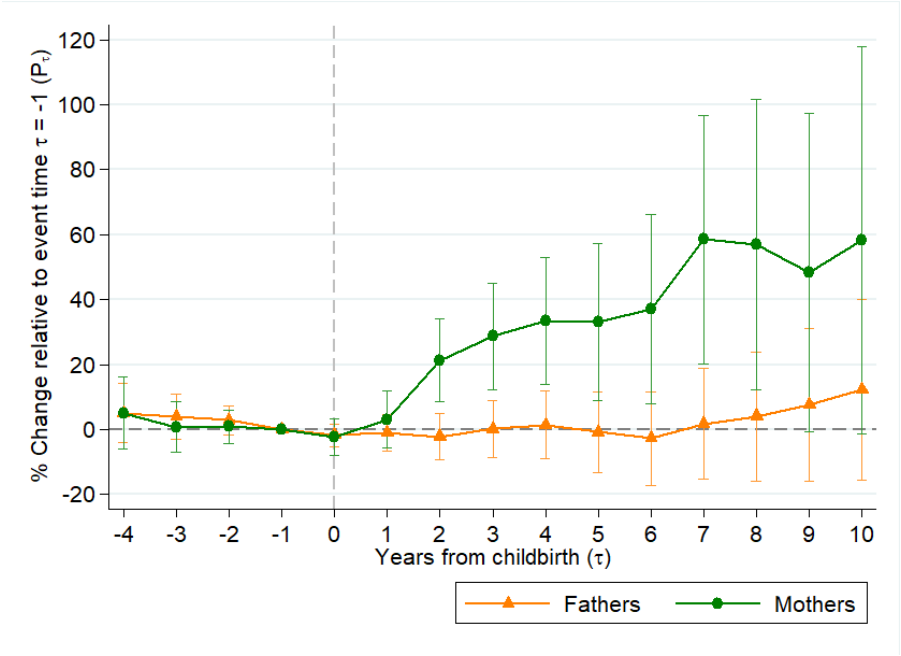


FIGURE 3 Impacts on Labor Informality. *Notes:* This figure shows, for men and women separately, the estimated impact of children on the probability of having an informal job conditional on being employed. Informal jobs include non-registered jobs, temporary jobs, jobs with no explicit written contract, and low-skilled self-employment. The figure reports the scaled coefficients P_τ as explained in Section 2.2. Since the omitted category is $\tau = -1$, the scaled coefficients measure the impact of children as a percentage of the counterfactual outcome relative to the year before the first childbirth. Controls include year, month, and age-in-years fixed effects. Data cover the period 1997--2016, and the sample includes parents observed at least once before and at least once after childbirth. The sample is restricted to mothers whose age at first childbirth is between 18 and 50 years old and fathers whose age at first childbirth is between 18 and 60 years old. The figure also shows the bootstrapped 90% confidence intervals for the scaled results using 500 replications and clustering at the individual level. Calculations based on the Social Protection Survey.

Additionally, using the alternative definitions of labor informality available in our data, we are able to show that the rise in informality in Figure 3 is not driven by changes that are specific to only some subcategories of informal jobs. On the contrary, Figure 4 shows that all definitions of informal labor—non-registered jobs (4a), temporary jobs (4b), jobs with no written contract (4c), and low-skilled self-employment (4d)—exhibit a similar pattern after childbirth. In other words, motherhood causes an increase in working women's informality rate regardless of the definition we adopt.

(a) Non-Registered Job

(b) Temporary Job

(c) Job with No Contract

(d) Self-Employment

FIGURE 4 Impacts on Labor Informality, Subcategories. *Notes:* These figures show, for men and women separately, the estimated impact of children on the probability of having an informal job conditional on being employed for each alternative definition of informal job: non-registered jobs (Figure 4a), temporary jobs (Figure 4b), jobs with no explicit written contract (Figure 4c), and low-skilled self-employment (Figure 4d). The figures report the scaled coefficients P_τ as explained in Section 2.2. Since the omitted category is $\tau = -1$, the scaled coefficients measure the impact of children as a percentage of the counterfactual outcome relative to the year before the first childbirth. Controls include year, month, and age-in-years fixed effects. Data cover the period 1997–2016, and the sample includes parents observed at least once before and at least once after childbirth. The sample is restricted to mothers whose age at first childbirth is between 18 and 50 years old and fathers whose age at first childbirth is between 18 and 60 years old. The figures also show the 90% confidence intervals for the scaled results clustering at the individual level. Calculations based on the Social Protection Survey.

Figure 5 shows the evolution of formal and informal female employment as a percentage of all women in the sample, unlike Figures 3 and 4 that were conditional on being employed. It is interesting to note that between $\tau = 0$ and $\tau = 1$ the fall in formal and informal jobs is similar, but from that moment on, informal employment quickly returns to its pre-child levels while formal employment never recovers. In other words, the medium- and long-term effect of motherhood on employment shown in Figure 1a is driven by the contraction of formal employment. Figure 5 also offers suggestive evidence that the adjustment of informal employment is relatively rapid. As has been shown in the context of macroeconomic shocks, workers' ability to switch from the formal to the informal labor market attenuates the negative impact of such shocks on employment (Dix-Carneiro and Kovak, 2017; Ulyssea and Ponczek, 2018).

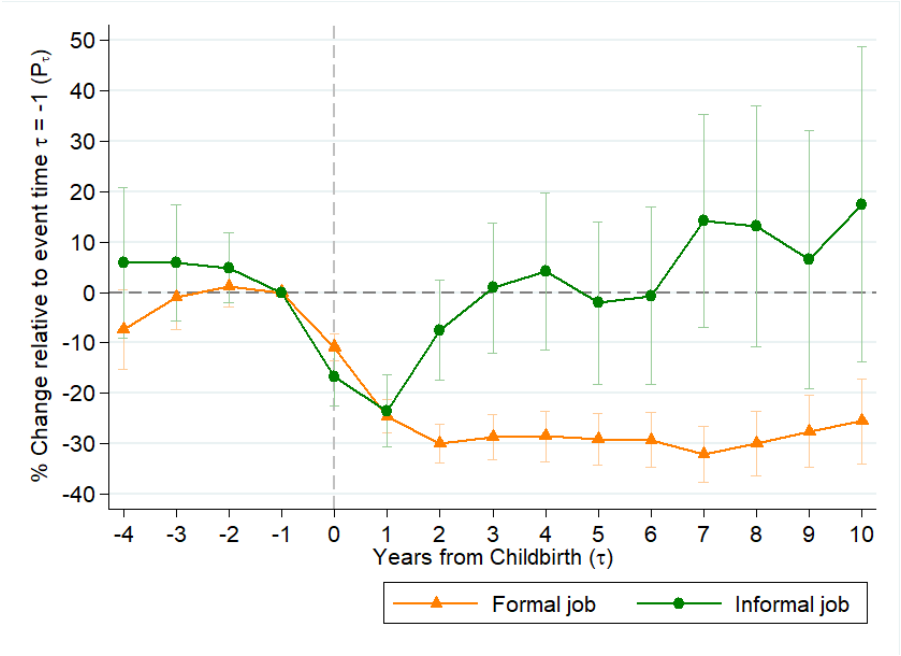


FIGURE 5 Impacts on Mothers' Formal and Informal Employment, Unconditional on Being Employed *Notes:* This figure shows the estimated impact of children on mothers' probability of having a formal or informal job. Informal jobs include non-registered jobs, temporary jobs, jobs with no explicit written contract, and low-skilled self-employment. The figure reports the scaled coefficients P_τ as explained in Section 2.2. Since the omitted category is $\tau = -1$, the scaled coefficients measure the impact of children as a percentage of the counterfactual outcome relative to the year before the first childbirth. Controls include year, month, and age-in-years fixed effects. Data cover the period 1997–2016, and the sample includes mothers observed at least once before and at least once after childbirth, and whose age at first childbirth is between 18 and 50 years old. The figure also shows the bootstrapped 90% confidence intervals for the scaled results using 500 replications and clustering at the individual level. Calculations based on the Social Protection Survey.

These results suggest that the flexibility offered by informal jobs may prevent some women from leaving the labor market after having their first child. In other words, it seems that labor informality acts as a buffer against the negative effect of motherhood on female employment in Chile. But, achieving flexibility through informal employment imposes high costs on women. Informal jobs offer poorer social protection and lower wages than formal jobs, and informal workers usually suffer a depreciation—or lack of accumulation—of some skills that are valuable in the labor market, which may help to explain the persistence of poor labor market outcomes of mothers even long after having had their first child.

3.2 | Heterogeneous Impacts by Education Level

Next, we analyze motherhood's impacts on women with different education levels, which in this context we think of as a dimension that proxies unobserved or potential labor productivity. Figure 6 reports the trajectories of different labor outcomes from separate estimations of Equation (1) for women with low education levels (never went to college) and high education levels (at least some college education).[27] The main result is that motherhood has a lower impact on women with higher levels of education. Taking the average effect from event time $\tau = 1$ to $\tau = 10$, Figure 6a shows that while employment decreases 29%

[27] Descriptive statistics for each education group are reported in Table B.1 in Appendix B.

for less-educated women, it falls 10% for the group of more-educated women. Figure 6b shows that, conditional on being employed, less-educated women work 7.5% fewer hours relative to the pre-child year. In contrast, hours worked do not change after motherhood for employed women with high education levels, as is the case for fathers.

Similarly, Figure 6c shows that, conditional on being employed, the effect of motherhood on the probability of having an informal job is large (about 39% taking the average from $\tau = 1$ to $\tau = 5$) and persistent for the less-educated group of women, while for the more-educated group, the effect is never statistically significant. Last, Figure 6d shows the heterogeneous responses of labor earnings for the two education groups. After motherhood, both women with low and high education levels experience a decrease in their earnings, but, again, the effects are smaller the higher the education level (-32% and -18%, respectively).

(a) Employment Rates

(b) Hours Worked

(c) Informality Rate

(d) Labor Earnings

FIGURE 6 Impacts by Education. *Notes:* These figures show the estimated impacts of having a child for mothers with high education (some college) and low education (never went to college) levels on employment rates (Figure 6a), hours worked per week (Figure 6b), labor informality (Figure 6c), and monthly labor earnings (Figure 6d). The effects on hours worked and labor informality are estimated conditional on being employed. The figures report the scaled coefficients P_τ as explained in Section 2.2. Since the omitted category is $\tau = -1$, the scaled coefficients measure the impact of having a child as a percentage of the counterfactual outcome relative to the year before the first childbirth. Controls include year, month, and age-in-years fixed effects. Data cover the period 1997–2016, and the sample includes mothers observed at least once before and at least once after childbirth, and whose age at first childbirth is between 18 and 50 years old. The figures also show the bootstrapped 90% confidence intervals for the scaled results using 500 replications and clustering at the individual level. Calculations based on the Social Protection Survey.

To sum up, according to our results motherhood has a larger negative impact on out-

comes for the group of less educated women. They face higher probabilities of exiting the labor force, reducing working hours or taking up informal jobs upon motherhood than women with at least some college education. Different mechanisms may be behind these differential responses. In the next section we build and parameterize a model economy that will allow us to explore the key mechanisms through which the characteristics of formal and informal jobs interplay with the labor market decisions of mothers with different productivity or educational levels. These mechanisms are related to opportunity costs of changing occupations, which vary for women with different productivity levels. The mechanisms are also related to the need of having flexible working hours and good quality social protection. In a developing country like Chile, while flexibility in hours is found in the informal sector, higher skill premia and better quality social protection are characteristics found in formal employment.

4 | THE MODEL

4.1 | Main Assumptions

To illustrate the key forces that connect having children with labor market outcomes of mothers in the presence of informal job opportunities, we build a simple model of occupational choice that includes both an extensive and an intensive margin of labor supply and where occupations differ along characteristics related to the technology to raise children. We model two types of occupations, which together represent the relevant labor market options of women in developing countries. The first occupation is formal salaried work, and the second is informal employment.

As we discussed before, formal and informal work differ in several dimensions, which we try to recreate with our modeling choices. First, we include the well-documented earnings gap between these two occupations (Tornarolli et al., 2014). Second, we model informal jobs as jobs that offer a more flexible time-schedule than formal salaried work. This assumption is backed up by Figure 2, and also by the results obtained from official household and labor surveys for many countries in Latin America.[28] Last, since formal and informal workers in developing countries are entitled to different qualities of social protection services (contributory versus non-contributory social protection), we include this feature in the model by entitling formal workers to a higher-quality bundle of such services. Additionally, in our model, the quality of social protection services affects the production of child quality, from which parents derive utility.

Although labor supply and fertility decisions are dynamic in nature, we choose a one-period model economy not only for its simplicity but also because when credit and savings constraints are important—as is the case in most developing countries—both labor and fertility decisions become more dependent on current earnings. Additionally, and according to the evidence presented in Lagakos et al. (2018), since life-cycle wage growth is considerably slower in poorer countries, dynamic considerations in occupational choices are likely to be less important there.

For the sake of simplicity, and according to the null impacts observed for fathers in the Chilean case, we model only women. Since in our empirical analysis all individuals have children, we consider fertility as exogenous. Last, given that our main focus is the effect of the first child, we abstract from modeling aspects related to the number of children.

[28] These surveys indicate that, on average, informal workers work around 20% fewer hours a week than their formal counterparts (LABLAC, 2018).

4.2 | Model Setup

In this simple one-period model, individuals (women) differ in their levels of ability z. These ability levels are distributed according to a function $\Gamma(z)$, and higher levels are associated with higher labor productivity. Heterogeneity in abilities can also be interpreted as differences in education levels across individuals. All individuals are endowed with one unit of time and an amount of nonlabor income, Y.[29] Fertility is exogenous, and every woman has a child.

Mothers face a typical consumption-leisure trade-off and make decisions regarding occupational choices and the investment of resources to produce child quality. Occupational choices result in one of three possible outcomes: not employed (NE), employed in a formal job (F), or employed in an informal job (I).[30] For every unit of time devoted to work, workers in occupations $j = F$ and $j = I$ generate labor earnings according to their ability levels, $\omega_j(z) = w_j z$, where $w_F > w_I$. Formal jobs offer less flexible time schedules than informal employment, since $t_F = \overline{t_F}$ is fixed (full-time jobs), while the exact amount of time devoted to informal employment can be chosen from a continuum of alternatives ($0 < t_I < 1$).

The utility of each individual is a function of her own consumption (c_m) and leisure (l), and of child quality (q), which are weighted in a Cobb-Douglas specification by ϕ_c, ϕ_l, and ϕ_q, respectively. The child quality production process uses three types of inputs: time (t_q), monetary inputs (c_q), and a bundle of social protection services (s_i). Such social protection services are key for child development, and they include paid parental leaves, paid vacations, health insurance, as well as other child-related benefits. In this model economy, s_i can be of two qualities: high quality, s_H, to which only individuals in formal employment are entitled to, or low quality, s_L, which is the default option for those not working or working in informal employment. Child quality is produced through a Cobb-Douglas function that combines these three inputs and takes the form $q = c_q^{\alpha} t_q^{\beta} s_i^{1-\alpha-\beta}$.[31]

The value functions of mothers, $V^j(z)$, result from the constrained maximization problems for each one of the three available occupational statuses: not employed ($j = NE$), informal worker ($j = I$), and formal worker ($j = F$). We denote with $W^j(z)$ the values for women without children. The occupational choices of mothers of ability z result from comparing $V^{NE}(z)$, $V^I(z)$, and $V^F(z)$. Similarly, to make their occupational decisions childless women of ability z compare the values $W^{NE}(z)$, $W^I(z)$, and $W^F(z)$. As shown in section 4.3, we can construct a quantitative version of this model economy in which we can further characterize the cutoffs that determine which z-types will end up choosing each one of the three possible occupations.

4.3 | A Parameterized Version of the Model Economy

In this section, we briefly discuss how we assign parameter values to endowments, preferences, and technology parameters in the benchmark economy. We then comment on the implications derived from this simple quantitative version of the model economy, which are all in terms of variables of interest for the main questions of this paper.

In this quantitative exercise, we set several parameters a priori and calibrate the remaining four parameters to produce an equal number of key model moments that are similar to the corresponding moments obtained from the data (targets). Table D.2.1 in Appendix D

[29] This amount of income can be interpreted as the earnings of other individuals in the household.

[30] In this model economy, since we do not model unemployment, not working coincides with being out of the labor force.

[31] Modeling choices regarding preferences and technology to produce child quality are standard in the literature analyzing the links between fertility and labor market outcomes of parents. See for instance Del Boca et al. (2014) or Heath (2017).

lists the set of parameters that we choose to set a priori and the calibrated parameter values.

First, we model education types as a continuum, $z \in [0,1]$, and each individual gets an initial draw for this type from a uniform distribution $\Gamma(z) = U(0,1)$. Since we set the length of a day (24 hours) to one, the length of a regular workday in the formal sector is $\overline{t_F} = 1/3$ (8 hours). We next set the formal sector wage premium per hour (adjusted by skill level) of work to 20%, so the wage in the formal sector is $w_F = 1.20 w_I$. This wage premium was obtained from a standard Mincer regression using the same working sample that we use in previous sections.[32]

For preference and technology parameters, we rely on Del Boca et al. (2014). According to their estimation results, and after normalizing $\phi_q = 1$, we set the value for $\phi_c = 0.728$. Since we model only mothers, and the estimates for the weights of leisure in Del Boca et al. (2014) are estimated separately for fathers and mothers, we leave ϕ_l as one of the parameters to be calibrated.[33] Regarding technology parameters, we use the results in Del Boca et al. (2014) to construct a ratio between α and β. According to their results, this ratio is about $\frac{\alpha}{\beta} = 0.2$ (Table D.2.1).

TABLE 2 Data and Model Moments for Calibrated Parameters

Parameters	Data moments (%)	Model moments (%)
Employment rate of mothers (Y)	53	53
Change in the employment rate of women (β)	-22	-22
Labor informality rate of mothers (ϕ_l)	29	28
Change in labor informality rate of women (s_L/s_H)	38	38

We choose four moments from the data to proceed with the calibration of the four remaining parameters, and all calibrated values can be found in Table D.2.1 in Appendix D. As shown in Table 2, data and model moments are quite close.[34] We use the employment rate of mothers (53%, average value in our sample for periods $1 \leqslant \tau \leqslant 10$), a target very closely related to the unearned income, to pin down the value $Y = 2.925$. We use the change in the employment rate of women after motherhood (-22%, average value in for periods $1 \leqslant \tau \leqslant 10$ in Figure 1a) as a moment that is very much conditioned by the contribution of parental time in the production of child quality, and we obtain a value for the parameter $\beta = 0.7475$. Additionally, we use the rate of labor informality of mothers (29%, average value in our sample for periods $1 \leqslant \tau \leqslant 10$) to calibrate the relative weight of leisure in the utility function, obtaining a value of $\phi_l = 0.926$. Last, we use the change in this rate of labor informality of women after they become mothers (38%, average value in for periods $1 \leqslant \tau \leqslant 10$ in Figure 3) to calibrate the parameter quantifying the relative quality of social protection services, s_L/s_H, and obtain a value of 0.43.

Figure 7 shows occupational choices in the benchmark economy, both for women with and without children. The cutoffs on the support of z that define who chooses each type of occupation are $\hat{z}^I_{NE}$ for going from not employed, $j = NE$, to informal work, $j = I$, and $\hat{z}^F_I$ for going from $j = I$ to $j = F$.

The model is able to produce a number of other results that are comparable to the data and have not been used in the calibration procedure. For instance, the share of nonlabor

[32] Notice that the absolute values of s_i and w_j are not relevant by themselves, since what matters for decisions are the ratios w_I/w_F and s_L/s_H.

[33] The estimates in Del Boca et al. (2014) for the parameters related to utility derived from child quality and private consumption are: ϕ_c=0.254 and ϕ_q=0.353.

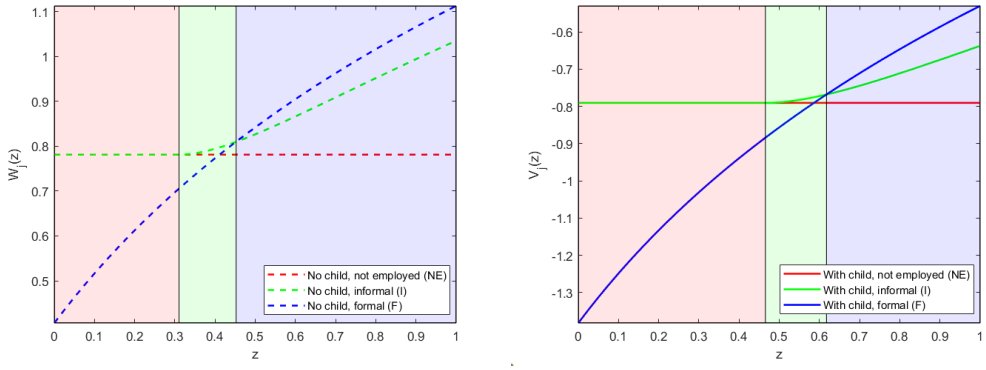
[34] All values for the data moments were obtained from the same sample of mothers (before and after becoming mothers, correspondingly) included in the empirical analysis of Section 3.

income in the income of mothers is 69% in the data and 76% in the model.[35] Additionally, the model produces an 5% drop in the hourly wage and a 20% drop in labor earnings, both of which are in line with the results presented in Figure 1c and Figure 1d, respectively. Notice, however, that the hourly wage decrease in Figure 1c is not statistically significant.

An interesting result of the model economy is that it produces an order of cutoffs for occupations that is consistent with the average education levels observed in the data for the three occupations: those who are not employed are, on average, less educated than informal workers, and informal workers are, on average, less educated than formal workers.[36] More importantly, the model can also reproduce the heterogeneous impacts of motherhood across education groups, which were described in section 3.2. For instance, comparing Figures 7a and 7b, it can be observed that the greatest costs of motherhood are borne by less educated mothers. As a consequence of motherhood, while higher-skilled mothers, i.e., those with higher values for z, do not change their occupational decisions and basically remain in formal employment, middle-skilled mothers are those that are more likely to switch occupations compared to their situation before childbirth. Such changes occur both along the intensive margin of the labor supply (for those women that switch from the formal to the informal sector, in which they are able to work shorter hours) as in the extensive margin, for those (relatively less skilled) women who directly opt out of the labor market. Conversely, very low-skilled mothers remain without employment after childbirth, as they were before this event took place. Therefore, all changes in the occupational status of women after becoming mothers are perfectly compatible with the heterogeneous effects of motherhood regarding employment, hours worked, labor earnings, and informality rate for low- and high-educated women that were presented in Figure 6. Additionally, notice that these results imply a sort of positive selection in terms of which women remained attached to the labor market as well as to formal employment, a result that can help to explain why the hourly wage drop is rather small and not statistically significant (see Figure 1c).

[35] This nonlabor income of mothers obtained from the data includes the earnings of the rest of the household members, which can be thought to be represented by parameter Y in our model economy.

[36] This conclusion is in part due to modeling choices and in part due to the parameterization that resembles the Chilean economy. First notice that the shapes of the values for occupations NE, F and I in Figure 7 clearly differ, and this is a result of the following: the value of NE does not change with z and the value for informal workers is first flat and then it becomes strictly convex starting from the cutoff over z for choosing informal work (which is associated to the minimum level of skill needed to choose working a positive amount of time, $t_I > 0$), while the value of formal workers is strictly concave in z. For any economy with a positive mass of individuals choosing each one of the three available occupations (NE, I, and F), this result holds true because only the least able women find more profitable to stay out of labor (since the value for NE does not change with z, the least able should be those choosing NE) and it also requires that the skill premium in the formal sector is sufficiently higher than in the informal sector (the strictly convex line in Figure 7 should not be too steep for high values of z, in other words, individuals with high skills do not revert their decisions of becoming formal workers).



(a) No Child (b) With Child

FIGURE 7 Values and Cutoffs for Occupational Choices of Women with and without A Child in the Benchmark Economy.

We use this parameterized model economy to perform two exercises to illustrate the mechanisms under which the characteristics of informal employment in Chile affect mothers' key labor market outcomes. The first exercise reduces the set of available occupational statuses to just not working or formal work. While the first row in Table 3 presents changes in employment (-22%) and informality rates (38%) after motherhood in the benchmark (calibrated) economy, the second row shows the model-implied drop in the employment rate for the economy without informal job opportunities (30%). This result indicates that the informal sector buffers the reduction in mothers' employment rate. Moreover, its quantitative contribution is considerable: in the absence of an informal sector, the model predicts that the drop in the employment rate would be 8 percentage points (or 36%) larger. Moreover, its quantitative contribution is considerable given that our empirical analysis shows a 22% drop in the employment rate, 8 percentage points (or 36%) lower than what the model economy predicts in the absence of an informal sector.

We can compare these magnitudes in the motherhood effect on employment to those obtained in (Berniell et al., 2020) for 29 developed economies. This work found an average drop across these countries of about 25% in the employment rate during the first 10 years after motherhood. Berniell et al. (2020) also find that the motherhood effect is smaller for countries with longer job-protected leave periods after motherhood, a policy dimension that in our model economy without an informal sector is associated with a lower value in the ratio $\frac{s_L}{s_H}$.[37] We produce an exercise in which we recalibrate the value of this ratio to obtain a 25% decrease in the economy without the possibility of informal employment. We obtain a value for $\frac{s_L}{s_H}$ of 0.35, which is lower than our calibrated value for the benchmark economy (0.43, see Table D.2.1). We take this value to produce an additional exercise to resemble the case of Chile but with a (relatively) higher quality of social protection in its formal sector. The results are shown in Table 3, and while the decreased employment rate is the same as in our benchmark economy, the effect of motherhood on labor informality is virtually zero.[38] This occurs because making the bundle of formal-sector social services relatively more generous attracts some women to continue working longer—but better paid—hours in exchange for being entitled to a higher quality of social protection services, which they value as an input to produce child quality.

All of these results taken together indicate that the motherhood effect on labor market

[37] That is, the lower the ratio $\frac{s_L}{s_H}$, the more generous the bundle of social protection services for (formal) working mothers.

[38] The exact value we obtain for the change in the informality rate is -0.05%.

outcomes is related to both the possibility of arranging more flexible work schedules than those required by formal employment and the relatively low quality of formal-sector social protection offered. Without informal job opportunities but with a formal sector that keeps offering relatively low-quality social protection for families, we could expect a larger drop in women's employment rate after they become mothers (30% compared to the 22% effect we find for Chile). But if the quality of social protection in the formal sector were increased, even when allowing for the existence of an informal sector that offers flexibility in hours, the increase in labor informality as a motherhood penalty would be notably tempered (in our case, it would be close to zero).[39]

TABLE 3 Changes in Labor Market Outcomes of Women that Become Mothers, in Four Versions of the Model Economy

Variables	Change in employment rate (%)	Change in labor informality (%)
Benchmark economy	-22	38
Economy without informal sector	-30	N/A
Economy without informal sector and with a lower $\frac{s_L}{s_H}$	-25	N/A
Economy with informal sector and with a lower $\frac{s_L}{s_H}$	-22	0

5 | CONCLUSION

Despite substantial improvements over the last century, large gender gaps are still present in domains such as labor supply and earnings. Motherhood stands out as one of the key factors driving these gaps. However, studies identifying the causal effect of children on mothers' labor outcomes have mostly focused on developed countries. Those results may not be extrapolated to developing countries, where labor regulations to balance work and family life are weaker, the provision of public childcare services is limited, and, importantly, informal job opportunities are readily available.

In this paper, we provide evidence of the effects of motherhood on women's labor outcomes in a developing country, Chile. By using an event-study methodology, we are able to estimate the impact of motherhood on several women's labor market outcomes in the short and long run. Our results show that the birth of the first child implies drastic changes in mothers' labor outcomes, but not in fathers', and that these effects persist over time. Importantly, we also find that after the first child is born, the probability of employed mothers having an informal job increases by substantially. All of these effects are stronger among less-educated women.

To shed light on the interplay between mothers' labor market decisions and formal and informal job characteristics, we build and parameterize a model economy in which women with different levels of labor productivity choose between working, either in formal or informal jobs, or not working at the onset of motherhood. Each choice provides women with different combinations of time flexibility, income, and social protection. The model

[39] Without an informal sector, some mothers would had ended up out of employment, earning even less but with more available time for child-rearing, while some others would had ended up in formal employment (earning more, with better social protection, but with little time to spend with their children). Therefore, the predictions of the model regarding other outcomes of interest, such as labor earnings and child quality, are not trivial. In our numerical exercises, in the economy without an informal sector labor earnings and child quality change very little with respect to the benchmark economy. In the case of the economy with an informal sector but with relatively poorer non-contributory social protection (lower $\frac{s_L}{s_H}$), the drop in labor earnings after motherhood is smaller (-15%) than in the benchmark case, while the child quality does not vary significantly. Results about these additional outcomes are available upon request.

results indicate that both time flexibility in the informal sector and the relatively poor quality of social protection offered by the formal sector in developing countries contribute to explain why women's labor informality increases sharply after motherhood.

Parenthood triggers a strong demand for flexibility to balance work and family life, and informal job opportunities offer an alternative to solve this trade-off, though it seems that only mothers adopt this strategy. In this way, the availability of flexible informal jobs acts as a buffer against the decline in female employment caused by the birth of the first child. Although this result is perfectly compatible with spouses jointly optimizing household welfare, it implies deteriorating labor market prospects of mothers. These asymmetric responses of mothers and fathers may in part explain the persistence of poorer labor market outcomes for mothers even long after they have had their first child. Improving the social protection benefits and flexibility in formal jobs may help to reconcile high-quality jobs with family life in developing countries.

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APPENDIX A. CONSTRUCTION OF LABOR MARKET TRAJECTORIES AND LABOR MARKET OUTCOMES

Our analysis is based on the six waves of the Chilean Longitudinal Social Protection Survey gathered between 2002 and 2016. Since the 2004 wave, the survey has been designed to follow about 16,000 individuals.[40] In each wave, the Social Protection Survey recovers information about the current and past labor status of the interviewee (employed, on leave, unemployed, or inactive). Respondents are asked to recall their labor market episodes during a reference period, which typically goes from the year of the last interview to the date of the current interview (see Table A.1), except for waves 2002/03, 2004/05, and 2015/16 that ask to recall labor trajectories in a longer period.

TABLE A.1 Labor History Module in the Social Protection Survey Waves

Wave	Recall information about labor market status since
2002/03	January 1980 (or since age 15)
2004/05	a) January 2002 if interviewed in 2002 b) January 1980 (or since age 15) if not interviewed in 2002 (new individuals entering the panel in 2004/05)
2006/07	a) January 2004 if interviewed in 2004/05 b) January 2002 if not interviewed in 2004/05
2008/09	January 2006
2012/13	January 2009
2015/16	a) January 2009 if individual belongs to the panel sample b) January 2001 (or since age 15) if individual belongs to the refreshed sample (new individuals entering the panel in 2015/16)

For each employment episode listed in the labor history module, respondents are asked to provide the following information:[41]

- Start and end date (month and year)
- Occupation type, classified as employer, independent worker, public sector employee, private sector employee, domestic service, unpaid family worker, or police or military force
- Employment term, classified as permanent, temporary/seasonal, occasional/casual, fixed term, or probationary
- Contract status, specifies whether the respondent signed a contract for that job (asked only if the respondent reported being an employee, either public or private, or in domestic service)
- Social security system (pension system) contribution status, includes individual or employer contributions

[40] Data gathering took place in the years 2002/2003, 2004/05, 2006/07, 2008/09, 2012/13, and 2015/16. The survey started in 2002/03 with a sample that was not representative of the Chilean population because it included only beneficiaries of the pension system (i.e., informal workers were not represented). The 2004/05 wave included additional individuals, making the sample representative of the Chilean population aged 18 years and older.

[41] In case an individual had more than one job in a given period of time, the information refers only to the main job.

- Average monthly wage, net of social security contributions, bonuses, extra hours, and child allowances
- Number of hours worked per week[42]

Based on the previous information, we build a monthly panel that includes the following outcome variables:

- *Labor force participation*: a dummy variable that takes the value 1 if the individual is employed (includes employees taking a leave of absence) or unemployed in the corresponding month, and it takes the value 0 otherwise.
- *Employment*: a dummy variable that takes the value 1 if the individual is employed (includes employees taking a leave of absence) in the corresponding month, and 0 otherwise.
- *Monthly labor earnings*: the average monthly wage from the main job (net of social security contributions, bonuses, extra hours, and child allowances) in the corresponding month. Monthly labor earnings equal 0 for unemployed or inactive individuals.

For those who are employed, we construct the following variables:

- *Informal employment*: a job in at least one of the following categories:
  - *Non-registered jobs*: a dummy variable that takes the value 1 if the individual did not contribute to the social security system in the corresponding month and 0 otherwise.
  - *Low-skilled (nonprofessional) self-employment*: a dummy variable that takes the value 1 if the individual was an independent worker in the corresponding month and her education level is below college and 0 otherwise.
  - *No written contract of employment*: a dummy variable that takes the value 1 if the individual was an employee (public, private, or domestic service) without a signed written contract or was an unpaid family worker in the corresponding month and 0 otherwise (employed with a signed written contract, employer, independent worker, or police or military force member).
  - *Temporary jobs:* a dummy variable that takes the value 1 if the job was temporary/seasonal, occasional/casual, fixed term, or probationary and 0 if it was permanent.
- *Formal employment*: one (1) minus the informal employment variable.
- *Hours worked*: the number of hours worked per week during the corresponding month.
- *Hourly wage*: the ratio of total monthly labor earnings to monthly hours worked. Wages are reported net of social security contributions, bonuses, extra hours, and child allowance.

To construct the labor trajectories, we always keep information available from the closest available report , except for the period 2009–2013, where we prioritize information from the 2015/16 wave rather than the 2012/13 wave.[43] In our sample, 67% of the monthly data is obtained from a very close report (which implies a recall period of 3 or fewer years before the interview), 16% of the monthly data correspond to a recall period between 3 and 5 years before the interview, and the rest (17%) corresponds to a recall period of more than 5 years before the interview.[44]

[42] The survey collects a single measure of the average monthly wage and hours for each employment spell.

[43] The Ministry of Labor and Social Protection of Chile who administers the survey warns about the potentially lower quality of the information in the 2012/13 wave.

[44] Our working sample is restricted to individuals that have their first child between 2002 and 2015—the exact

APPENDIX B

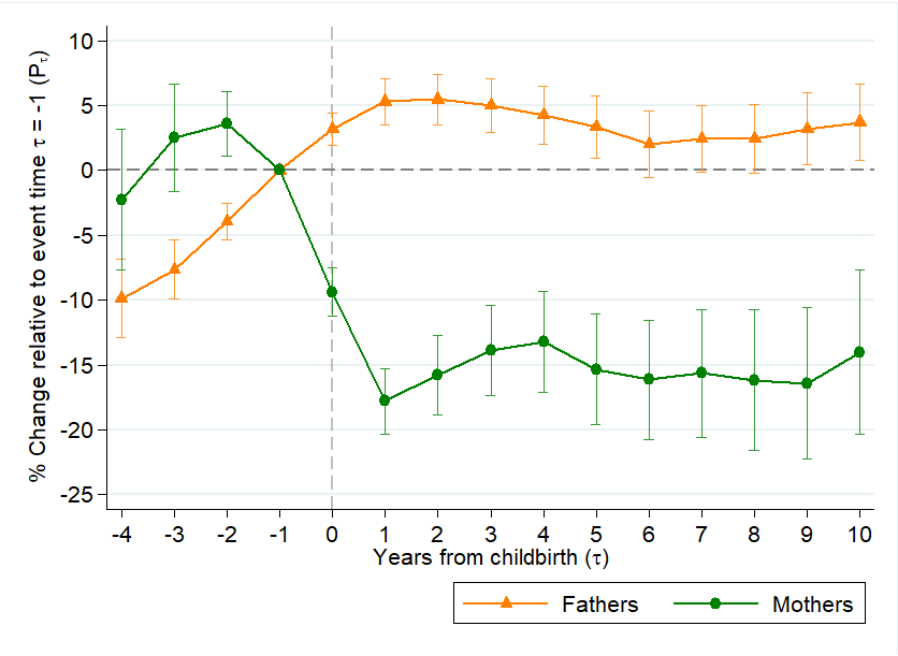

FIGURE B.1 Impacts on Labor Force Participation *Notes:* This figure shows, for men and women separately, the estimated impacts of having children on labor market participation. The figure reports the scaled coefficients P_τ as explained in Section 2.2. Since the omitted category is $\tau = -1$, the scaled coefficients measure the impact of children as a percentage of the counterfactual outcome relative to the year before the first childbirth. Controls include year, month, and age-in-years fixed effects. Data cover the period 1997–2016, and the sample includes parents observed at least once before and at least once after childbirth. The sample is restricted to mothers whose age at first childbirth is between 18 and 50 years old and fathers whose age at first childbirth is between 18 and 60 years old. The figure also shows the bootstrapped 90% confidence intervals for the scaled results using 500 replications and clustering at the individual level. Calculations based on the Social Protection Survey.

dates of birth (month and year) are available for only those children born in or after 2002—whose age at the birth of the first child is between 18 and 50 years old for women and 18 and 60 years old for men, and for whom we observe their labor market status at least once before and at least once after becoming a parent. These conditions result in an unbalanced panel of 2,445 women and 1,924 men. Labor market outcomes cover the period between 1997 and 2016.

TABLE B.1 Summary Statistics

	τ=1 to 10		τ=-1			
	Mothers	Fathers	Lower educated		Highly educated	
			Mothers	Fathers	Mothers	Fathers
Complete sample						
Year of birth	1984	1981	1988	1985	1985	1983
	(1.99)	(2.28)	(5.37)	(7.08)	(6.83)	(7.67)
Age at first child	23.08	25.49	22.17	24.27	24.75	26.61
	(0.30)	(0.43)	(4.07)	(5.58)	(5.23)	(5.86)
With some college education	0.39	0.36	0.00	0.00	1.00	1.00
	(0.02)	(0.02)	(0.00)	(0.00)	(0.00)	(0.00)
In the labor force	0.61	0.94	0.45	0.78	0.54	0.72
	(0.06)	(0.03)	(0.48)	(0.40)	(0.47)	(0.42)
Employed	0.53	0.90	0.38	0.73	0.48	0.68
	(0.07)	(0.03)	(0.46)	(0.42)	(0.47)	(0.43)
Monthly labor earnings (2015 Chilean pesos)	149551	342642	76615	194353	146630	272278
	(31392)	(44487)	(112493)	(172026)	(216775)	(275665)
Sample of workers						
Hours worked per week	40.68	46.45	42.93	46.60	40.75	45.46
	(0.34)	(0.34)	(11.07)	(9.46)	(11.84)	(10.13)
Hourly wage (2015 Chilean pesos)	1886	2133	1255	1531	1961	2266
	(169)	(161)	(887)	(1150)	(1329)	(1533)
Informal worker	0.29	0.31	0.43	0.43	0.32	0.31
	(0.02)	(0.02)	(0.49)	(0.48)	(0.46)	(0.44)
Unregistered worker	0.18	0.18	0.23	0.22	0.19	0.16
	(0.01)	(0.02)	(0.41)	(0.40)	(0.38)	(0.36)
Temporary job	0.17	0.17	0.29	0.28	0.22	0.20
	(0.02)	(0.03)	(0.45)	(0.44)	(0.41)	(0.38)
No contract	0.11	0.09	0.21	0.16	0.17	0.14
	(0.02)	(0.01)	(0.40)	(0.35)	(0.36)	(0.33)
Non-professional self-employed	0.09	0.11	0.06	0.12	0.02	0.03
	(0.01)	(0.02)	(0.23)	(0.32)	(0.14)	(0.15)
No. of individuals in complete sample	2,455	1,924	1,523	1,253	928	671

Notes: Columns 1 and 2 show, separately for mothers and fathers, the mean and standard deviation (in parentheses) of sociodemographic and labor market variables over the 10 years after first childbirth ($\tau = 1$ to 10). Columns 3--6 report the same statistics for lower- and highly educated mothers and fathers, one year before the first childbirth ($\tau = -1$). Monthly labor earnings take the value 0 when the individual is not working in a given month. See Appendix A for more details on the definition of each variable. The sample includes parents observed at least once before and at least once after childbirth. The sample is restricted to mothers whose age at first childbirth is between 18 and 50 years old and fathers whose age at first childbirth is between 18 and 60 years old. Calculations based on the Social Protection Survey

TABLE B.2 Regression Coefficients, Sample of Mothers

	(1) In labor force	(2) Employed	(3) Hours	(4) Hourly wage	(5) Earnings	(6) Informal	(7) Unregistered	(8) No contract	(9) Temporal job	(10) Self-employed (NP)	(11) Informal (uncond.)	(12) Formal
τ=-4	-0.010	-0.011	-0.132	171.94**	6,058.79	0.025	0.013	0.012	0.016	0.006	0.007	-0.018
	(0.013)	(0.013)	(0.590)	(82.89)	(4,177.19)	(0.022)	(0.019)	(0.020)	(0.020)	(0.010)	(0.010)	(0.011)
τ=-3	0.011	0.004	-0.267	103.30**	5,367.39	0.004	0.006	0.007	-0.003	0.001	0.007	-0.002
	(0.010)	(0.010)	(0.428)	(48.73)	(3,310.23)	(0.017)	(0.014)	(0.015)	(0.015)	(0.006)	(0.008)	(0.009)
τ=-2	0.016**	0.009	-0.117	72.70***	4,750.70**	0.004	0.017*	0.003	-0.004	0.002	0.006	0.003
	(0.006)	(0.007)	(0.257)	(25.23)	(2,071.31)	(0.010)	(0.009)	(0.009)	(0.009)	(0.004)	(0.005)	(0.006)
τ=0	-0.051***	-0.060***	-0.446*	-28.41	-16,957.37***	-0.009	0.001	0.001	-0.001	0.011**	-0.024***	-0.036***
	(0.006)	(0.007)	(0.252)	(21.91)	(1,990.97)	(0.010)	(0.009)	(0.009)	(0.009)	(0.005)	(0.005)	(0.006)
τ=1	-0.106***	-0.128***	-1.183***	-16.72	-36,779.20***	0.010	0.014	-0.002	0.013	0.029***	-0.036***	-0.092***
	(0.010)	(0.010)	(0.368)	(39.52)	(3,249.19)	(0.015)	(0.013)	(0.013)	(0.012)	(0.007)	(0.008)	(0.009)
τ=2	-0.101***	-0.136***	-1.320***	-71.33	-43,639.03***	0.063***	0.048***	0.020	0.049***	0.049***	-0.012	-0.124***
	(0.013)	(0.013)	(0.452)	(49.10)	(4,533.14)	(0.018)	(0.015)	(0.015)	(0.015)	(0.009)	(0.010)	(0.012)
τ=3	-0.094***	-0.128***	-1.176**	-113.97**	-45,604.86***	0.077***	0.048***	0.036**	0.058***	0.046***	0.001	-0.130***
	(0.015)	(0.015)	(0.515)	(57.74)	(5,614.80)	(0.021)	(0.017)	(0.017)	(0.017)	(0.011)	(0.011)	(0.015)
τ=4	-0.093***	-0.132***	-1.128**	-85.90	-49,401.72***	0.082***	0.045**	0.031*	0.052***	0.049***	0.006	-0.139***
	(0.018)	(0.017)	(0.569)	(69.63)	(6,830.04)	(0.023)	(0.018)	(0.018)	(0.019)	(0.012)	(0.013)	(0.017)
τ=5	-0.112***	-0.153***	-1.157*	-104.20	-60,227.12***	0.074***	0.039*	0.034*	0.052**	0.044***	-0.003	-0.151***
	(0.020)	(0.020)	(0.643)	(82.23)	(8,097.04)	(0.025)	(0.020)	(0.019)	(0.020)	(0.014)	(0.014)	(0.019)
τ=6	-0.121***	-0.159***	-1.408**	-157.40*	-68,868.07***	0.076***	0.041*	0.030	0.053**	0.040**	-0.001	-0.160***
	(0.022)	(0.022)	(0.708)	(93.71)	(9,481.74)	(0.028)	(0.023)	(0.021)	(0.022)	(0.016)	(0.016)	(0.022)
τ=7	-0.119***	-0.160***	-2.055***	-128.17	-73,001.61***	0.114***	0.059**	0.032	0.078***	0.056***	0.021	-0.182***
	(0.024)	(0.024)	(0.781)	(118.89)	(10,969.41)	(0.031)	(0.026)	(0.023)	(0.025)	(0.019)	(0.019)	(0.024)
τ=8	-0.126***	-0.156***	-1.735**	-117.35	-71,455.44***	0.105***	0.059**	0.019	0.086***	0.056**	0.019	-0.176***
	(0.027)	(0.027)	(0.847)	(139.18)	(12,741.39)	(0.034)	(0.028)	(0.024)	(0.027)	(0.022)	(0.021)	(0.027)
τ=9	-0.130***	-0.157***	-1.802*	-130.20	-74,616.00***	0.085**	0.059*	0.029	0.072**	0.056**	0.009	-0.167***
	(0.030)	(0.030)	(0.939)	(145.27)	(14,713.28)	(0.037)	(0.031)	(0.027)	(0.028)	(0.024)	(0.022)	(0.031)
τ=10	-0.113***	-0.133***	-1.910*	-191.48	-70,795.03***	0.098**	0.064*	0.035	0.093***	0.052*	0.025	-0.160***
	(0.034)	(0.034)	(1.035)	(150.52)	(17,257.08)	(0.041)	(0.034)	(0.028)	(0.031)	(0.027)	(0.025)	(0.035)
Constant	0.183***	0.164**	42.130***	1,964.98***	-67,280.69***	0.620***	0.445***	0.507***	0.425***	0.025	0.075	0.089
	(0.069)	(0.069)	(4.302)	(657.94)	(15,114.17)	(0.131)	(0.121)	(0.135)	(0.127)	(0.051)	(0.053)	(0.062)
Observations	255,935	255,935	111,639	105,004	249,032	113,175	112,735	97,604	113,840	113,853	255,420	255,420
R-squared	0.168	0.155	0.045	0.06	0.18	0.067	0.050	0.073	0.064	0.017	0.012	0.145

*Notes:*This table shows the estimated impacts of having children on mother's labor market outcomes. Results presented in columns 3–4 and 6--10 are estimated, conditional on being employed. The figures report the coefficients β (not scaled) of equation (1). See Section 2.2 for more details. The omitted category is $\tau = -1$ (the year before the first childbirth). Controls include year, month, and age-in-years fixed effects. Data cover the period 1997--2016, and the sample includes mothers observed at least once before and at least once after childbirth. The sample is restricted to mothers whose age at first childbirth is between 18 and 50 years old. Standard errors are clustered at the individual level and reported in parentheses. Calculations based on the Social Protection Survey. *** p < 0.01, ** p < 0.05, * p < 0.10.

TABLE B.3 Regression Coefficients, Sample of Fathers

	(1) In labor force	(2) Employed	(3) Hours	(4) Hourly wage	(5) Earnings	(6) Informal	(7) Unregistered	(8) No contract	(9) Temporal job	(10) Self-employed (NP)	(11) Informal (uncond.)	(12) Formal
τ=-4	-0.068***	-0.067***	-0.985**	222.74***	-6,710.61	0.023	0.013	0.016	0.022	-0.015	-0.013	-0.054***
	(0.014)	(0.014)	(0.501)	(83.71)	(6,489.48)	(0.021)	(0.017)	(0.017)	(0.019)	(0.013)	(0.014)	(0.015)
τ=-3	-0.054***	-0.055***	-0.372	136.66**	-4,977.45	0.017	0.011	0.029**	0.006	-0.007	-0.011	-0.043***
	(0.010)	(0.011)	(0.350)	(57.30)	(5,079.42)	(0.015)	(0.013)	(0.013)	(0.014)	(0.010)	(0.011)	(0.012)
τ=-2	-0.029***	-0.033***	-0.030	66.77**	-3,268.95	0.012	0.013*	0.018**	0.005	-0.001	-0.005	-0.028***
	(0.006)	(0.007)	(0.201)	(28.39)	(3,136.65)	(0.010)	(0.008)	(0.008)	(0.009)	(0.005)	(0.007)	(0.008)
τ=0	0.025***	0.028***	-0.245	-1.65	7,349.89**	-0.007	-0.002	-0.014**	0.003	0.005	0.005	0.024***
	(0.006)	(0.007)	(0.184)	(23.09)	(2,974.15)	(0.008)	(0.007)	(0.007)	(0.008)	(0.004)	(0.007)	(0.007)
τ=1	0.044***	0.044***	-0.260	-27.17	10,508.48**	-0.003	-0.008	-0.020**	0.013	0.010	0.012	0.033***
	(0.008)	(0.009)	(0.270)	(36.73)	(4,795.25)	(0.012)	(0.010)	(0.010)	(0.011)	(0.007)	(0.010)	(0.011)
τ=2	0.047***	0.046***	-0.085	-57.55	6,120.38	-0.007	-0.007	-0.020	0.006	0.010	0.007	0.040***
	(0.010)	(0.011)	(0.346)	(50.84)	(6,269.12)	(0.015)	(0.013)	(0.012)	(0.013)	(0.009)	(0.013)	(0.014)
τ=3	0.044***	0.039***	-0.132	-40.61	4,653.11	0.001	-0.007	-0.022	0.016	0.012	0.010	0.029*
	(0.011)	(0.012)	(0.407)	(61.08)	(7,573.04)	(0.018)	(0.015)	(0.014)	(0.015)	(0.011)	(0.015)	(0.017)
τ=4	0.038***	0.029**	-0.081	-26.89	4,891.11	0.004	-0.014	-0.029*	0.022	0.012	0.010	0.020
	(0.012)	(0.013)	(0.462)	(70.60)	(9,001.68)	(0.020)	(0.017)	(0.015)	(0.017)	(0.013)	(0.018)	(0.019)
τ=5	0.031**	0.027*	0.148	-98.55	2,638.68	-0.002	-0.018	-0.029*	0.021	0.009	0.002	0.025
	(0.013)	(0.015)	(0.498)	(71.40)	(10,422.68)	(0.023)	(0.019)	(0.017)	(0.019)	(0.014)	(0.020)	(0.022)
τ=6	0.019	0.017	0.309	-96.52	2,058.77	-0.008	-0.013	-0.029	0.006	0.005	-0.007	0.024
	(0.014)	(0.016)	(0.565)	(81.56)	(12,163.75)	(0.026)	(0.022)	(0.019)	(0.021)	(0.017)	(0.023)	(0.025)
τ=7	0.022	0.019	0.131	-82.01	3,045.84	0.005	0.001	-0.012	0.008	0.016	0.006	0.014
	(0.015)	(0.017)	(0.638)	(102.05)	(13,933.40)	(0.030)	(0.025)	(0.021)	(0.023)	(0.020)	(0.026)	(0.028)
τ=8	0.023	0.022	0.255	-122.14	9,229.74	0.012	0.017	-0.020	0.009	0.035	0.013	0.009
	(0.015)	(0.017)	(0.687)	(103.95)	(16,274.61)	(0.033)	(0.028)	(0.023)	(0.026)	(0.023)	(0.030)	(0.032)
τ=9	0.030**	0.021	0.430	-148.50	9,939.84	0.022	0.030	-0.011	0.013	0.038	0.023	-0.001
	(0.015)	(0.018)	(0.764)	(113.11)	(18,547.72)	(0.038)	(0.032)	(0.026)	(0.029)	(0.026)	(0.034)	(0.036)
τ=10	0.035**	0.020	0.432	-143.31	3,282.72	0.036	0.037	-0.007	0.011	0.060*	0.036	-0.016
	(0.016)	(0.020)	(0.874)	(131.53)	(20,919.17)	(0.043)	(0.036)	(0.030)	(0.032)	(0.031)	(0.039)	(0.041)
Constant	0.366***	0.271***	42.102***	1,630.46***	-50,723.92***	0.627***	0.441***	0.328**	0.375***	0.213**	0.210***	0.061
	(0.067)	(0.068)	(3.806)	(592.90)	(19,186.14)	(0.141)	(0.126)	(0.134)	(0.123)	(0.086)	(0.061)	(0.070)
Observations	203,034	203,034	153,325	143,995	193,230	157,343	156,625	127,589	157,808	157,809	202,642	202,642
R-squared	0.291	0.248	0.033	0.05	0.22	0.026	0.017	0.029	0.030	0.013	0.013	0.126

Notes: This table shows the estimated impacts of having children on father's labor market outcomes. Results presented in columns 3--4 and 6--10 are estimated, conditional on being employed. The figures report the coefficients β (not scaled) of equation (1). See Section 2.2 for more details. The omitted category is $\tau = -1$ (the year before the first childbirth). Controls include year, month, and age-in-years fixed effects. Data cover the period 1997–2016, and the sample includes fathers observed at least once before and at least once after childbirth. The sample is restricted to fathers whose age at first childbirth is between 18 and 60 years old. Standard errors are clustered at the individual level and reported in parentheses. Calculations based on the Social Protection Survey. *** p < 0.01, ** p < 0.05, * p < 0.10.

APPENDIX C

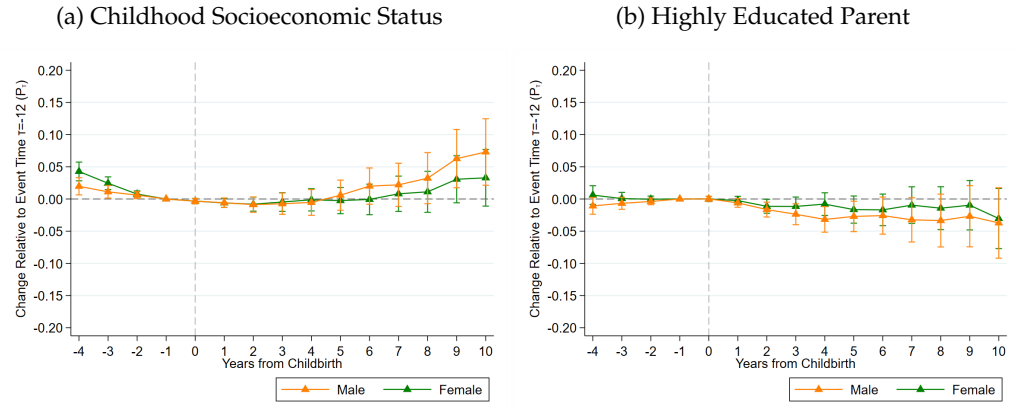

FIGURE C.1 Impacts on Predetermined Variables. *Notes:* These figures show, for men and women, the estimates of β_τ from $Y_{itm\tau} = \sum_{k \neq -1} \beta_k I(k = \tau) + \epsilon_{itm\tau}$ on predetermined variables. They are indicator variables for self-reported socioeconomic status that equals either *very good* or *excellent* during childhood and for having a highly educated parent (at least one parent finished high school). The omitted category is $\tau = -1$, i.e., the year before the first childbirth. Data cover the period 1997–2016, and the sample includes those parents whose first childbirth was during that period. The sample is restricted to mothers whose age at first childbirth is between 18 and 50 years old, fathers whose age at first childbirth is between 18 and 60 years old, and individuals observed at least once before childbirth and at least once after (unbalanced panel).95% confidence intervals based on standard errors clustered at the individual level. Calculations based on the Social Protection Survey.

APPENDIX D

D. 1 | Value Functions

We describe the value functions of women with ($V^j(z)$) and without ($W^j(z)$) children, which result from the following maximization problems of women with ability z who choose among alternative occupations $j = \{NE, F, I\}$ (not employed, formal worker, and informal worker).

For mothers, the value of not being employed is

$$\begin{aligned} V^{NE}(z) &= \max_{t_q, l, c_m} \phi_c \log(c_m) + \phi_l \log(l) + \phi_q \log(q), \qquad \text{(B.1)} \\ \text{subject to} \quad t_q + l &\leqslant 1, \\ c_m + c_q &\leqslant Y, \\ q &= c_q^{\alpha} t_q^{\beta} s_L^{1-\alpha-\beta}, \\ \text{and} \quad t_q, l, c_m, c_q &\geqslant 0. \end{aligned}$$

The value for a mother with ability z in the case of choosing to work in formal employment is

$$\begin{aligned} V^{F}(z) &= \max_{t_q, l, c_m} \phi_c \log(c_m) + \phi_l \log(l) + \phi_q \log(q), \qquad \text{(B.2)} \\ \text{subject to} \quad t_q + \overline{t_F} + l &\leqslant 1, \\ c_m + c_q &\leqslant \omega_F(z)\overline{t_F} + Y, \\ q &= c_q^{\alpha} t_q^{\beta} s_H^{1-\alpha-\beta}, \\ \text{and} \quad t_q, l, c_m, c_q &\geqslant 0. \end{aligned}$$

Last, the value for a mother with ability z who chooses informal employment is

$$\begin{aligned} V^{I}(z) &= \max_{t_q, t_I, l, c_m} \phi_c \log(c_m) + \phi_l \log(l) + \phi_q \log(q), \qquad \text{(B.3)} \\ \text{subject to} \quad t_q + t_I + l &\leqslant 1, \\ c_m + c_q &\leqslant \omega_I(z) t_I + Y, \\ q &= c_q^{\alpha} t_q^{\beta} s_L^{1-\alpha-\beta}, \\ \text{and} \quad t_q, t_I, l, c_m, c_q &\geqslant 0, \end{aligned}$$

where her choice regarding the amount of time devoted to informal work is such that

$$t_I^*(z) = \frac{\omega_I(z)(\alpha\phi_q + \phi_c) - Y(\beta\phi_q + \phi_l)}{\omega_I(z)(\alpha\phi_q + \beta\phi_q + \phi_l + \phi_c)}.$$

So, a woman with ability z will choose a positive amount of working time ($t_I^* > 0$) if

$$\frac{\omega_I(z)}{Y} \geqslant \frac{\beta\phi_q + \phi_l}{\alpha\phi_q + \phi_c}, \qquad \text{(B.4)}$$

otherwise $t_I^*(z) = 0$. Notice that this condition is likely to be satisfied for high enough ability levels, z, if monetary inputs in the production of child quality are very productive (α is relatively high) and/or if time inputs are not very productive (β is relatively low). This condition is also likely to be satisfied if the valuation for leisure is low (low ϕ_l) and/or for

private consumption is high (high ϕ_c).

To compare labor market decisions of women after having a child, it is also useful to describe the values for childless women with ability z in each possible occupation j, which we denote as $W^j(z)$. While the value for a childless woman that does not work is just $W^{NE}(z) = \phi_c \log(Y) + \phi_l \log(1)$, the value for a woman working in the formal is $W^F(z) = \phi_c \log(\omega_F(z)\overline{t_F} + Y) + \phi_l \log(1 - \overline{t_F})$. A woman of ability z working in the informal sector solves

$$W^I(z) = \max_{t_I} \phi_c \log(\omega_I(z)t_I + Y) + \phi_l \log(1 - t_I),$$

which results in a value

$$W^I(z) = \phi_c \log\Big\{\frac{\phi_c[\omega_I(z) + Y]}{(\phi_l + \phi_c)}\Big\} + \phi_l \log\Big\{\frac{\phi_l[\omega_I(z) + Y]}{\omega_I(z)(\phi_l + \phi_c)}\Big\}.$$

D. 2 | Parameterization of the Model Economy

TABLE D.2.1 Parameter values

Parameters	Values	Source
Set a priori		
$\overline{t_F}$	1/3	8 hours a day
w_f/w_i	1.20	Mincer regression
ϕ_c	0.728	Del Boca et al. (2014)
α	0.2β	Del Boca et al. (2014)
Calibrated		
Y		2.925
β		0.7475
s_L/s_H		0.430
ϕ_l		0.926