To Leave or not to Leave: The Effects of Motherhood over Female Labour Supply in the United Kingdom

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Abstract

The substantial increase in female labour force participation observed in the second half of the last century has lost its pace worldwide. In this paper, I propose a new hypothesis for this phenomenon: the employment costs of motherhood (ECM), defined as the additional cost an employed mother has to pay while raising their children, are not decreasing as expected. A natural policy to mitigate this effect is the provision of job-protected maternity leave for workers right after birth. In this paper, I analyse this issue in two steps: (a) by proposing a theoretical model that defines the employment costs of motherhood in its structure; and (b) by analysing the effects of a British policy change that increased the length of maternity leave over female labour supply. My theoretical setup shows that a policy change that increases maternity leave is only effective if the level of ECM is high enough. My empirical findings show that the boost in the British maternity leave system increased the probability of a mother being at work one year after the birth by 8.8 percentage points. The effects on single mothers are even more substantial: 14.1 percentage points. In the long run, the effects on all mothers persist, with a 9.9 percentage point increase in the probability of being employed three years after the birth). The effect on single mothers fades down: only 2.2 percentage points increase (not significant) in the same probability.

Keywords: Motherhood, Labour Supply, Maternity Benefits

JEL Codes: J08, J13, J22

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1 Introduction

> Children are a battle of a different sort... A battle without banners or war horns, but no less fierce... As hard as birth can be, what comes after is even harder.
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> *Catelyn Stark, in A Clash of Kings (1999) by George R. R. Martin*

Over the past decades, most countries in the world experienced an intense increase in female labour force participation. However, this process started to lose its pace from the early 2000s (Blau and Kahn, 2006). This goes against the part of the literature that predicted that gender convergence - both in terms of education and gender roles - would narrow down the differences between men and women in the labour market (Goldin, 2006). How can a world with increasing convergence be consistent with a persistent differential in labour supply? The impacts of motherhood are among the potential explanations for this behaviour. In this paper, I propose a new mechanism to explain why the female labour supply is not converging as expected: the employment costs of motherhood (ECM) are not changing over time. This may be one of the causes for the persistent difference in the levels of labour supply between men and women.

The employment costs of motherhood are defined as the time, effort, money, health, or emotional costs a mother has to pay to stay in the labour force while raising their children. I formalise this concept by proposing a non-stationary search model that allows the workers to get pregnant over time. I define ECM in the model's structure and show that the behaviour of these costs during and after the pregnancy may help explain the drop in female labour force participation once motherhood starts. The channel that links ECM and labour supply is reservation wages: if at some point after the conception, the mother's reservation wage out-pass the wage she receives at her job, she will decide to leave the labour force for a while. At the same time, a mother unemployed during the pregnancy will observe her reservation wage increasing through time, making it harder for her to get hired. This intuition, first proposed in Browning (1992), can explain why mothers have a smaller labour force attachment compared to non-mothers and why mothers of old children have higher levels of participation in comparison to mothers of infants (Kleven et al., 2019a).

In my model, the workers are entitled to enjoy a period of job-protected maternity leave after birth. A maternity leave policy is defined by how much a mother receives during the leave period (maternity payments) and for how long she is entitled to stay at home (job-protection length), having zero employment costs of motherhood. My plan with this model is to show that if the length of maternity leave is high enough, the benefits of continuing to work outweigh the present value of ECM. If that is true, increasing maternity leave would imply a lower level of ECM, which would positively affect labour supply, at least in the short run. This can reduce the adverse effects of motherhood on the female labour supply. However, if the generosity of maternity leave is not high enough (i.e., low levels of maternity payments), increasing the length of maternity leave may not affect the labour supply.

At the same time, the employment costs of motherhood are not directly observable. For this reason, the idea of this paper is to give a first step in the direction of recovering this object from the data. To this end, I intend to use a policy change that happened in the UK and increased the length of job-protected maternity leave by 26 weeks in 2003. The exogenous change in the maternity leave policy combined with the functional structure of the model will help me to identify the employment costs of motherhood and understand the relationship between motherhood and labour supply[1]. Finally, I propose some comparative statics exercises that help me to rationalize my empirical findings.

My empirical results are in line with the preliminary findings of the model. The policy change that boosted the length of maternity leave in the UK increased the probability of a mother being at work by 8.75 percentage points one year after the birth. The effect on first-child mothers is 33% larger but not significant. This is also consistent with some findings in

[1]The match between my theoretical and empirical findings will be performed in a later stage of this project.

the literature that support the idea that increasing the length of maternity leave entitlements affects the intensive, but not the extensive margin of making children. When I analyze the effects of this policy change on single mothers, I find more substantial effects, and this is in line with one of the central insights of my model: if one believes that the employment costs of motherhood are higher for single mothers, the effects of a policy change that mitigate these costs when they are at their highest level should also be stronger. The effects of the maternity leave increase on labour supply are also significant in the long run (9.9 percentage points increase for the group composed of all mothers), but this is not true for single mothers.

This paper aims to contribute to the labour supply literature in at least four dimensions: (a) by proposing and modelling the mechanism through which the maternal costs of employment affect labour supply; (b) by estimating the effects of increasing the maternity leave mandates over female labour supply; (c) by recovering the behaviour of the child-rearing costs over the different stages of motherhood; and (d) by implementing a counterfactual analysis to compare the different features of the British maternity leave system.

The text is organized as follows: section 2 presents a brief review of the literature and describes the British institutional background. This section also describes the main policy change I will analyze here. Section 3 presents the theoretical model I will use to generate some insights into the labour supply decisions of mothers, as well as to help me to explain the empirical findings described in sections 4 and 5. In section 6 I discuss some of the limitations of my analysis, as well as the next potential steps I have in mind for the paper. Section 7 concludes the text.

2 Literature and Institutional Background

The literature documents extensive evidence about the impacts of childbirth on female workers' labour market outcomes. Early studies on the topic found that children and family status could explain a considerable part of the gender gap in wages in many countries. Blau and Kahn (1992) shows that the ratio of earnings between men and women had a similar pattern across several countries: they document that women in the UK were paid 63 cents on the dollar (relative to men) between 1985 and 1988. Among married workers, this ratio was 57 cents on the dollar. The same ratios in the US were 68 and 59, respectively. Waldfogel (1998) found that 40% to 50% of the gender gap in wages could be explained by differential returns depending on marital status in the UK and US. This figure was stronger among workers with children. The author argues that this difference can be partially explained by the lack of accumulation (or depreciation) of human capital during the period in which mothers stay out of the labour force to take care of family responsibilities.

Another part of the literature focuses on the glass-ceiling phenomenon: female workers do not reach the best-paid positions (Bertrand, 2013). The explanation for this phenomenon arises from the idea that generous maternity leave systems can lead to discrimination toward female workers. Furthermore, women may choose less demanding jobs due to different tastes for amenities (job stability, flexibility in hours and workplace, etc.), and these differences in preferences come from the higher involvement of mothers with child-rearing. Goldin (2014) proposes a counterargument to this idea: the glass-ceiling mechanism does not explain why different amounts of time out of the labour force have a significant effect on the time-adjusted earnings in some occupations but not in others.

Other studies analyse the effects of childbirth itself on labour supply. Although the majority of women tend to be in the labour force before the birth of their first child, there is extensive evidence that labour market attachment is not the same once motherhood starts (Kleven et al., 2019b in Denmark; Angelov et al., 2016 in Sweden; and Kuziemko et al., 2018 in the UK and US). The first explanation for this fact is related to the gender role attitudes towards child-rearing responsibilities. A worker has to make decisions about education, marriage, fertility, and labour market participation over his or her life cycle. These decisions are potentially influenced by their personal and collective views and attitudes regarding motherhood (Fortin, 2005) and are likely to be transmitted across generations. This can create a strong path-dependence over time and slow the gender convergence down.

Another explanation for the negative relationship between children and female labour supply comes from the within-household labour decisions. Suppose the agents in a household share the same labour income, and at least one agent is necessary to bear the childcare responsibilities. In that case, the Pareto efficient decision will involve the agent with the lower income to supply fewer or zero work hours in equilibrium. An alternative way to rationalise this explanation is to assume that there is a two-stage process in the household labour supply decision: the agents will share non-labour income following some sharing rule, and then decide about his or her labour supply and consumption (Chiappori, 1992). This view could help to explain why the mothers are the ones who usually leave the labour force after childbirth and why this effect is weaker for single mothers.

Finally, young women may have difficulties anticipating the maternal costs of the labour supply. If this is true and women underestimate these costs before becoming mothers, they might make human capital decisions believing that raising a child is easier than it is. This could help to explain two empirical findings at once: why the extinction of the human capital differences between men and women did not lead to a stronger decrease in the gender gap as predicted by the theory; and why the fall in participation rates is stronger for the most educated women regardless of its higher initial participation level before the motherhood (Goldin and Mitchell, 2017).

In this sense, a policy able to mitigate the effects of motherhood on the labour supply is the provision of job-protected maternity leave after birth. However, the effects of such policy on the female labour supply are not settled in the literature. Dustmann and Schönberg (2012) study the effects of three main changes in maternity leave coverage in Germany and found that a policy that is too generous can have a negative in fact on labour supply: the reform that increased the length of job-protected maternity leave in 1992 by 18 months increased also the probability that the mother is working two to three years after the birth. This is in line with the findings from Lalive and Zweimüller (2009) that analysed the effects of a significant expansion in the length of maternity leave in Austria from one to two years and found that the reform delayed return to work. They also find that this reform decreased earnings and the probability of being employed in the short but not in the long run. Lalive et al. (2014) study the same reforms and find that increasing the amount of cash benefits does not hurt the mother's labour market outcomes in the medium run. They also run a counterfactual analysis to conclude that a maternity leave system that combines payments and job protection strictly dominates other types of systems in terms of time spent with children right after birth and labour supply in the medium-run.

In this paper, I study the effects of an increase in the British maternity system in 2003. The right to maternity leave in the UK was introduced in 1976 within the Employment Protection Act. Every new mother who had at least two years of continuous employment with the same employer[2] were eligible for this benefit. Eligible women were entitled to return to work up to 29 weeks after the birth. Also, they received maternity payments: 90% of wage replacement for the first six weeks after the birth and 12 weeks of a flat rate allowance[3].

In 1994, an eligibility reform took place in the country: the requirement for the two-year employer-specific tenure was removed. All employed pregnant women, regardless of tenure or hours worked, were entitled to 14 weeks of job-protected leave. Women with at least 26 weeks of employment[4] (employer-specific) were entitled to 18 weeks of the job-protected leave period. The payment benefits also changed: the Statutory Maternity Payment benefit was introduced, guaranteeing - for workers with at least 26 weeks of employment - 6 weeks of 90% wage replacement, plus 12 weeks of flat-payments (equivalent £48.80 per week in 1994's values). Workers under 26 weeks of tenure received 18 weeks of flat payments.

In 2003, the central reform analysed here was introduced. This policy change increased

[2]More specifically, women would have to be employed for two years in a full-time job for the same employer in the 11th week before the expected date of birth. Part-time workers were also eligible for the benefit but would have to work for at least five years with the same employer.

[3]These payments were equivalent to £32.85 per week in current values and were equivalent to about 30% of the average weekly salary of women in the UK (Stearns, 2018). Nowadays, these flat payments are £151.97 per week and are updated annually in April.

[4]In the 15th week before the expected due date.

the number of job-protected leave weeks from 18 to 26 weeks. Workers with at least 26 weeks of employer-specific tenure were also entitled to additional 26 weeks of job protection (adding up to 52 weeks of leave) with the first half of these weeks with payments (6 weeks with 90% of wage replacement, and 20 weeks of flat payments, now at £100 per week) and the remaining 26 weeks without payments. This reform also extended the flat-rate payments to self-employed workers, who would receive payments for 26 weeks[5].

The objective of this paper is to exploit the structure of the maternity leave system in the UK, as well as the policy change that happened in 2003 to recover the employment costs of motherhood from the model described in the next section.

3 Theoretical Framework

To help to understand and interpret my empirical findings, I develop a non-stationary search model with the possibility of pregnancy and employment-dependant child-rearing costs. I follow the setup proposed by Van den Berg (1990), with two main differences: here, time is discrete, and I allow workers to change from a pre-pregnancy to a pregnancy state with a positive probability. In this version of the model, I only allow the worker to have one child. The model is designed to represent the context of the British economy, but what I present here is a simplified version of the model I have in mind (which is yet to be developed).

3.1 Model

In this model, time is discrete. There is a set of identical workers that discount the future with a rate $\beta < 1$. Workers can be either employed or unemployed. Unemployed workers receive job offers at rate λ_t and draw a wage w from a known distribution $F(w)$, that has

[5]The statutory maternity payments are mostly funded by the government. However, the employer is responsible for paying for the benefit as a regular salary and deducting this amount from the tax and national insurance contributions due in the same calendar year. A self-employed worker can claim this benefit if she has contributed to the national insurance for at least 13 of the 66 weeks before the baby's due date. In this case, the benefit must be claimed through the Department of Work and Pensions.

connected support inside the interval $[\underline{w}, \overline{w}]$. They receive a flow utility b if unemployed and work for the wage w if employed. To make things as simple as possible, in this version of the model I do not allow for on-the-job search or job destruction. This implies that an employed worker will stay in her job forever unless she decides to leave by herself (using a decision rule that is better described below).

The motherhood timeline is described by five distinct periods $t = \{$pre-pregnancy, pregnancy, maternity leave, post-maternity leave, stationary$\} = \{0, 1, T_0, \tau_1, T_1\}$. Every worker starts in the *pre-pregnancy* period $t = 0$. The unemployed worker without children receives wage offers with probability $\lambda_0 > 0$. If she accepts the offer, she starts working for a wage w. The worker can get pregnant with probability $p \in (0, 1]$. If she gets pregnant, she starts the *pregnancy* state, otherwise she stays in the current *pre-pregnancy* period $t = 0$.

If the worker gets pregnant, she has a decision to make before moving to $t = 1$. She can either decide *to leave* her job and move to unemployment or *not to leave* her job and stay employed in $t = 1$. If the worker arrives in the pregnancy period as an unemployed (either because she decided to leave her job or because she found no acceptable job offer in $t = 0$), she stays unemployed until $t = T_1$. In the model's structure, this is equivalent to impose that $\lambda_t = 0$ for $t \in \{1, T_0, \tau_1\}$.

From $t = 1$, the pregnant worker starts incurring a child-rearing cost. If she is unemployed, she faces a cost $c^u(t), \forall t \in \{1, T_0, \tau_1, T_1\}$. If the pregnant worker is employed, she pays a cost $c^e(t)$. With that, I can define the *employment costs of motherhood* in period t as $ECM(t) = c^e(t) - c^u(t)$. This object can be understood as the additional flow value a mother will have to pay in each period t to work while raising a child. Such costs might involve both monetary costs like childcare or baby-siting, as well as emotional costs arising from the time the mother has to stay away from the child.

In the end of period $t = 1$, the employed worker has two decisions to make about the future: *to leave* or *not to leave* her job at $t = T_0$ and, conditional on not leaving, *to take* or *not to take* maternity leave in the same period. This decision is denoted by $ML = 1$ and

$ML = 0$, respectively. If she takes maternity leave, she starts period $t = T_0$ being at home, paying the cost $c^u(T_0)$, and receiving a fraction $RR \in [0, 1]$ of her wage. If she decides not to take maternity leave, she pays the cost $c^e(T_0)$ and receives her full wage.

At the end of T_0, she must decide *to leave* or *not to leave* her job at $t = \tau_1$. If she decides not to leave, she moves to $t = \tau_1$ and must once more decide *to leave* or *not to leave* her job at $t = T_1$. From $t = T_1$ onward, the model becomes stationary and converges to a random search model: the unemployed worker pays a child-rearing cost $c^u(T_1) = \mathbb{C}^u$ and is again able to search for jobs, receiving wage offers at rate $\lambda_{T_1} \geq 0$. Since there is no job-destruction in the model, the employed worker stays employed forever. Figure 1 shows a scheme of the model's timeline.

With the setup defined, I can describe the value functions of the worker in each stage of motherhood. The value function for an unemployed worker in the pre-pregnancy period is denoted by:

$$\begin{aligned} V^u(0) = b + \beta\Big\{(1-p) \times \big[(1-\lambda_0)V^u(0) + \lambda_0 \int_{\underline{w}}^{\overline{w}} \max\{V^e(w', 0), V^u(0)\}dF(w')\big] \\ +p \times \big[(1-\lambda_0)V^u(1) + \lambda_0 \int_{\underline{w}}^{\overline{w}} \max\{V^e(w', 1), V^u(1)\}dF(w')\big]\Big\} \end{aligned} \tag{1}$$

The employed worker at pre-pregnancy has value function:

$$V^e(w, 0) = w + \beta\Big[(1-p) \times \max\{V^e(w, 0), V^u(0)\} + p \times \max\{V^e(w, 1), V^u(1)\}\Big] \tag{2}$$

In the pregnancy period, the value functions unemployed and employed workers are:

$$V^u(1) = b - c^u(1) + \beta V^u(T_0) \tag{3}$$

$$\begin{aligned} V^e(w, 1) = w - c^e(1) \\ +\beta \max\Big\{\max\big\{V^e(w, T_0, ML = 0), V^e(w, T_0, ML = 1)\big\}, V^u(T_0)\Big\} \end{aligned} \tag{4}$$

The value functions in the maternity leave period are denoted by:

$$V^u(T_0) = b - c^u(T_0) + \beta V^u(\tau_1) \tag{5}$$

$$V^e(w, T_0, ML = 0) = w - c^e(T_0) + \beta \max\Big\{V^e(w, \tau_1), V^u(\tau_1)\Big\} \tag{6}$$

$$V^e(w, T_0, ML = 1) = w \times RR - c^u(T_0) + \beta \max\Big\{V^e(w, \tau_1), V^u(\tau_1)\Big\} \tag{7}$$

In the post-maternity leave period, the value functions are:

$$V^u(\tau_1) = b - c^u(\tau_1) + \beta V^u(T_1) \tag{8}$$

$$V^e(w, \tau_1) = w - c^e(\tau_1) + \beta \max\Big\{V^e(w, T_1), V^u(T_1)\Big\} \tag{9}$$

Finally, in the stationary period:

$$V^u(T_1) = b - \mathbb{C}^u + \beta\Big\{(1 - \lambda_{T_1})V^u(T_1) + \lambda_{T_1} \int_{\underline{w}}^{\overline{w}} \max\{V^e(w', T_1), V^u(T_1)\}dF(w')\Big\} \tag{10}$$

$$V^e(w, T_1) = w - \mathbb{C}^e + \beta V^e(w, T_1) \tag{11}$$

Equations 1 to 11 describe the utility of employed and unemployed workers before, during, and after the pregnancy. Figure 2 shows a scheme of the model's structure. The solution of this model is built by backwards induction: the worker in the stationary period will only accept to work if her wage is not smaller than a reservation wage $R(T_1)$. This reservation wage will determine if an unemployed worker will accept or reject a wage offer from $t = T_1$ and if an employed worker will decide to leave or not to leave her job at $t = T_1 - 1 = \tau_1$. Given the optimum strategies in $t = T_1$ and $t = \tau_1$, the employed worker decides to leave or not to leave her job in $t = T_1 - 2 = T_0$. At $t = 1$, the employed worker decides if she is willing to take or not to take maternity leave and, conditional on this decision, to leave or not to leave her job in $t = T_0$. Likewise, at $t = 0$ she decides to leave or not to leave her job at $t = 1$ if she is employed, or if she is willing to accept a job offer if she is unemployed.

Below, I introduce some assumptions necessary to guarantee the existence and uniqueness of the equilibrium, as well as a parametric form for the child-rearing costs over time:

Assumption 1. *Wage offers are drawn randomly from a stationary distribution $F(w)$ that is a continuous function of w, strictly monotonically increasing in w for some interval $w \in [\underline{w}, \overline{w}]$, with $0 \leq \underline{w} < \overline{w} < \infty$, and with $\lim_{w \to \overline{w}} F(w) = 1$*[6].

Assumption 2. *The distribution of wages follows an uniform distribution in the interval $[\underline{w}, \overline{w}]$, with $0 \leq \underline{w} < \overline{w} < \infty$.*

Assumption 3. *Between the conception and the stationary period, the child-rearing costs for a unemployed worker is a sequence of non-negative numbers that are bounded above, i.e., $\exists K < \infty$ such that $c^u(t) \leq K, \forall t \in \{1, ..., T_1 - 1\}$. Furthermore, $\exists T_1 \in \mathbb{N}$ such that the child-rearing cost for unemployed workers is constant for all $t \geq T_1$, i.e., $c^u(t) = \mathbb{C}^u$. In this version of the model, $T_1 = 4$*

Assumption 4. *The child-rearing cost function for unemployed workers is zero at $t = 0$, non-negative between the conception and the birth (i.e., for $t \in \{1, ..., T_0 - 1\}, c^u(t) \geq 0$), reaches its maximum in the period of birth ($t = T_0$), and decays linearly after that. The child-rearing cost function for employed workers is given by $c^e(t) = \eta c^u(t)$, for $\eta \geq 1$.*

Assumption 5. *The child-rearing cost function is given by $c^u(t) = \theta^t$, for $t \in \{1, T_0\}$ and decays after the birth following $c^u(t) = a \times c^u(t-1)$, for $t \in \{\tau_1, T_1\}$ and $a \in [0, 1]$.*

Assumptions 4 and 5 imply that the child-rearing costs for employed workers are also well defined for all periods after the conception and allows me to define $c^e(t) = \mathbb{C}^e = \eta \mathbb{C}^u, \forall t \geq T_1$. It also defines the parameter η, which represents the ratio of the child-rearing costs while employed relative to staying at home. This is the parameter that governs the employment costs of motherhood: the bigger is η, the higher are the costs associated with child-rearing

[6] Assumption 1 is, for this stage of the paper, just an idea of a less restrictive assumption I could impose to the model. For now, I will ignore this assumption and impose a stronger assumption about the distribution of wages (assumption 2).

while employed. Assumption 5 also determines the rate of decay of the child-rearing costs after the birth.

The model described above contains 10 exogenous variables (b, p, λ_0, λ_{T_1}, RR, θ, η a, $\underline{w}$, and $\overline{w}$) and a constant parameter (β). It is assumed that the worker knows the arrival rates, the pregnancy probability, the wage distribution, and the maternity benefits she is entitled to. She does not know in advance when she is getting pregnant, when a job offer will arrive, and what the wage associated with this job offer is. In every state and period t, the worker's objective is to maximize her present value of utility over an infinite horizon. Before characterizing the dynamic behaviour of the worker's optimal strategy, define the present value of the employment costs of motherhood between periods t and $t+k$ as:

$$ECM(t, t+k) = \sum_{j=t}^{t+k} \beta^{j-t}\{c^e(t) - c^u(t)\} = (\eta - 1)\sum_{j=t}^{t+k} \beta^{j-t} c^u(t), \forall k \in \mathbb{N} \text{ and } t > 0$$

Notice that assumptions 4 and 5 also imply that the present value of the employment costs of motherhood is non-negative for any interval of time after the conception.

3.2 Equilibrium

This subsection is not finished but presents 90% of the equilibrium notion I will use to link the theoretical setup described in subsection 3.1 with the empirical findings described in section 4. To describe a full notion of equilibrium, I still need to calculate the worker's optimum strategy when she receives a wage offer at period $t = 0$. This strategy will be described by a reservation wage rule $R(0)$ that is going to be dependent on her future decisions about leaving or not leaving her job once pregnancy starts. To simplify the results presented from this moment, I will assume that there is a mass of employed workers at $t = 0$ that are receiving wages $\tilde{w}$ that are uniformly distributed in the interval $[\underline{w}, \overline{w}]$. I will focus my analysis on these workers, without characterizing their search behaviour if they are unemployed in the pre-pregnancy period[7].

I start by presenting result 1, which characterizes the dynamics of the worker's optimum strategy in the stationary period.

Result 1. *Let assumptions 2-4 be satisfied. Then, the worker will follow a reservation rule strategy to decide whether to accept or reject a job offer in the stationary period* $t = T_1$*. This rule will be characterized by a correspondence* $R(T_1)$ *that denotes the reservation wage of the worker at period* T_1*, and satisfies the following equation:*

$$R(T_1) = b + [\mathbb{C}^e - \mathbb{C}^u] + \frac{\lambda_{T_1}}{r} \int_{R(T_1)}^{\overline{w}} \overline{F}(w')dw' \tag{12}$$

Where $r = \frac{\beta}{1-\beta}$ *and* $\overline{F}(w) = 1 - F(w)$*.*

Proof. See appendix A.

First, it is important to highlight that result 1 yields an adapted version of the reservation wage equation provided by Burdett and Mortensen (1998). The only differences here are the absence of job destruction, on-the-job-search, and the introduction of the employment costs of motherhood[8]. Before presenting the conditions for existence and uniqueness for this reservation wage strategy, I define a restriction determining the feasibility of a search strategy.

Definition 1. *A solution for the worker's optimum strategy is feasible if and only if the reservation wage of this worker is not bigger than the maximum wage offered in the economy. This is equivalent to impose* $R(t) \leq \overline{w}$*,* $\forall t \in \{0, ..., T_1\}$

Result 2 presents the conditions for the existence and uniqueness of the worker's optimum search strategy in the stationary period:

[7] I am only doing that because I still do not have the reservation wage rules for $t = 0$. This is not a problem at this stage because, given that the workers draw wage offers in the interval $[\underline{w}, \overline{w}]$, their reservation wage at $t = 0$ would be the object determining the value of $\underline{w}$.

[8] I am also considering the distribution of wages as an exogenous object here.

Result 2. *Let assumptions 2-4 be satisfied. Also, impose the feasibility condition.*

The equation characterizing the worker's reservation wage in the stationary state is given implicitly by:

$$R(T_1) = b + [\mathbb{C}^e - \mathbb{C}^u] + \frac{\lambda_{T_1}}{r} \int_{R(T_1)}^{\overline{w}} \frac{\overline{w} - w'}{\overline{w} - \underline{w}} dw' \tag{13}$$

Furthermore, the solution for the equation above exists and it is unique.

Proof. See appendix B.

Result 2 is important because allows me to focus only on those solutions that are feasible. Non-feasible solutions are not interesting here because they imply that the worker would not search for a job during the stationary period. This is equivalent to say that a solution at the stationary period of motherhood is only feasible if the maximum payoff of a working mother is not smaller than the net utility of an unemployed mother. This condition is also important for the internal consistency of the model: if a worker cannot be better off while employed, there is no reason for this worker to keep looking for a job. The feasibility condition also helps to determine the uniqueness of the optimum search strategy and has a very intuitive implication: if a solution is not feasible, no wage offer in the economy is acceptable. This implies that any reservation wage is a solution since there is no offer to be accepted.

With the solution for the stationary period established, I can characterize the worker's optimum strategy for the periods before T_1. Given the forward-looking nature of the model, the optimum strategy of the employed worker in period $t < T_1$ depends on two factors: her optimum strategies in all periods between t and T_1, as well as the wage $\tilde{w}$ she is earning at t. In this version of the model, for period $t = T_1 - 1 = \tau_1$, her decision to leave or not to leave at T_1 is straightforward: she decides to leave at $t = T_1$ if the wage $\tilde{w}$ she is earning at $t = T_1 - 1 = \tau_1$ is smaller than her reservation wage at T_1. In other words, conditional on being employed at $T_1 - 1$, she decides to leave at T_1 if $\tilde{w} < R(T_1)$ and not to leave if $\tilde{w} \geq R(T_1)$.

Nevertheless, the decisions for previous periods are more complex. Conditional on being employed at $t = T_1 - 2$, the decision to leave or not to leave her job in $t = T_1 - 1$ depends on whether she is deciding to leave or not to leave her job at $t = T_1$. Likewise, conditional on being employed at $t = T_1 - 3$, the decision to leaver or not to leave her job at $t = T_1 - 2$ depends on whether she decides to leave or not to leave at $t = T_1 - 1$ and at $t = T_1$. The argument can be extended up until the decision to accept or not accept a job offer at $t = 0$. From now on, assume that assumptions assumptions 2-4 are always satisfied and that the feasibility condition always hold.

Result 3 summarizes the worker's decision about to leave or not to leave her job at $t = T_1 - 1 = \tau_1$:

Result 3. *The employed worker in $t = T_0$ decides to leave her job at $t = \tau_1$ if and only if $\tilde{w} < R(\tau_1)$. Otherwise, she decides not to leave. The reservation wage $R(\tau_1)$ is characterized by:*

Case I - *If she does not leave at T_1:*

$$R(\tau_1) = \beta R(T_1) + (1 - \beta)b + (1 - \beta)\big\{c^e(\tau_1) - c^u(\tau_1)\big\} \tag{14}$$

Case II - *If she leaves at T_1:*

$$R(\tau_1) = b + \{c^e(\tau_1) - c^u(\tau_1)\} \tag{15}$$

Proof. See appendix D.

Result 3 shows the two potential reservation wage strategies the worker has for $t = \tau_1$. If she never leaves her job, her reservation wage is a weighted average between her reservation wage in the stationary period, the flow value of unemployment, and the employment costs of motherhood at τ_1. If she decides to leave her job in the stationary period, the weight for $R(T_1)$ goes to zero and all weight goes to $b + \{c^e(\tau_1) - c^u(\tau_1)\}$.

The employed worker in $t = T_1 - 3 = 1$ has 6 potential reservation wages depending on her decisions in the future. The first decision is about to take or not to take maternity leave at $t = T_0$. She takes maternity leave if the value of taking the leave is not smaller than the value of not taking the leave, i.e., if $V^e(w, T_0, ML = 1) \geq V^e(w, T_0, ML = 0)$. This is summarized in result 4:

Result 4. *The worker decides to take maternity leave if and only if:*

$$\tilde{w} < R^{ML} = \frac{c^e(T_0) - c^u(T_0)}{1 - RR} \tag{16}$$

Furthermore, the worker will always take maternity leave if:

$$RR \geq \overline{RR} = \frac{\overline{w} - \{c^e(T_0) - c^u(T_0)\}}{\overline{w}}, \text{ if } c^e(T_0) - c^u(T_0) \leq \overline{w}, \text{ and 0 otherwise.} \tag{17}$$

Proof. See appendix E

Result 4 is important because shows that the decision about taking or not taking maternity leave depends on the size of the employment costs of motherhood in the birth period, as well as the wage replacement rate offered by the maternity leave policy. It also shows that this decision is completely dependent on the wage the employed worker is receiving at birth: the workers with better wages prefer not to take maternity leave because the amount of money lost by the wage replacement policy is not as big as the employment costs of motherhood. Equation 16 shows that, if the worker receives full wage replacement during maternity leave, there is no reason for her to not take maternity leave (conditional on having positive employment costs of motherhood at T_0).

Given the worker's decision to take or not to take maternity leave after the birth, she has to decide to leave or not to leave her job at $t = T_0$. Result 5 summarizes the this decision:

Result 5. *The employed worker in $t = 1$ decides to leave her job at $t = T_0$ if and only if $\tilde{w} < R(T_0)$. Otherwise, she decides not to leave. The reservation wage $R(T_0)$ is characterized by the following conditions:*

Case I - *If she does not take maternity leave and never leaves her job:*

$$R(T_0) = \beta^2 R(T_1) + (1-\beta^2)b + (1-\beta)ECM(T_0, \tau_1) \tag{18}$$

Case II - *If she does not take maternity leave and leaves at T_1:*

$$R(T_0) = b + \frac{ECM(T_0, \tau_1)}{1+\beta} \tag{19}$$

Case III - *If she does not take maternity leave and leaves at τ_1:*

$$R(T_0) = b + [c^e(T_0) - c^u(T_0)] \tag{20}$$

Case IV - *If she takes maternity leave and never leaves her job:*

$$R(T_0) = \frac{1}{RR(1-\beta)+\beta}\Big\{\beta^2 R(T_1) + (1-\beta^2)b + (1-\beta)\beta[c^e(\tau_1) - c^u(\tau_1)]\Big\} \tag{21}$$

Case V - *If she takes maternity leave and leaves at T_1:*

$$R(T_0) = \frac{1}{RR+\beta}\Big\{(1+\beta)b + \beta[c^e(\tau_1) - c^u(\tau_1)]\Big\} \tag{22}$$

Case VI - *If she takes maternity leave and leaves at τ_1:*

$$R(T_0) = \frac{b}{RR} \tag{23}$$

Proof. See appendix D.

Results 4 and 5 are intrinsically related because they show that the worker's optimum strategy depends on how generous the wage replacement stipulated by the maternity leave policy is. It also shows that the equilibrium path diverges depending on the worker's wage. If the worker earns more than the cutoff defined by equation 16, she does not take maternity leave and her reservation wage is contained in cases I, II, and III. If her wage is below the cutoff, she takes maternity leave, and her optimum strategy is contained in cases IV, V, and VI.

It remains to understand what is the worker's optimum strategy once the pregnancy starts. Result 6 describes this decision conditional on the worker's optimum strategies after the birth::

Result 6. *The employed worker in $t = 0$ decides to leave her job at $t = 1$ if and only if $\tilde{w} < R(1)$. Otherwise, she decides not to leave. The reservation wage $R(1)$ is characterized by the following conditions:*

Case I *- If she does not take maternity leave and never leaves her job:*

$$R(1) = \beta^3 R(T_1) + (1-\beta^3)b + (1-\beta)ECM(1,\tau_1) \tag{24}$$

Case II *- If she does not take maternity leave and leaves at T_1:*

$$R(1) = b + \frac{ECM(1,\tau_1)}{1+\beta+\beta^2} \tag{25}$$

Case III *- If she does not take maternity leave and leaves at τ_1:*

$$R(1) = b + \frac{ECM(1,T_0)}{1+\beta} \tag{26}$$

Case IV *- If she takes maternity leave and never leaves her job:*

$$\begin{aligned} R(1) = \frac{1}{1-\beta(1-RR)(1-\beta)}\Big\{&\beta^3 R(T_1) + (1-\beta^3)b \\ &+(1-\beta)\big[ECM(1,1) + \beta^2 ECM(\tau_1,\tau_1)\big]\Big\} \end{aligned} \tag{27}$$

Case V *- If she takes maternity leave and leaves at T_1:*

$$R(1) = \frac{1}{1+\beta(RR+\beta)}\Big\{(1+\beta+\beta^2)b + ECM(1,1) + \beta^2 ECM(\tau_1,\tau_1)\Big\} \tag{28}$$

Case VI *- If she takes maternity leave and leaves at τ_1:*

$$R(1) = \frac{1}{1+\beta RR}\Big\{(1+\beta)b + ECM(1,1)\Big\} \tag{29}$$

Case VII *- If she leaves at T_0:*

$$R(1) = b + ECM(1,1) \tag{30}$$

Proof. See appendix D.

Result 6 allows one to compare the worker's reservation wage strategies after the conception conditional on her decisions in the future. With that, assuming a mass of employed workers receiving wages $\tilde{w}$ that are uniformly distributed in the interval $[\underline{w},\overline{w}]$, I can define the fraction of workers deciding to leave their work in each stage of the motherhood timeline. The fraction of workers deciding to leave their jobs once they get pregnant is given by $\gamma(1) = \frac{R(1)-\underline{w}}{\overline{w}-\underline{w}}$. Conditional on not leaving on $t=1$, the fraction of workers deciding to leave in $t = T_0$ is given by $\gamma(T_0) = \frac{R(T_0)-R(1)}{\overline{w}-R(1)}$. The fraction of mothers surviving until $t = T_0$ that decide to leave at $t=\tau_1$ is $\gamma(\tau_1) = \frac{R(\tau_1)-R(T_0)}{\overline{w}-R(T_0)}$ and the fraction of mothers surviving until $t=\tau_1$ that decide to leave at $t = T_1$ is $\gamma(T_1) = \frac{R(T_1)-R(\tau_1)}{\overline{w}-R(\tau_1)}$. Finally, the fraction of mothers that decide to leave the labour force between the conception and the stationary period is given by $\Gamma = \gamma(1)+\gamma(T_0)+\gamma(\tau_1)+\gamma(T_1)$. The fraction of workers deciding to take maternity leave is given by $\Delta = \frac{R^{ML}-\underline{w}}{\overline{w}-\underline{w}}$[9].

[9] I will describe this fraction as the total fraction of employed workers at $t = 0$, not as the fraction of eligible women (i.e., women who survived until $t = 1$).

3.3 Comparative Statics

In this subsection, I present some comparative statics exercises for the model described above. Two primary outcomes will be analyzed after the conception: the fraction of workers deciding to take maternity leave and the share of workers deciding to leave their job during the motherhood timeline.

I start by assuming a simple calibration to generate my main results and propose changes in this calibration to check the changes in the outcomes. In a later stage of the paper, the idea is to estimate some of these parameters (especially η). To this end, I assume $\beta = 0.95$, $b = 25$, $\underline{w} = 30$, and $\overline{w} = 100$. I do not want to analyze differences in the search behaviour for now, so $\lambda_0 = \lambda_{T_1} = 0.02$, meaning that the arrival rates are the same before and after the pregnancy. To define the employment costs of motherhood, I assume three things: (a) $\theta = 5$, so the unemployment child-rearing cost at birth is equal to the flow value of unemployment; (b) $\eta = 4$, meaning that an employed worker has a cost that is four times bigger than what she would have to pay if unemployed; and (c) $a = 0.75$, so the employment costs of motherhood decay by 25% of its previous value every period after the birth. The probability of pregnancy p is not important for this calibration because I am only analyzing the behaviour of employed workers who have already gotten pregnant.

Figure 8 presents the proportion of workers deciding to leave their jobs in each stage of motherhood. Panel (a) shows that for the case in which the worker has no wage replacement and is only entitled to job protection at period T_0. The pattern in this panel shows that some workers decide to leave right after conception and the majority of leavers decide to leave during the birth period. Under this scenario, 64.3% of the workers decide to take maternity leave. Panel (b) shows that increasing the wage replacement rate to 25% reduces the proportion of leavers by 2.5% and, conditional on not leaving until birth, all workers take maternity leave. Panel (c) shows that doubling the amount of wage replacement reduces the proportion of leavers by 2.4%. Finally, panel (d) shows that giving full wage replacement to the worker does not change the proportion of leavers but changes the timing in which the worker decides to leave: the worker with full wage replacement has no incentive to leave her job before enjoining the leave she is entitled to. Second, there is an explicit temporal substitution about the timing to leave the labour force.

To understand the importance of the employment costs of motherhood over the mother's decision about leaving or not leaving her job, I replicate this figure by cutting the level of ECM by half, i.e., $\eta = 2$. Figure 9 tells two interesting stories: (a) halving the employment costs of motherhood reduces the proportion of workers deciding to leave their job by 58.6%; and (b) increasing the level of wage replacement only causes a positive impact on labour supply if the employment costs of motherhood are high enough. The results in this case also show that the proportion of workers deciding to take maternity leave is much smaller when the employment costs of motherhood are halved: the case with no wage replacement has no worker deciding to take maternity leave, and only 4.8% of the workers decide to take the leave for a replacement rate of 25%. Doubling the level of wage replacement from 25% to 50% has, however, a significant impact on the proportion of maternity leave takers, with 28.6% of mothers deciding to take the leave for half of wage replacement. Nevertheless, this number is more than 70% smaller than the case with twice the level of ECM.

Figure 10 shows the proportion of mothers deciding to leave their job at different stages of motherhood and different values of η. Several effects can be disentangled with this exercise. Panel (a) shows that the higher ECM, the higher the proportion of workers deciding to leave their job right after conception. For the specific calibration used here, the proportion of these workers increases from $\eta = 2$. This effect is mitigated if the level of wage replacement is higher: for $\eta = 5.5$, $\gamma(1)$ is 61% smaller in the case with full wage replacement relative to the case with no wage replacement. Moreover, maternity leave has a crucial impact on the worker's decision to leave her job when the employment costs of motherhood are at their peak. Panel (b) shows the rapid increase in $\gamma(T_0)$ once η increases, but this effect is wholly cancelled with full wage replacement.

Panel (c) in figure 10 shows the reversed effect: wage replacement may reduce the proportion of workers deciding to leave their job during the birth period but cannot prevent the leaving effect once maternity leave is done. It also shows an interesting feature: if the level of ECM is sufficiently high ($\eta \geq 2$), no worker will decide to leave her job after maternity leave. Panel (d) shows that, however, if the level of ECM is low enough ($\eta < 2$), some workers may decide to leave their job during the stationary period. This happens because the employed workers at the bottom of the wage distribution prefer to leave their jobs at this moment and search for better-paid positions[10]. Once ECM increases, this phenomenon disappears because it is no longer interesting for the worker to stay in the labour force. Panels (e) and (f) show that increasing the employment costs of motherhood increase the fraction of workers deciding to take maternity leave even without any wage replacement. When the wage replacement is full, the proportion of workers taking leave increases linearly with ECM and, at the same time, fewer workers decide to leave their jobs[11].

4 Data and Empirical Strategy

This paper aims to understand the labour market decisions of working mothers around childbirth. Ideally, this requires information about fertility and employment status before, during, and after the pregnancy. Furthermore, to estimate the employment costs of motherhood described in section 3, I will use a policy change that happened in the UK and increased the length of job-protected maternity leave in the country. In this section, I describe both the data used for my analysis and the empirical strategy employed here.

[10] This is a direct consequence of the structure imposed to the model: here, workers can only search for jobs before pregnancy or once the stationary period starts. Because of that, if the level of ECM is low enough, it is not interesting for the worker to leave her job before the stationary period.

[11] This process could be stronger if I increase ECM but remember that here I am limiting my analysis only to feasible solutions. This implies that I have a maximum value of η that allows me to have a feasible solution. Going above this threshold kills feasibility.

4.1 Data

The data comes from the *British Household Panel Survey* (BHPS). This survey began in 1991 and followed a representative sample of individuals living in the UK until 2008. Over the 18 waves of the panel, more than 32,000 individuals were interviewed, with the full panel containing more than 330,000 observations. This longitudinal survey enfolds a wide range of socioeconomic variables including information about the composition of the households, housing conditions, education, health, fertility, labour market activities, values, income, among other things.

The BHPS is well suited for my goals here for two reasons: (a) it is a British survey that covers exactly the period in which the changes in maternity benefit policies happened in the country; and (b) contain key demographic and economic information suitable for my analysis. More specifically, since my objective is to understand what happens with the labour market attachment decisions around the pregnancy, information about fertility and date of birth are important[12]. As I will describe in subsection 4.2, two variables are essential to estimate my results: the distance (in months) between the interview and the birth of the respondent's children, and the age of the youngest child in the household.

Another nice feature of the survey is the possibility to link individual and household information, making it possible to match data (especially labour market related) from the respondent's husbands and wives. I can recover information about job-specific employment spells, and check if the woman is currently on maternity leave. I can also construct proxy variables for the eligibility to maternity benefits, and to understand the worker's job market behaviour before, during, and after the pregnancy.

Table 1 presents the summary statistics for a set of selected variables and subsamples. Here, I focus on a sample of observations between 2000 and 2006. The results show that

[12] Although the information about the date of birth is not available for the main public, I was able to request and receive a special use license for this variable. This allows me to have this crucial information at the month-year level. Detailed information at the day-month-year level is also available, but only physically in some locations provided by the UK Data Service

54% of the British households had at least one child and that, on average, each individual had 2.4 children. The mean age of the sample is 47.5 years, and the sample is predominantly white. Also, 3% of the individuals reported having an infant (a child with less than one year old) and the mean age of mothers in this sub-group is 30.8 years old. The results also show a clear pattern in the probability of being employed, with mothers of infants being 41% less likely to be at work in comparison to mothers of children with 3 and 4 years old. When compared to mothers of children between 5 and 15 years old, such difference is 52%.

4.2 Empirical Strategy

To recover the employment costs of motherhood from the model described in section 3, I will proceed in three steps: (1) estimate the effects of increasing the length of job-protected maternity leave over labour force attachment; (2) simulate the same change in the model, and evaluate the theoretical impact of this change over employment (for any potential level of ECM); and (3) choose the level of ECM that generates the closest impact over employment as the one observed in the data[13]. In this subsection, I describe these steps in detail.

To estimate the impacts of increasing the duration of maternity leave over the employment level of infant mothers, I will use a differences-in-differences (DD) design allowing for individual unobserved heterogeneity. The main idea here is to compare the change in the average level of employment from women who gave birth after the policy change in comparison to a group of women who gave birth before the maternity leave reform (and, therefore, are not likely to be affected by the change). I estimate the following equation:

$$Y_{i,t+k} = \alpha + \beta_1 infant_{it} + \beta_2 post_{it} + \beta_3 infant_{it} * post_{it} + X'_{i,t+k}\theta + \lambda_i + \delta_t + \varepsilon_{i,t+k} \tag{31}$$

The dependent variable in equation 31 is an indicator denoting if the mother i is at work k years after giving birth. The variable $infant_{it}$ is a dummy indicating if the individual has

[13] Step 3 is intended to be performed in a later stage of this project.

an infant. For most specifications, I will consider an infant a child less than one year old. The main comparison group comprises mothers with the youngest child between 3 and 4 years old (for reasons that will be clear below). The variable $post_{it}$ will take value one for all observations after the policy change (6/4/2003) and zero otherwise. Finally, the vector X contain a set of control variables: indicators of having a higher education degree, marital status, employment status of the mother's partner, as well as variables controlling for age, number of children, age of the youngest child in the household, and household income. The terms λ_i and δ_t represent individual and year fixed effects, respectively. All the specifications presented here use clustered standard errors at the individual level.

The parameter β_3 is the coefficient of interest and measures the impact of increasing the duration of job-protected maternity leave on the probability of being employed k years later, holding everything else constant[14].The crucial identification assumption here is the parallel trends hypothesis, i.e., the absence of group-specific unobservable components that may influence the employment status of the workers. The first step to guaranteeing this assumption's validity is choosing a proper comparison group. For this reason, I decided to use mothers of children between 3 and 4 years old as the main control group.

Furthermore, I identify the effects of increasing the length of maternity leave over labour supply using a 3-year window around the change. I do that for two main reasons. First, to avoid the possibility of the control group being affected by the policy change. The group of mothers with children between 3-4 years old after 2003 must have given birth before the change in 2003[15]. Second, two significant policy changes happened in 1999 and 2007 and could contaminate my findings: the first reform changed the eligibility rules, allowing every

[14]I analyse the employment status one year later for an obvious reason: since the maternity leave benefit was increased to one year after the birth, the probability of being employed within one year is higher after the change by construction. I am analysing the employment status at least one year after childbirth allows me to mitigate this concern. That would not be true if the mother had two children in a row: she had a child in year t, enjoyed a year of maternity leave, and had another child in year $t+1$, enjoying an extra year of the benefit. However, a quick look at the data shows that this is not a concern, with an average gap between two siblings being superior to 3 years.

[15]I make sure to avoid assigning the few mothers who gave birth after the change in 2003 and had a three years old child in 2006 to the control group.

employed mother to take 18 weeks of job-protected maternity leave. The second reform increased the number of flat-payment weeks from 20 to 33[16]. Using only the data between 2000-2006 allows me to avoid these policy changes.

Although it is not possible to test the parallel trends hypothesis directly, I provide some evidence in its favour using by comparing the treatment and control groups. First, table 2 shows that the policy change is not correlated with the worker's characteristics and fertility pattern. This table is generated estimating the effects of the policy change on several outcomes, using the specification presented in equation 31. The only exception is column (1), a simple regression on the probability of having an infant before and after the policy change. No correlation is detected. Columns (2)-(10) estimate the effects of the policy change on a set of outcomes, and no meaningful differences between the treatment and control groups are detected. The only significant correlation is detected on the effect of the policy change on the probability of being black.

Another concern about the DD design under this setup is related to the potential manipulation of the due date by the mothers. This is unlikely to be the case since the law regulating the change was approved less than six months before its implementation. Also, if the effects of the policy are not immediate or the take-up from mothers is low in the first periods after the policy change, the DD strategy could be compromised. Since maternity benefits were introduced in the UK almost three decades before the policy change, it is reasonable to believe that its knowledge was widespread. Moreover, figure 6 shows the event-study coefficients over the probability of being on maternity leave. The first sample, called the target sample, is composed of female workers between 18 and 40 years old. The results on the first panel show that women in the treatment group were significantly more likely to be on maternity leave right after the reform. It is also evident that the take-up of the policy was immediate and stable after the policy change. The second panel in this image shows the same coefficients over a placebo sample, composed of women over 40 years old

[16] I also plan to exploit these changes in a later stage of this paper.

and less likely to be affected by the policy. The placebo group results show no significant differences between the treatment and control for less exposed women (although the sample sizes here are considerably smaller). Finally, I propose a placebo falsification procedure that shows other evidence in favour of the DD strategy in section 5.

The estimated value of β_3 is one of the empirical moments I will use to be matched will the theoretical moment that relates maternity leave length and female labour supply from the model described in section 3. However, this step will only be performed at a later stage of this project.

5 Results

In this section, I present the initial results of my empirical analysis. I start by introducing some motivating descriptive statistics that are related to some of the findings from the model described in section 3. Then, I present the estimates of the effects of increasing the length of job-protected maternity leave over the female labour supply. I do this by exploiting the policy change described in section 2 and using the methodology described in section 4. I also perform some robustness exercises to check the reliability of my findings.

5.1 Motivating Descriptive Statistics

The BHPS asks every job-seeker in the sample a question about the minimum pay rate she would be willing to accept in order to work. One of the main predictions from the model described in section 3 is the behaviour of reservation wages once the worker gets pregnant. To investigate the behaviour of this variable in the data, I first calculate its pattern around the pregnancy[17]. Figure 3 presents the average of the normalized reservation wages for both men

[17]Notice that the reservation wage equations generated by the model are about the worker's decision to leave or not to leave her job. The reservation wages I present here are those asked for unemployed workers looking for a job. Although I still do not model the behaviour of these workers, the idea is to generalize the model in order to also understand their behaviour during the motherhood timeline.

and women in the quarters around the pregnancy[18]. The figure shows an interesting pattern, with female reservation wages increasing after the conception, decreasing considerably in the last quarter of the pregnancy, then increasing to a higher and stable level after the birth.

Although I do not model the male behaviour in this paper, it is interesting to notice the different behaviour of the reservation wages of men and women: in the quarter before conception men and women have a reservation wage that is 7% smaller relative to the one in the quarter of the birth. After conception, both groups increase their reservation wages, but women have a more intense increase. In the second quarter of the pregnancy, women decrease their reservation wages, but to a level that is 10% above the birth quarter's level. Men also decrease their reservation wages, but to a level almost 25% below the one at birth. In the last quarter before the pregnancy, the reservation wages of mothers reach their peak and decrease sharply in the quarter of birth. Men also have a strong increase in reservation wages during the period. The pattern after the birth is relatively similar between the groups, but the levels of the relative reservation wages stay 14% higher for women one year after the birth.

In order to understand the behaviour of reservation wages relative to people without children, and to control for some important confounding factors, I run the following regression:

$$log(R_i) = \alpha + \beta_1 young_i^k + \beta_2 old_i^k + X_i'\theta + \delta_t + \varepsilon_i \tag{32}$$

Where $log(R_i)$ is the log of the hourly reservation wage individual i declares and X_i is a set of control variables for the same individual[19]. The variable $young_i^k$ is a dummy equal to one if the individual has a child younger than k years old, and old_i^k is a dummy equal to one

[18] I present the normalized reservation wages relative to the average reservation wage at the birth quarter, in order to make the measure comparable between men and women. Male's reservation wages are 20% higher relative to women.

[19] Given the fact that the question about reservation wages is only asked for job-seekers, allowing for unobserved individual heterogeneity in the model would reduce my sample size considerably. For this reason, I decided to estimate this equation as a collection of cross-sections. Here, I include the same variables as the ones described in section 4.2, plus a set of indicators controlling for race, and time in the current unemployment spell.

if the individual has a child at least k years old. With that, β_1 represents the reservation wage increment given by a person with a young child, relative to a person with no children. I estimate equation 32 for different values of k and use all the 18 years of the BHPS for individuals declaring a reservation wage.

Panels (a) and (b) in figure 4 presents the marginal effects of having a young child relative to having no children for different values of k.I also estimate this equation for two different samples composed of all workers and workers with only one child, respectively. Both samples present a positive pattern in reservation wages conditional on having infants in the household, but the sample composed by all mothers shows a stronger pattern for most values of k. The sample of mothers with only one child presents a positive and statistically significant difference in reservation wages only for children up to one-year-old. This might be indicative that mothers with more than one child, that are supposed to have higher employment costs of motherhood, have higher levels of reservation wages both relative to non-mothers and mothers of a single child. However, the comparison between the two groups has, for any value of k, no statistically significant differences. Furthermore, in line with the pattern predicted by the model, the spike in reservation wages seems to be stronger in the first years of the child, when the employment costs of motherhood are supposed to be higher, and fade down over the years.

These results should, however, be interpreted with caution: given the fact that the reservation wages question is only asked for job-seekers, a lot of selection might be happening here. At the same time, such estimates can be seen as a lower-bound for the effects over reservation wages: if one believes that the mothers who leave the labour force after having children are exactly the ones for which the reservation wages rose too much after childbirth[20], the ones who survive and keep looking for a job are precisely the workers for which the employment costs of motherhood are not too high and, therefore, have a lower level of reservation wages. These are exactly the ones I can observe from the BHPS' sample. Also, one must have in

[20]The ones with non-feasible reservation wages, to use the terminology presented in section 3.

mind that the definition of reservation wage is not exactly accurate or precise. The workers in the survey are asked what is the minimum rate of pay they would be willing to receive in order to accept a job offer, and this is not necessarily something easy to answer or with a precise definition[21].

Another important measure, likely to be correlated with the employment costs of motherhood, are the costs of childcare a worker have to pay in order to be in the market and raise her children. The BHPS asks the weekly costs of childcare to working mothers in the sample. Once more, it is important to acknowledge the selection in this measure: only individuals who decide to pay for childcare and stay in the labour market are observed here. Panel (c) in figure 4 shows the marginal effects arising from equation 32, but without a constant and with the log of costs with childcare as the dependent variable. That changes the comparison group in this panel: the coefficients in panel (c) represent the increment in the costs with childcare for mothers with the youngest child with less than k years old, relative to mothers with children with at least k years old. The pattern in this panel shows that spending on childcare increases until the child is 4 years old and, from this point, decreases with the age. This coincides exactly with the minimum school entry age in the British educational system, which allows kids with at least 4 years old to enter school for two reception years[22]. Panel (d) in the same figure restricts the sample to mothers of only one child, but there is no meaningful differences from the group composed by all mothers.

Finally, the BHPS also asks the job-seeker about how many hours he or she is willing to work in case they find a job. Figure 5 presents the marginal effects calculated after the

[21] To alleviate this issue, I control equation 32 with a dummy indicating if the worker is long term unemployed. Prasad (2003), using German micro-data, finds evidence that time in unemployment may distort the worker's perception about the labour market conditions and, therefore, affect the reservation wage measure. Another possibility (to be implemented) is to check the proportion of workers who declared a given reservation wage and accepted a wage offer below this value later on.

[22] Furthermore, families having children with at least 4 years old were entitled to receive 12.5 weeks of free childcare per year in Britain since 1998. This incentive would probably increase the likelihood of a mother with a child of 4+ years old decide to use childcare and, at the same time, reduce the cost of childcare from that age. La Valle and Smith (2009) provides a good summary about this policy, and founds that this entitlement did not seem to have contributed to a significant increase in the maternal employment as intended by the policy.

estimation of equation 32 with the log of desired hours as dependent variable. Once more, I estimate the equation for different values of k and separately for men and women. The pattern in this figure is clear: on the one hand, fathers increase the number of hours they are willing to work relative to men without children, and this effect is stronger when the child is young. Mothers, on the other hand, present a reduction in the number of desired hours relative to non-mothers and this effect is stronger for those with only one child.

5.2 The Effects of Maternity Leave over Labour Supply

I estimate equation 31 using four different subsamples: all mothers, all mothers with only one child, single mothers (that are more likely to have higher employment costs of motherhood), and single mothers with only one child. Table 3 shows the DD coefficients representing the effects of the maternity leave increase over the probability of being at work one year after the birth. Column (1) shows a positive and significant effect over this probability for all mothers, with an 8.75 percentage points increase in the probability of being at work one year after birth in comparison to the control group. This is equivalent to a 21.9% increase in the probability of being at work while having an infant relative to the pre-reform period. The effect over first-child mothers (column 2) is even stronger, but not significant[23]. This is in line with some findings in the literature supporting the idea that the increase in maternity leave entitlements are more likely to affect the intensive margin of the decision of having children, rather than the extensive margin (Golightly et al., 2020).

Column (3) shows the effects of the maternity reform over employment status one year after the birth for single mothers only. The effect for this group is 61% stronger relative to

[23] I have an idea to explain this fact in a future version of my theoretical model: a first-time mother does not know exactly how large the employment costs of motherhood are. For this reason, both the pregnancy and employment decisions for workers without children are harder to anticipate. With that, these mothers are more likely to have a worse 'motherhood-match' with the firm they decide to work with. When the first birth happens and the mother discovers the true value of ECM, the likelihood of her discovering she has a bad 'motherhood-match' is higher. A mother who already has one child already has a pretty good idea about the true value of ECM and, for this reason, her signal about the value of the 'motherhood-match' after the second child is much more precise. To implement this in the model and make this reflect the findings presented in columns (1) and (2) of table 3, I could introduce a 'value of the match' component in the mother's utility that is unknown ex-ante, but has a known distribution.

the estimates for all mothers, but the difference is not statistically significant. The effects for first-child single mothers (column 5) is the strongest among the four groups, but not statistically significant. This is aligned with the argument that the first child is the one for which the employment costs of motherhood are the highest, and this is especially true for non-married mothers[24]. Figure 7 presents the predicted probabilities of being employed one year after the birth for both treatment and control groups. The pattern in this figure shows a similar behaviour for both groups before the reform, but from 2003 the two groups diverge with the control workers presenting a similar level of employment and the treated mothers with an increasing tendency to be employed over the years.

To check the credibility of my findings, I performed a placebo falsification procedure using the same data. To this end, instead of having a null hypothesis assuming that maternity leave reform had no effect on female labour supply, I test the alternative hypothesis. If I cannot reject the null hypothesis under the alternative, I have a more compelling argument in favour of my original findings. To implement this procedure, I estimated a triple-differences model (DDD) using as placebo group workers with more than 40 years old. This group is less likely to be affected by the policy change and (see figure 6), at the same time, it is unlikely to be a substitute to the group of women less than 40 years old (at least in most sectors). The model is a modification of equation 31, now including a dummy (and its interactions) indicating individuals in the placebo group:

$$\begin{gathered} Y_{i,t+k} = \alpha + \beta_1 infant_{it} + \beta_2 post_{it} + +\beta_3 infant_{it} * post_{it} + \\ \delta_1 placebo_{it} + \delta_2 placebo_{it} * infant_{it} + \delta_3 placebo_{it} * infant_{it} + \delta_4 placebo_{it} * post_{it} + \\ \delta_5 infant_{it} * post_{it} * placebo_{it} + X'_{i,t+k}\theta + \lambda_i + \delta_t + \varepsilon_{i,t+k} \end{gathered} \tag{33}$$

The parameter of interest in equation 33 is δ_5, which represents the effects of the policy change over female workers in the placebo group. The parameter β_3 still represents the

[24]Notice that a non-married mother not necessarily lives alone or does not have a partner. I have estimated the the model controlling for that, but the results do not change. I also tried to perform an analysis splitting the sample for single mothers with and without partners, but the sample sizes were too small.

effects for treated mothers. Column (5) in table 3 presents the estimates of these parameters for all mothers and shows that the effect over the treatment group is basically unchanged. Furthermore, the effect for the placebo group is much smaller and not significant. This is a piece of extra evidence that the changes calculated in 3 are mostly coming from the treated mothers, a result that is in line with the findings presented in Gruber (1994).

I also analyzed the effects of the reform in the long-term labour supply decisions. Table 4 presents the estimates of equations 31 and 33 on the probability of being at work three years after the birth[25]. The results for all mothers are similar to the ones for the short-term labour supply and much stronger for first-child mothers. However, the effects for single mothers seem to fade down over the years: for all single mothers, the effect over the probability of being employed three years after the birth is 84% smaller relative to being employed one year after the birth. For first-child single mothers who remained with only one child three years later, the effect is 32% smaller. The results about the placebo falsification procedure (in the fifth column) show once more that the majority of the effects come from the target sample of treated mothers, although the effects over the placebo sample are 4 times bigger (but not statistically significant). This could be a shred of evidence that, in the long run, other factors that are not captured by my econometric specification may affect the mother's labour supply decisions[26].

6 Limitations and Next Steps

Although the model described in section 3 already provides some interesting insights about the worker's optimum behaviour, some of its limitations are worth to be mentioned.

[25]Unfortunately, the BHPS was discontinued in 2009, making impossible to analyze the effect of the policy change in later years. However, a sub-sample of BHPS' respondents remained being interviewed in the survey's successor: the Understanding Society survey was released in 2009 and was based on the BHPS. It has the same features as its predecessor, with a lot more information, especially about children. I plan to explore the data on this survey in a later stage of this project.

[26]Furthermore, the policy change that happened in 2007 – which increased the entitlements to flat-payments by 13 weeks (and, therefore, reduced the number of non-paid maternity leave to 19 weeks) - could also contaminate part of these long-term employment outcomes.

The first one is related to the fact that the maternity leave policy only captures the first stage of the British maternity leave system, which gives a fraction of the worker's wage. The other two stages, with flat and no payments, are yet to be introduced in the model's structure. I believe this will not be a problem, since the solution procedure would be the same, only with more periods to take into account. Furthermore, my plan for the future is to define the time period of the model in weeks instead of these vague time periods I have right now. That would give me more flexibility to run counterfactuals: for instance, the effects of increasing the number of weeks with wage replacement, flat, or no payments.

This, however, generates another problem. Given the forward-looking nature of the model, the *to leave or not to leave* decision in period t depends on all decisions between t and T_1. This implies that the more periods I add to the model, the greater will be the complexity to solve it and describe an appropriate equilibrium. To tackle this issue, an idea is to impose some restrictions over the employment costs of motherhood: imagine that, instead of having 1 period of maternity leave as I have now, I have L periods of maternity leave. If ECM is decreasing and the worker decides not to leave in the first period after the start of maternity leave, it is not hard to show that she is not leaving until the last period of maternity leave. This would allow me to rule out some of the decisions outside the equilibrium path and make the solution easier.

Another thing to be improved in the model's structure is the distribution of accepted wages, so far assumed to be exogenous. A natural way to follow is to model the firm's side of the market and, imposing some sort of zero-profit condition, define a distribution of wages offered in the equilibrium. In order to avoid a sort of *Diamond Paradox Equilibrium*, I would have to introduce heterogeneity in the model. There are at least two ways of doing that: (a) by assuming heterogeneous firms that offer different wages in equilibrium; (b) by introducing heterogeneity in the worker's front; and (c) do the two things together. Option (a) could be done by assuming that different firms have different costs of having a mother absent during the maternity leave process. This would create an equilibrium in which firms with lower replacement costs would offer higher wages. Option (b) could also introduce some uncertainty in the model's structure: if neither the mother nor the firms know the exact value of ECM before the birth (but maybe the distribution of these costs), they would make decisions based on a belief about this distribution. The worker could receive a (noisy) signal about her true ECM and then formulate her reservation wage strategy. Those workers who underestimated their true value of ECM would be, therefore, more inclined to leave their jobs after birth.

Finally, five assumptions about the search process could be strengthened. The first one regards the fact that I only allow a worker to look for a job in the pre-pregnancy and in the stationary period. This is just to simplify the calculations and could be relaxed in a future version of the model. The second thing is related to the search effort of mothers and non-mothers. Although I allow different arrival rates for these workers depending on which stage of motherhood they are in, a better calibration of these rates should be proposed (maybe with some search effort background). The third issue is related to the assumption that the wage distribution for non-mothers and mothers is the same. This is something to be checked. Allowing for different distributions is, however, not hard to implement or estimate. I could also introduce job destruction in the model and this - conditional on modelling the firm side and the matching process in equilibrium - could help me to generate unemployment rates that could be used as additional moments to match in a potential structural estimation step. Finally, assuming a uniform wage distribution is not necessarily realistic nor reasonable. However, I already tested the robustness of the results allowing a log-normal and a beta distribution and my main findings seems to maintain the same pattern. An interesting thing that changes when I allow a different distribution is the proportion of workers deciding to take maternity leave: if I put a bigger mass of workers around the cutoff defined in equation 16, the proportion of leave takers changes dramatically.

On the empirical front, a lot of improvements can be implemented. The first one relates to the econometric specification and the definition of control and treatment groups. Some robustness checks could be applied by changing the definition of these groups and by deepening the placebo falsification procedure, using other groups as placebo. Another possibility is to analyze other policy changes that happened in the UK around the same period. The 1994 eligibility reform and the 2007 reform that increased the number of weeks with flat payments are two initial possibilities.

The last and most complex step for the future is related to reconciling the theoretical structure of the model with my empirical findings. My preliminary results show that the maternity leave boost in the UK indeed increased the probability of a mother being employed one year after the birth. However, I still have to calculate the fraction of these mothers that are employed in the same job they were before the pregnancy, i.e., the fraction of workers who indeed decided not to leave their job after the birth. This positive result is evidence that the employment costs of motherhood are high enough for the maternity leave boost to cause a positive effect on labour supply[27]. Furthermore, the increase in the maternity leave length only gave extra job protection for the mothers without any further payments. Although I am still not capturing this possibility in the current stage of my model, it is easy to anticipate that the only way for this to happen in the model's structure is with a significantly high level of ECM during the periods of maternity leave entitlements.

Finally, my main objective for this paper is to recover some information about the behaviour of the ECM in the different stages of motherhood. The first idea to reach this objective is to assume some functional form for ECM (something in line with assumptions 4 and 5) and try to recover the shape of this function using the policy change described above. Another possibility is to use the employment spell history from the BHPS to better understand the timing in which the mothers decide to leave their jobs after the conception. That would allow me to impose a less restrictive shape to ECM.

[27] Assuming, of course, that my model is correct.

7 Conclusion

> The role of a formal theory (besides generating testable predictions) is to help to recover some unobservable features that are needed for interpreting the results and formulating normative judgments
>
> Chiappori (1992)

The substantial increase in female labour force participation has observed a slowdown in recent years. In this paper, I propose a new explanation for this phenomenon: the employment costs of motherhood - defined as the additional cost an employed mother has to pay while raising a child - are not decreasing with time.

To this end, I propose a theoretical model that introduces the employment costs of motherhood in its structure. One of the predictions of this model is that a more generous maternity leave scheme has the potential to reduce the number of mothers deciding to leave their job after conception. Nevertheless, this is only true if the level of ECM is high enough.

Then, I exploit a policy change that happened in the UK and increased the length of job-protected maternity leave in the country. My main findings show that this increase caused a positive and significant effect on the female labour supply, but this effect tends to disappear over the years. I also estimate that the effects on single mothers are much more robust in the short run but decay faster in the long run. The effects on first-child mothers are more intense but not significant. This could be evidence that first-child mothers have more difficulty anticipating the actual value of ECM, making the labour supply decision of these workers less precise.

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Tables

Table 1: Descriptive Analysis

Variable	All Sample	Mothers of Infants	Mothers of children between 2 and 4 years old	Mothers of children between 5 and 15 years old
Female	0.53	1.00	1.00	1.00
	(0.5)	(0)	(0)	(0)
Age	47.50	30.76	33.88	37.34
	(19.08)	(8.6)	(7.64)	(10.31)
Married	0.54	0.61	0.68	0.60
	(0.5)	(0.49)	(0.47)	(0.49)
White	0.91	0.85	0.91	0.89
	(0.29)	(0.36)	(0.28)	(0.31)
Black	0.01	0.02	0.01	0.01
	(0.09)	(0.13)	(0.11)	(0.09)
Asian	0.02	0.05	0.05	0.03
	(0.14)	(0.23)	(0.21)	(0.16)
Other Races	0.01	0.00	0.00	0.01
	(0.08)	(0.07)	(0.06)	(0.08)
Has at least one Child	0.54	1	1	1
	(0.5)	(0)	(0)	(0)
Number of Natural Children	2.37	1.78	2.10	2.34
	(1.32)	(1.12)	(1.11)	(1.18)
Number of Children under 15	0.54	1.98	1.91	1.62
	(0.93)	(1.19)	(0.91)	(0.71)
Has an Infant in the Household	0.03	1.00	0.00	0.00
	(0.16)	(0)	(0)	(0)
Currently at Work	0.57	0.35	0.59	0.68
	(0.49)	(0.48)	(0.49)	(0.47)
Currently Employed	0.58	0.54	0.60	0.68
	(0.49)	(0.5)	(0.49)	(0.47)
Employed one Year Before	0.57	0.62	0.56	0.65
	(0.49)	(0.49)	(0.5)	(0.48)
N	114105	2192	4087	11861

Note: standard deviations in parentheses

Table 2: Correlation

Variables	(1) Has an Infant	(2) Married	(3) Higher Degree	(4) Partner's Income	(5) Household Income	(6) Mean Age	(7) White	(8) Black	(9) Asian	(10) Other
post	-0.0371									
	(0.0919)									
infant*post		0.0149	-0.0276	30.61	-83.89	-0.0142	-0.00569	0.0114*	0.00139	-0.00175
		(0.0189)	(0.0193)	(77.06)	(94.03)	(0.0199)	(0.0187)	(0.00660)	(0.0142)	(0.00659)
Observations	3,285	3,285	3,285	3,285	3,285	3,285	3,285	3,285	3,285	3,285
R-squared	0.800	0.046	0.069	0.457	0.462	0.999	0.040	0.033	0.066	0.007
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Individual FE	NO	YES	YES	YES	YES	NO	NO	NO	NO	NO
Individual Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Clustered standard errors in parentheses.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 3: Effects of the increase on the length of maternity leave over the probability of being at work one year after the birth - British Household Panel Survey

Variables	(1)	(2)	(3)	(4)	(5)
infant*post	0.0875**	0.117	0.141*	0.211	0.0882**
	(0.0374)	(0.0818)	(0.0720)	(0.139)	(0.0397)
infant*post*placebo					0.0357
					(0.105)
Observations	5,696	1,711	1,742	730	5,696
R-squared	0.047	0.055	0.080	0.079	0.048
Subsample 1	All Mothers	All Mothers	Single Mothers	Single Mothers	All Mothers
Subsample 2	Any # of Children	Only 1 Child	Any # of Children	Only 1 Child	Any # of Children
Year	YES	YES	YES	YES	YES
Individual	YES	YES	YES	YES	YES
Individual Controls	YES	YES	YES	YES	YES

Clustered standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4: Effects of the increase on the length of maternity leave over the probability of being at work three years after the birth - British Household Panel Survey

Variables	(1)	(2)	(3)	(4)	(5)
infant*post	0.0990**	0.214	0.0222	0.0671	0.0840*
	(0.0435)	(0.211)	(0.0707)	(0.0705)	(0.0471)
infant*post*placebo					0.146
					(0.116)
Observations	4,771	1,585	1,458	650	4,771
R-squared	0.026	0.057	0.066	0.086	0.027
Subsample 1	All Mothers	All Mothers	Single Mothers	Single Mothers	All Mothers
Subsample 2	Any # of Children	Only 1 Child	Any # of Children	Only 1 Child	Any # of Children
Year	YES	YES	YES	YES	YES
Individual	YES	YES	YES	YES	YES
Individual Controls	YES	YES	YES	YES	YES

Clustered standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Figures

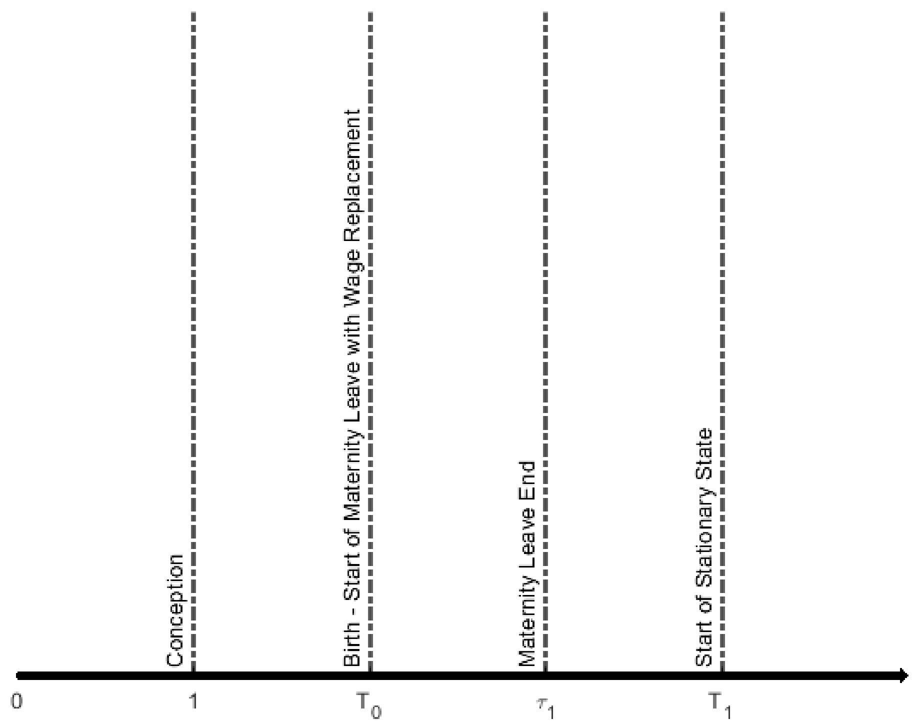

Figure 1: Model's timeline.

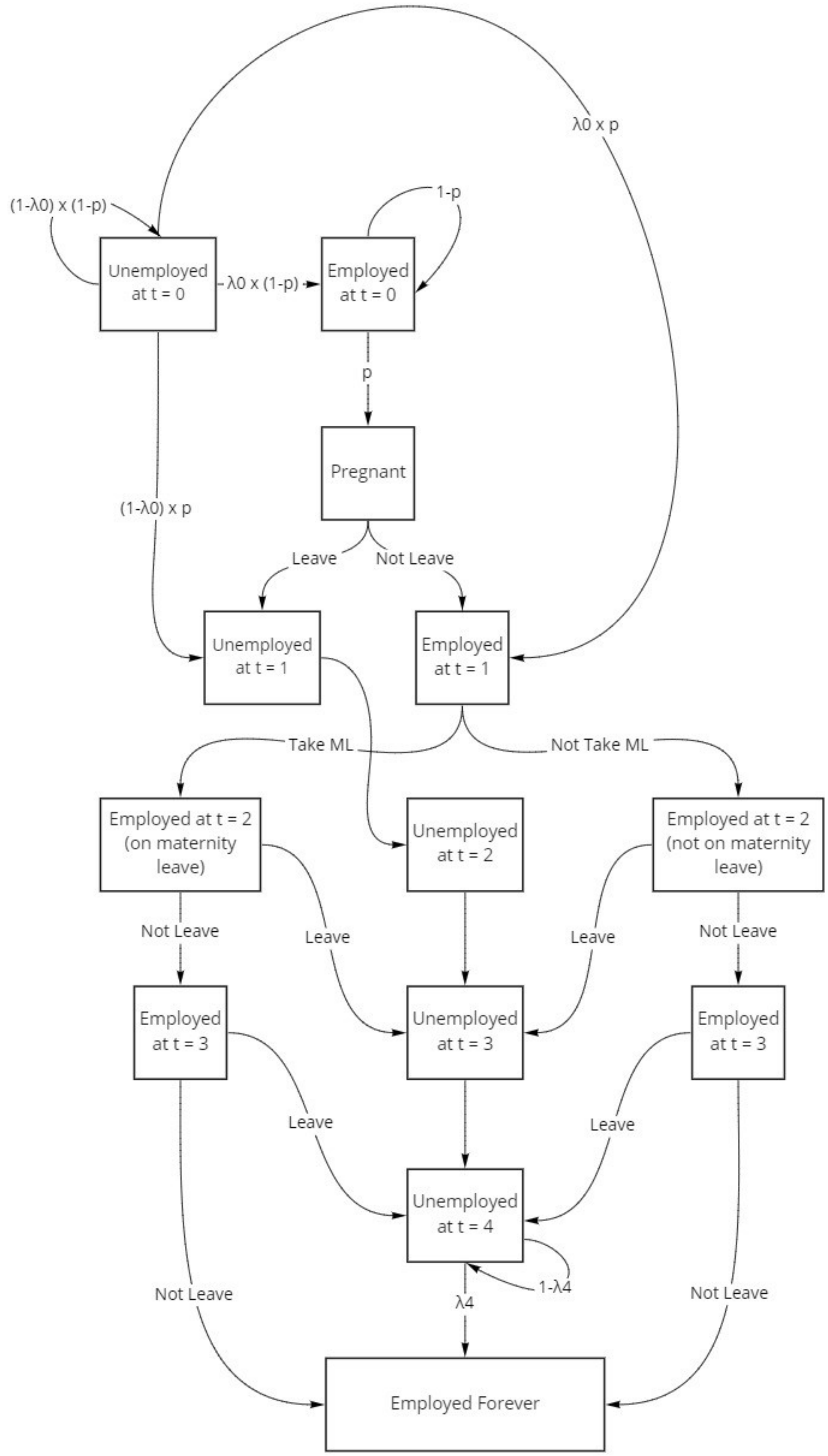

Figure 2: Model's Structure.

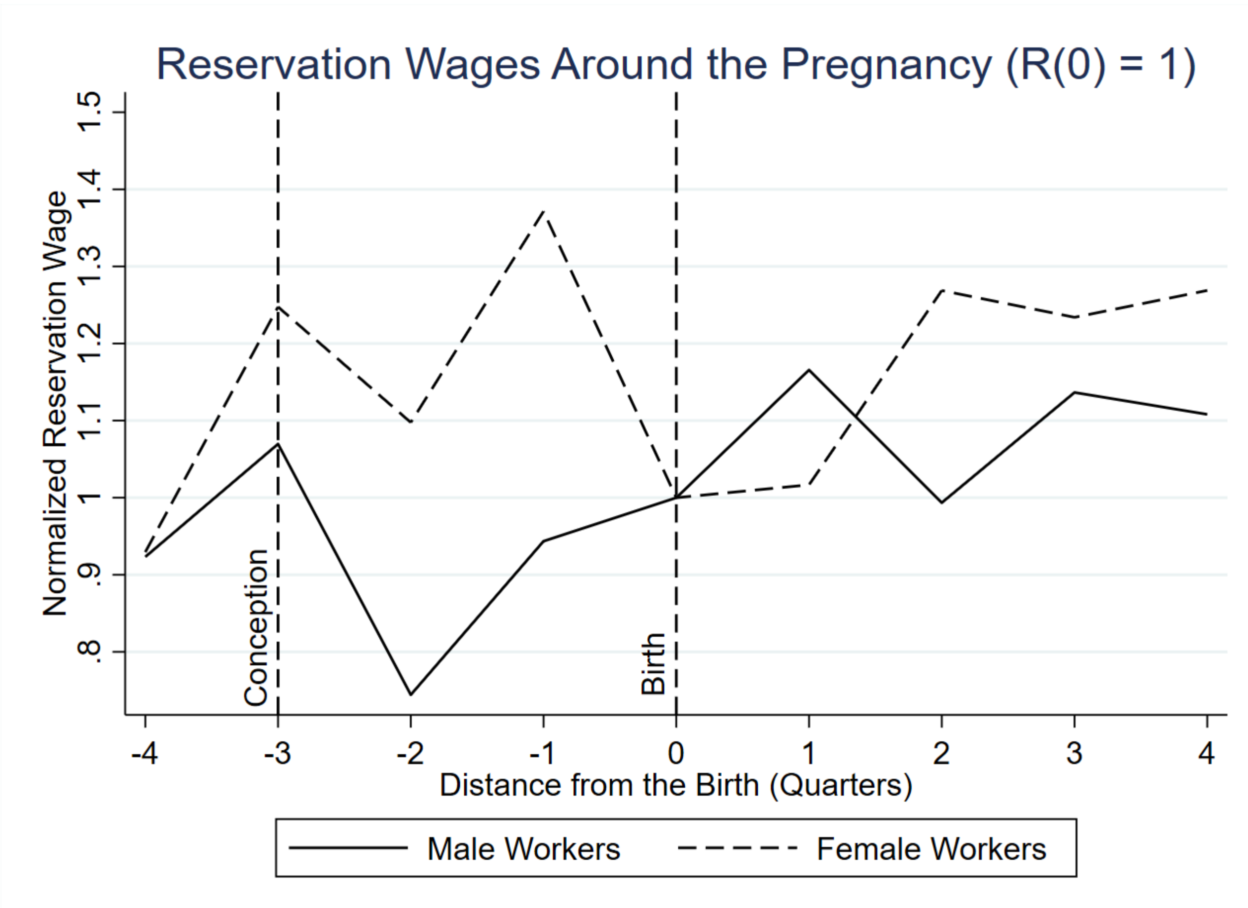

Figure 3: Average reservation wages around the pregnancy. I normalise the reservation wages to be equal to one in the quarter of birth to make men and women comparable.

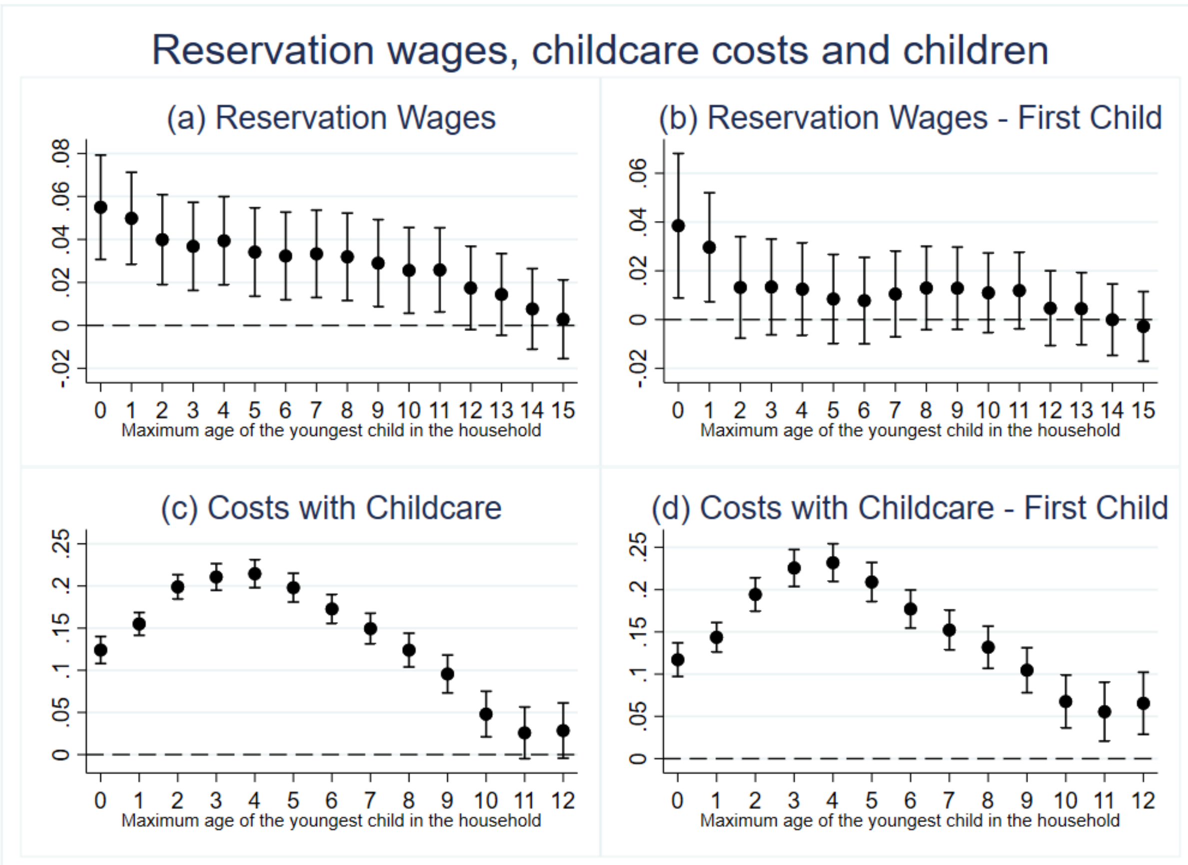

Figure 4: Correlation between reservation wages, childcare costs and the age of the worker's youngest child. Panel (a) presents the marginal effects estimated from equation 32 for female workers and different values of k. Panel (b) does the same thing, but restrict the sample to female workers with only one child. Panel (c) presents the marginal effects estimated from a modified version of equation 32, making the comparison here be between mothers of a child with at most k years old against mothers with a child with more than k years old. Panel (d) does the same thing, but for the subset of mothers with only one child.

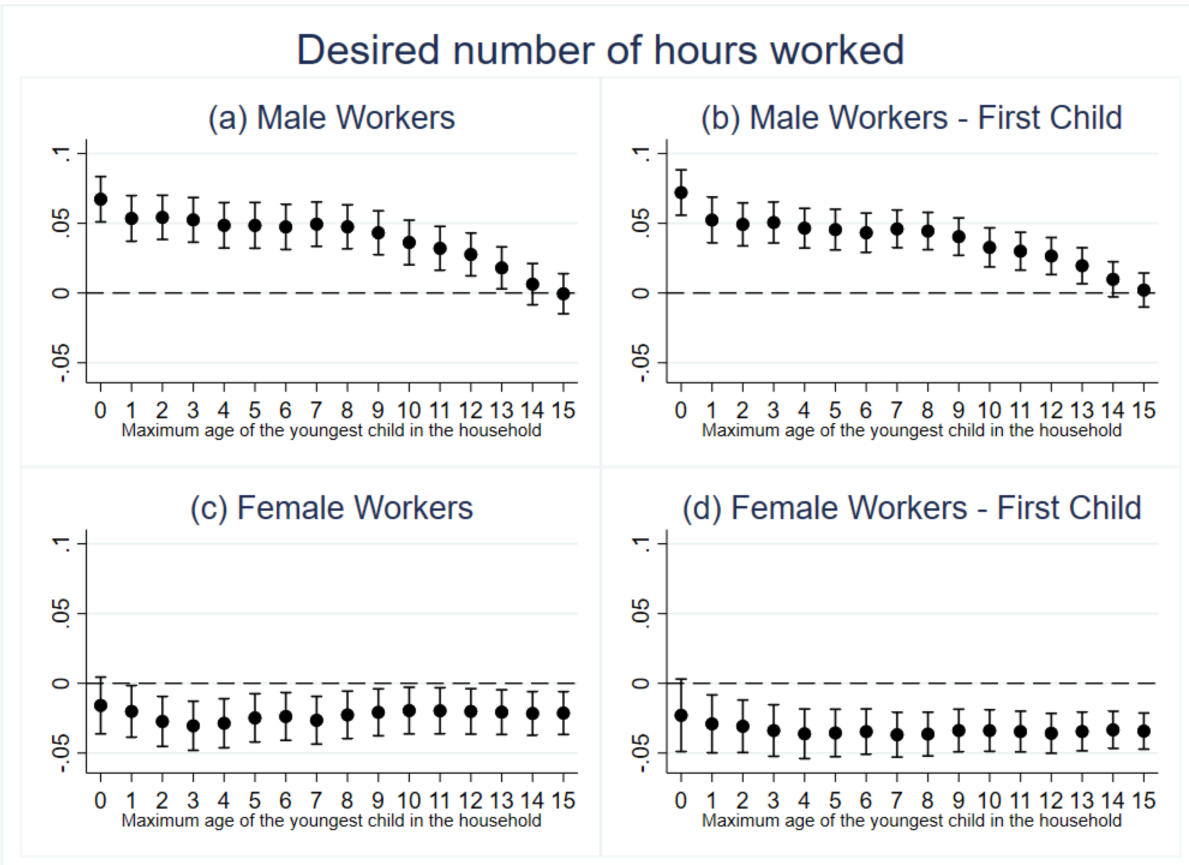

Figure 5: Correlation between the desired number of hours worked and the age of the worker's youngest child. Panels (a) and (b) presents the marginal effects estimated from equation 32 for male and female workers, respectively. Panels (c) and (d) do the same thing, but for the sample of parents with only one child.

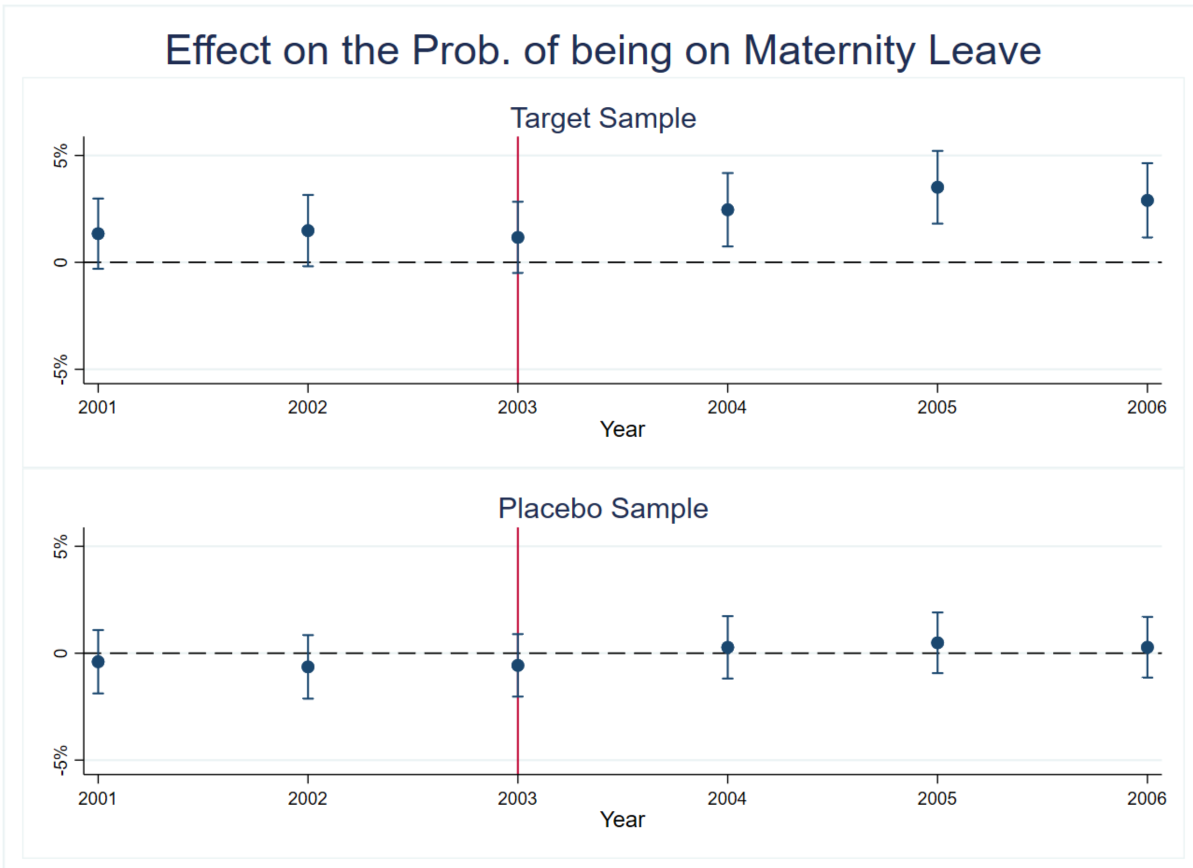

Figure 6: Event study coefficients on the probability of being on maternity leave over the years. These dots in this plot represent the relative probability of women in the treatment group being on maternity leave, relative to the control group. The coefficients are normalized to be zero in 2000. The target sample is composed by women between 18 and 40 years old. The placebo sample is composed by workers that are older than 40 years old.

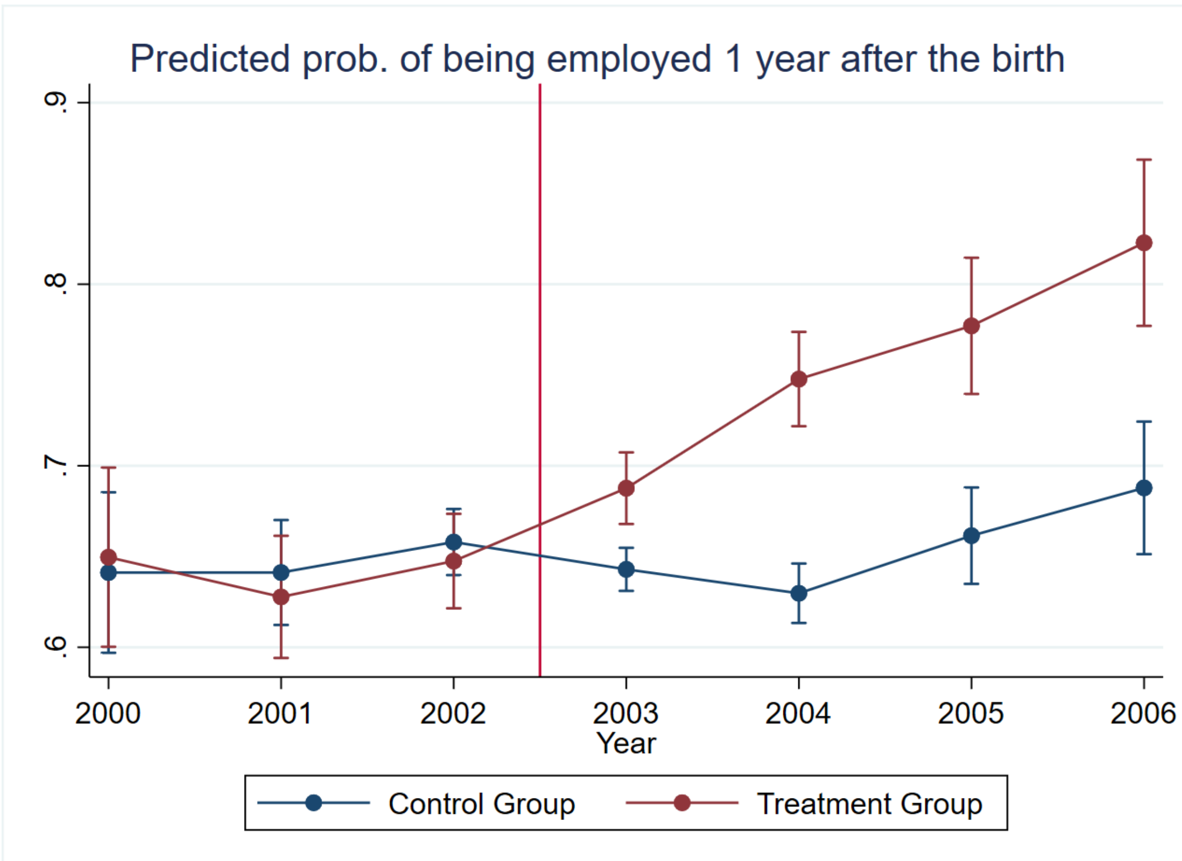

Figure 7: Predicted probabilities of being at work one year after the birth for the treatment and control groups. It is important to notice that 'one year after the birth' is anything between one and two years after the birth event. This is because of the survey design, that asks the individual's employment status in the moment of the interview. The survey also allows me to avoid workers who, for some reason, are still under maternity leave one year after the birth (they could have had two children in a row, for instance). The probability above is about the event of being employed and having worked at least one day in the week before the survey.

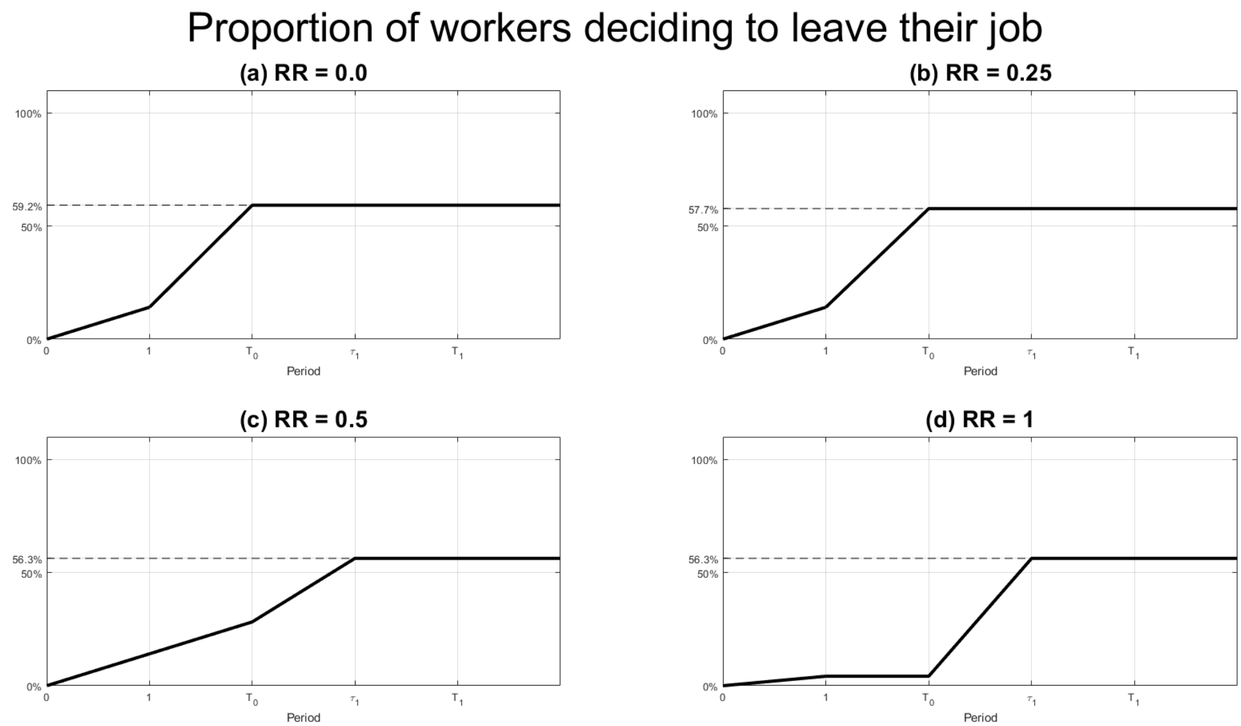

Figure 8: Proportion of workers deciding to leave their job after the conception.

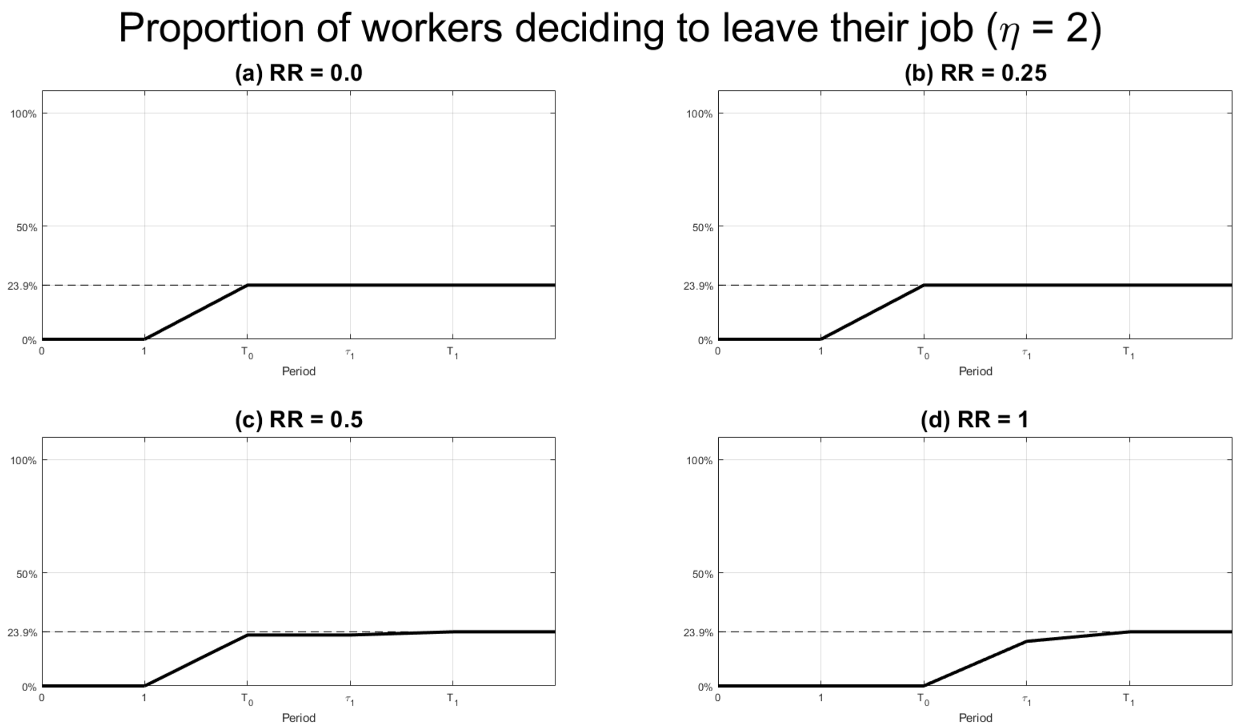

Figure 9: Proportion of workers deciding to leave their job after the conception.

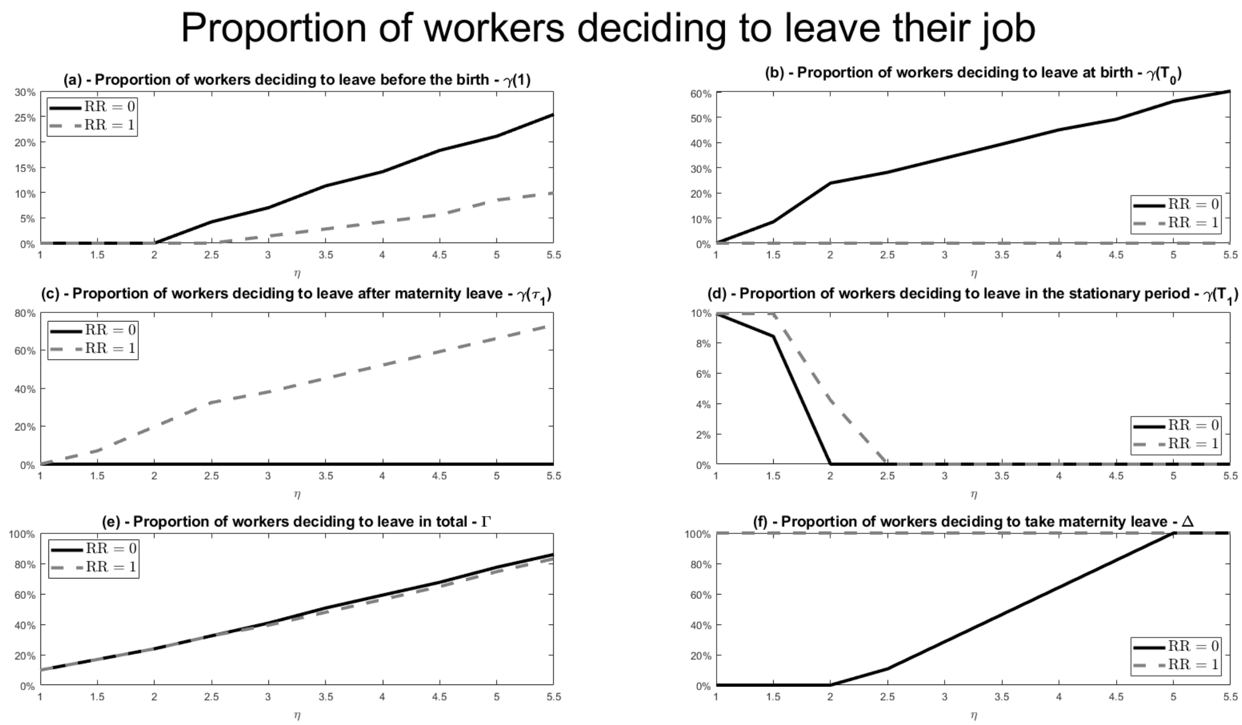

Figure 10: Proportion of workers deciding to leave their job after the conception depending on the size of ECM.

Appendices

A Proof of Result 1

Proof. The reservation wage in the stationary period $R(T_1)$ is defined such that $V^e[R(T_1), T_1] = V^u[T_1]$. First, notice that equation 11 can be rearranged such that:

$$V^e[w, T_1] = \frac{w - \mathbb{C}^e}{1 - \beta} \tag{34}$$

Second, rearranging equation 10 generates:

$$(1 - \beta)V^u(T_1) = b - \mathbb{C}^u + \beta\lambda_{T_1} \int_{\underline{w}}^{\overline{w}} max\{V^e(w', T_1) - V^u(T_1), 0\}dF(w') \tag{35}$$

Using the results provided in appendix C in the equation above yields:

$$V^u[T_1] = \frac{1}{1 - \beta}\Big\{b - \mathbb{C}^u + \lambda_{T_1}\frac{\beta}{1 - \beta}\int_{R(T_1)}^{\overline{w}} \overline{F}(w')dw'\Big\} \tag{36}$$

Equaling equations 34 and 36 with the definition of reservation wages generates:

$$R(T_1) = b + [\mathbb{C}^e - \mathbb{C}^u] + \lambda_{T_1}\frac{\beta}{1 - \beta}\int_{R(T_1)}^{\overline{w}} \overline{F}(w')dw' \tag{37}$$

This completes the proof for $t = T_1$. ■

B Proof of Result 2

Proof. Equation 13 is derived by developing equation 12 under assumption 2.

This generates a polynomial of 2nd degree:

$$\beta\lambda_{T_1}R(T_1)^2 - 2\Big\{(1-\beta)(\overline{w}-\underline{w}) + \beta\overline{w}\lambda_{T_1}\Big\}R(T_1) + \Psi + \beta\lambda_{T_1}\overline{w}^2 = 0 \tag{38}$$

where, $\Psi = 2(1-\beta)(\overline{w}-\underline{w})\Big[b + (\mathbb{C}^e - \mathbb{C}^u)\Big]$

The solutions for this equation are given by:

$$R(T_1) = \overline{w} + \Big(\frac{1-\beta}{\beta}\Big)\Big(\frac{\overline{w}-\underline{w}}{\lambda_{T_1}}\Big) \pm\sqrt{\Big(\frac{1-\beta}{\beta}\Big)\Big(\frac{\overline{w}-\underline{w}}{\lambda_{T_1}}\Big)}\sqrt{\Big(\frac{1-\beta}{\beta}\Big)\Big(\frac{\overline{w}-\underline{w}}{\lambda_{T_1}}\Big) + 2\Big\{\overline{w} - [b + (\mathbb{C}^e - \mathbb{C}^u)]\Big\}} \tag{39}$$

The first solution of this equation (that sums the 3rd term) will never be feasible and it is discarded. The second solution (that subtracts the 3rd term) is feasible only if:

$$\Big(\frac{1-\beta}{\beta}\Big)\Big(\frac{\overline{w}-\underline{w}}{\lambda_{T_1}}\Big) \leq \sqrt{\Big(\frac{1-\beta}{\beta}\Big)\Big(\frac{\overline{w}-\underline{w}}{\lambda_{T_1}}\Big)}\sqrt{\Big(\frac{1-\beta}{\beta}\Big)\Big(\frac{\overline{w}-\underline{w}}{\lambda_{T_1}}\Big) + 2\Big\{\overline{w} - [b + (\mathbb{C}^e - \mathbb{C}^u)]\Big\}}$$

Squaring and simplifying both sides of this equation yields the following condition:

$$\overline{w} - \mathbb{C}^e \geq b - \mathbb{C}^u \tag{40}$$

Now, I prove that the condition presented in equation 40 implies existence. The solution of equation 38 exists only if:

$$(1-\beta)(\overline{w}-\underline{w}) + 2\beta\lambda_{T_1}\Big\{\overline{w} - [b + (\mathbb{C}^e - \mathbb{C}^u)]\Big\} \geq 0$$

Given the condition presented in equation 40, the inequality above always holds[28].

Finally, the proof for uniqueness was already presented: if the feasibility condition holds, equation 38 has two real solutions. The first one is never feasible, implying that the feasible one is unique. ■

[28] But notice that the condition for existence itself is less restrictive. I will ignore that for the moment.

C Integrals

I start by developing the integral for $t = T_1$. First, I show how to calculate the integral on the right-hand side of equation 10. Using the definition of reservation wage $V^e[R(T_1), T_1] = V^u[T_1]$ and the fact that the value of employment is increasing in w, notice that this integral can be rewritten as:

$$\int_{\underline{w}}^{\overline{w}} max\{V^e(w', T_1) - V^u(T_1), 0\} dF(w') = \int_{R(T_1)}^{\overline{w}} \{V^e(w', T_1) - V^u(T_1)\} dF(w')$$

The solution for this integral is found using integration by parts:

$$\begin{aligned} \int_{R(T_1)}^{\overline{w}} \{V^e(w', T_1) - V^u(T_1)\} dF(w') = \Big[V^e(w', T_1) - V^u(T_1)\Big] F(w') \Bigg|_{w'=R(T_1)}^{w'=\overline{w}} - \\ \int_{R(T_1)}^{\overline{w}} \frac{\partial V^e(w', T_1)}{\partial w'} F(w') dw' \end{aligned} \tag{41}$$

Using the definition of reservation wages, notice that the first term in the right-hand side of this equation can be simplified:

$$\begin{aligned} \Big[V^e(w', T_1) - V^u(T_1)\Big] F(w') \Bigg|_{w'=R(T_1)}^{w'=\overline{w}} = \Big[V^e(\overline{w}, T_1) - V^u(T_1)\Big] F(\overline{w}) - \\ \Big[V^e(R(T_1), T_1) - V^u(T_1)\Big] F(R(T_1)) = V^e(\overline{w}, T_1) - V^u(T_1) = \int_{R(T_1)}^{\overline{w}} \frac{\partial V^e(w', T_1)}{\partial w'} dw' \end{aligned} \tag{42}$$

Plugging equation 42 in equation 41 and differentiating equation 34[29] yields:

$$\begin{aligned} \int_{R(T_1)}^{\overline{w}} \{V^e(w', T_1) - V^u(T_1)\} dF(w') = \frac{1}{1-\beta} \int_{R(T_1)}^{\overline{w}} \{1 - F(w')\} dw' = \\ \frac{1}{1-\beta} \int_{R(T_1)}^{\overline{w}} \overline{F}(w') dw' \end{aligned} \tag{43}$$

[29]The main reason for not allowing on-the-job search in the model is to simplify this step.

D Proof of Results 3, 5, and 6

Proof. The solution procedure for the reservation wages equations works as follows: conditional on the worker's decision about leaving or not leaving her job after period t, one can find the value of her reservation wages at t through the equations $V^e(R(t), t) = V^u(t)$.

For case I in result 3, the worker's reservation wage is such that:

$$R(\tau_1) - c^e(\tau_1) + \frac{\beta}{1-\beta}\big\{R(\tau_1) - \mathbb{C}^e\big\} = \frac{b - \beta\mathbb{C}^u}{1-\beta} - c^u(\tau_1) + \Big(\frac{\beta}{1-\beta}\Big)^2 \lambda_{T_1} \int_{R(T_1)}^{\overline{w}} \overline{F}(w')dw'$$

Rearranging this equation yields:

$$R(\tau_1) = b + (1-\beta)\big\{c^e(\tau_1) - c^u(\tau_1)\big\} + \beta\big\{\mathbb{C}^e - \mathbb{C}^u\big\} + \beta\frac{\lambda_{T_1}}{r}\int_{R(T_1)}^{\overline{w}} \overline{F}(w')dw'$$

Adding and subtracting βb in the right hand side of the equation above generates:

$$R(\tau_1) = \beta b + \beta\big\{\mathbb{C}^e - \mathbb{C}^u\big\} + \beta\frac{\lambda_{T_1}}{r}\int_{R(T_1)}^{\overline{w}} \overline{F}(w')dw' + (1-\beta)\big\{c^e(\tau_1) - c^u(\tau_1)\big\} + b - \beta b$$

Notice that the first three terms in the right hand side of this equation are equivalent to $\beta R(T_1)$. This implies that:

$$R(\tau_1) = \beta R(T_1) + (1-\beta)b + (1-\beta)\big\{c^e(\tau_1) - c^u(\tau_1)\big\}$$

And this equation is equal to equation 14. The procedure to calculate cases I and IV in result 5, and cases I and IV in result 6 is analogous.

All the other cases are calculated by equaling the values of employment and unemployment in each period, conditional on the worker's decision in the future. I leave the calculations for the reader. ■

E Proof of Result 4

Proof. The worker takes maternity leave if the value of taking maternity leave is not smaller than the value of not taking the leave. From equations 6 and 7, we have that $V^e(w, T_0, ML = 1) \geq V^e(w, T_0, ML = 0)$ only if:

$$w \times RR - c^u(T_0) + \beta \max \left\{ V^e(w, \tau_1), V^u(\tau_1) \right\} \geq w - c^e(T_0) + \beta \max \left\{ V^e(w, \tau_1), V^u(\tau_1) \right\} \quad (44)$$

Rearranging equation 44 generates the cutoff RR^{ML} described in equation 16. To find the minimum wage replacement value that induces all workers to take maternity leave one just need to evaluate equation 44 at the best wage in the economy ($w = \overline{w}$) and find the value of RR that makes the inequality hold. This value is $\overline{RR}$ and this completes the proof. ■