Female Employment and Child Care

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Abstract

I develop a dynamic model of labour supply, fertility, marriage, and child care decisions of women and men in a collective framework to estimate the degree of substitutability between formal child care and housework hours. I estimate the model using 1968-1996 waves of PSID. My estimates suggest that formal child care are close substitutes to housework hours implying that subsidising child care should affect its take-up. I then use the estimated model to evaluate the impact of child care subsidy programs on employment and wage profiles of women. The results indicate that such polices increase employment and wages of women only if the cost of child care is not fully subsidised and the largest increase is observed for single women from lower education backgrounds.

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1 Introduction

In the past 50 years many countries, including the US, have experienced large increases in labour force participation of women which in turn has reduced part of the gender pay gap (Blau and Kahn, 2017). Yet motherhood is still contributing to lower wages and its consequences on mothers' earnings persists throughout their working life (Adda et al., 2017; Kleven et al., 2018). Mothers take time off work and work fewer hours after having children and the lower working hours of women arguably contribute to the remaining gender pay gap associated with lower human capital of women (Blundell et al., 2016; Francesconi, 2002).

In light of the increases in involvement of women in the labour market, the need for policies balancing family-work life of mothers are becoming ever more relevant and provision of affordable child care could conceivably contribute to such a balance (Attanasio et al., 2008). Due to the relevance of such policies for women' employment, various countries have adopted child care support programs. However, the role of child care policies on labour supply of mothers is not well understood and the literature studying the impact of these policies provide mixed evidence on how these policies impact mothers' labour supply (See Blau and Currie (2006), and Morrissey (2017) for surveys).

The main objective of this paper is therefore to provide further empirical evidence on how child care support affects female employment and fertility behaviour. There are various mechanisms through which child care policies affect labour supply. First, such policies might increase labour supply of mothers by reducing reservation wage but might also decrease participation or hours of work by increasing net labour income. The second mechanism is through production of the main public good produced in the household, i.e. children (Becker, 1973). Since child care contributes to production of this public good, subsidising its costs can change the gains from marriage. Such subsidies therefore could not only affect married and single individuals differently, but also could have an impact on marital decisions.

To understand the issues related to employment and child care decisions, I develop a discrete choice dynamic programming model of employment and child care decisions in a collective framework with no commitment and estimate it using the Panel Study of Income Dynamics in the US. In the model, wages, employment, child care usage, fertility, and marital decisions are endogenously determined and part-time and full-time human capital affect wages differently. Household decisions are modelled using a Nash bargaining framework, where outside options are specified as spouses' value of making decisions as single individuals. This framework allows me to study the long-term impacts of child care subsidy programs on wages and various life-cycle outcomes of women and men.

The closest paper to this article is Chan and Liu (2018) developing a life-cycle model of female labour supply, fertility, and child care decisions to study the labour supply responses to child care programs in Norway [1][2]. My paper builds on their model in the following ways: first, I allow for mothers and fathers to gain utility from the time spent with the child through production of a public good that can be enjoyed by both parents. Therefore, children are equivalent to a household good produced by the out of labour market time of parents as well as the time that a child spends in day care. By modelling the choice of purchasing child care together with labour supply of women and men, I intend to understand: first, whether the time spent by the parents in producing the household good (children) and the time that a child spends in day care are substitutable. Second, if the different returns to part-time and full-time employment affects the affordability and therefore the use of child care.

Secondly, Chan and Liu (2018) model the decisions of women in a unitary framework while I allow for the labour supply decisions of both husbands and wives to be determined through a collective model with no commitment [3]. Modelling marital and labour supply decisions allow me to incorporate the considerations of women regarding loss of human capital and therefore lower income upon divorce. Child care programs on one hand might improve outside option to marriage by decreasing cost of child care upon divorce to the extent that women with lower investment in labour market might find divorce less costly. In this case, specialization in the labour market to self-insure against loss of human capital might be less valuable and one would expect to observe a decrease or no impact of such subsidies on labour supply. On the other hand, if child care subsidies leads to specialization in home production and therefore lower labour supply, wives' net income versus the net income of their partners upon divorce might be lower. In a collective framework, the partner with lower outside option has to transfer more resources to the partner to make marriage a feasible option. Therefore, if consumption is relatively more valuable than home production, we would expect an increase in mothers' labour supply. Therefore, the net effect of subsidies when marital decisions are taken into account remains ambiguous.

The present paper therefore contributes to the existing literature on child care and

[1]For a survey on Discrete Choice Dynamic Programming literature, see Keane et al. (2011).

[2]Estimating labour supply responses to child care programs goes back to Heckman (1974). Ribar (1995), Apps et al. (2016), and Gong and Breunig (2017) are among the papers that study the choice of child care and labour supply in a static framework. Del Boca (2002) and Haan and Wrohlich (2011) model fertility and labour supply decisions but they do not explicitly model human capital formation.

[3]The first paper that includes marriage as a choice in a discrete choice dynamic framework is Van der Klaauw (1996) but he uses a unitary setting. See (Gemici and Laufer, 2011), (Mazzocco and Yamaguchi, 2006), and (Eckstein et al., 2016), and (Voena, 2015) for dynamic models that incorporate marital decisions in a collective framework with no commitment.

female labour supply, in three ways: first, I empirically document that the hourly returns to full-time and part-time experiences are not different although there are large differences in the wage levels. This difference implies that full-time and part-time wages differ in other dimensions such as occupation rather than in returns to human capital. The second contribution of this paper is to estimate the degree of substitutability between formal child care and housework hours. Taking into account wages, employment, fertility, and marital decisions in the households, I show that housework hours and hours of child care are close substitutes. This result indicates that changes in the cost of childcare should have significant effects on child care take-up and female labour supply decisions.

The third contribution of this paper is to study the implications of free child care policy programs on child care take-up, wages, employment, and marital decisions. To study the precise nature of the impact of changes in childcare costs I conduct several policy experiments with different levels of child care cost subsidies. The first observation from this experiment is that as child care gets more subsidised, its take-up increases. Since child care is an input into household good production (children), a decrease in its cost increases its usage. Secondly, female labour supply responses depend on marital status with single mothers, specifically from lower education backgrounds, responding the most. Since child care is an input into the production function, parents want to use it. However since its cost is not fully subsidised, single mothers have to participate in the labour market to pay for the fraction of the cost which is not subsidised. As a result, single mothers work more. A 10 percent decrease in the cost of child care is associated with a 5.4 percent increase in lower educated single mothers' participation rate. This increase in labour supply, is associated with a 2.4 percent increase in life-time wages of lower educated mothers. However, married mothers do not need to increase their participation as much since they can use the husbands' income to finance the remaining cost of care therefore their labour supply remains almost unchanged. Thirdly, as the subsidies get more generous, single mothers' labour supply increases and they work more in the full-time employment sector and therefore the increase in their wages becomes more salient. An important observation is that when the cost of child care is fully subsidised, both single and married mothers decrease their labour supply. Therefore, if the purpose of such policies is to increase female labour supply and wages, only a fraction of child care costs should be subsidised.

Lastly, I exploit the implications of the policy experiments mentioned above on the marriage market. Following the adoption of partially subsidised child care, the fraction of divorcees decreases. This result is observed because partly subsidised child care programs increase the gains from specialization in marriage. Married mothers can use the subsidised child care while there is no need for them to participate in the labour market because

their partners can finance the remaining cost of child care. Women therefore specialize in household production and their partners in the labour market. This gain from specialization reduces the fraction of divorced individuals. On the other hand, when child care is fully subsidised there is no need for specialization in the household since there is no cost associated with using child care. Therefore, the policy decreases the costs of divorce and leads to an increase in the fraction of divorcees.

The next section, discusses the model. Section 2 explains the data used i the estimation. Sections 4 and 5 explain the estimation and report the estimated parameters of the model. Section 6 reports the results of the policy experiments.

2 Model

In this section I develop a dynamic model of labour supply, fertility, child care, and marital decisions of women w and men m. I start modeling behaviour of non-college and college graduate individuals at age $a = 18$ and $a = 22$, respectively. Individual i can be a woman or man, $j \in \{w, m\}$, and starts her/his finite life with no work experience and the decision horizon ends at age $A = 50$, an age after which there are no fertility decisions for most people.

2.1 Choice Sets

In each period, labour supply, fertility, child care, and marital decisions are endogenously determined as a result of an individual's or a couple's optimizing behaviour. Men always work full-time but women can choose between three different states of employment denoted by $k \in \{f, p, o\}$ representing full-time (f) and part-time (p) employment, and not working (o). At each age a, individuals decide on labour supply (l_a^j), fertility ($n_a^j \in \{0, 1\}$) as well as the decision to marry. Mothers and fathers also decide on how much child care to use ($H_{CC,a}^j$). Hours of child care are also discrete: $CC \in \{f_{cc}, p_{cc}, o_{cc}\}$ representing full-time, part-time and no child care, respectively. When married, husband and wife jointly decide on the above choices as well as the decision to divorce. The vector of choices are as follows:

Single men's choices: $\Psi_{single}^m = (l_a^m, H_{CC,a}^m, n_a^m)$

Single women's choices: $\Psi_{single}^f = (l_a^w, H_{CC,a}^w, n_a^w)$

Married couple's choices: $\Psi_{mar} = (l_a^w, l_a^m, H_{CC,a}, n_a)$

2.2 Human Capital and Wage Equations

In estimating the returns to participation in the labour market, one of the main issues is selection bias (Heckman, 1977). The problem is that wages of non workers are not

observed. If those who decide to work are individuals with a higher productivity at home, by ignoring the wages of non-workers, one might get a selection bias in estimation of the wage equation. A similar selection problem persists when we estimate the returns to part-time and full-time employment decisions. In particular, there might be some unobserved factors which affect part-time and full-time employment decisions and are correlated with observed factors such as labour market experience, presence of children, marriage, and/or availability of child care. I address the problem of selection bias by estimating part-time and full-time wage equations, which are functions of observed and unobserved factors, together with participation decisions. The dynamic unobserved factors can endogenize the impact of factors affecting wages, which are not observed in the data but eventually determine participation into part-time and full-time employment.

Previous work on the issues related to part-time and full-time employment has addressed the differences in part-time and full-time human capital in different ways. Blundell et al. (2016) estimate a wage equation in which part-time employment affects wages through depreciating the human capital and they allow for this depreciation rate to vary by education levels. However, they do not differentiate between accumulated part-time and full-time human capital. In Keane and Wolpin (2010) wage equation, the previous part-time and full-time employment status affects wages differently but they also do not model the life-cycle part- and full-time human capital. They further allow for the rental price of part- and full-time employed individuals to differ. Adda et al. (2017) assume that part-time employment increases human capital by half of full-time employment. Chan and Liu (2018) model the life-time stock of part-time and full-time human but they do not allow the effect of these different experiences to differ by current employment status of the individual. To my knowledge, Francesconi (2002) is the only paper which allows for the differential impact of life-time stock of part- and full-time human capital on wages and also estimates different wage equations based on individual's current employment status.

I estimate wage equations similar to Francesconi (2002) to address various effects of part- and full-time working experience on wages and to understand whether these effects differ from each other. Part-time and full-time hourly wage equations are:

$$\begin{aligned} log(y^w_{k,a}) = \beta^w_{0,k} + \beta^w_{1,k} X_{f,a-1} + \beta^w_{2,k} (X_{f,a-1})^2 \\ + \beta^w_{3,k} S^w + \beta_{4,k} X_{p,a-1} \\ + \beta_{5,k} (X_{p,a-1})^2 + \epsilon^w_{k,a} \end{aligned}$$

$y^w_{k,a}$ are women's hourly wages depending on age and employment status $k \in \{f, p\}$. X_k are part-time and full-time specific experiences. $S^w \in \{0, 1\}$ is equal to 1 if the in-

dividual is a college graduate and is equal to 0 if has lower education levels. $\epsilon^w_{k,a}$ reflect any changes in earnings which is independent of household decision process [4]. $\epsilon^w_{k,a}$ are per period shocks to full-time and part-time wage offers. In the wage equations, hours of work are translated into part-time and full-time experience levels which affect wages differently and the returns to full-time and part-time experiences vary by the current employment status. Allowing such differences in parameters can generate state dependence in part-time and full-time employment and enforce employment in the sector with a higher accumulated human capital.

Since men only work full-time their wages depend only on full-time experience:

$$log(y^m_{f,a}) = \beta^m_{0,f} + \beta^m_{1,f} X_{f,a-1} + \beta^m_{2,f}(X_{f,a-1})^2 + \beta^m_{3,f} S^m + \epsilon^m_{f,a}$$

$\epsilon^m_{f,t}$ is the shock to the full-time wage offers of men. The wage shocks are independently and identically normally distributed:

$$\epsilon^m_{f,a} \overset{i.i.d}{\sim} N(0, (\sigma^m_f)^2)$$
$$\epsilon^w_{f,a} \overset{i.i.d}{\sim} N(0, (\sigma^w_f)^2)$$
$$\epsilon^w_{p,a} \overset{i.i.d}{\sim} N(0, (\sigma^w_p)^2)$$

The dynamics is introduced to the model using a learning-by-doing framework in which past experiences directly determine wages. In a learning by doing model the value of work is no longer simply wages but includes the return to experience. Part-time and full-time work experience accumulate according to the following laws of motion:

$$X^j_{f,a} = X^j_{f,a-1} + 1 \times 1\{l^j_a = f\}$$
$$X^w_{p,a} = X^w_{p,a-1} + 1 \times 1\{l^w_a = p\}$$

By working full-time or part time the sector specific human capital accumulates by 1. Since men always work full-time, their age and experience can be used interchangeably; e.g. a male college graduate's full-time experience is $X^m_{f,a} = age^m - 22$.

[4] I expect the estimated wage equations to differ from Francesconi (2002) since my unconditional wage estimates take into account not only fertility and employment decisions but also marital and child care decisions.

2.3 Individual's and Couple's Problems

In the model, single and married individuals face different choice sets, state spaces, and constraints. See section 2.5 for the set of variables that enter the state space. I start with explaining the behaviour of single individuals in the terminal period A and then I move backwards to period $A-1$. I explain the model from the terminal period since the model does not have a closed form solution and it is solved numerically using backward recursion.

2.3.1 Singles at age A

The individual's problem in the terminal period is to maximize the instantaneous utility subject to budget and time constraints. The individual's problem in period A is characterized as follows:

$$V_A^j(\Omega_A^j) = \max_{\Psi_{single}^j} \quad U(c_A^j, Q_{1,A}^j, Q_{2,A}^j, \epsilon)$$

$$s.t. \qquad h_A^j = 17 - l_A^j$$

$$y_{f,A}^j l_A^j \times 1\{l_A^j = f\} + y_{p,A}^w l_A^w \times 1\{l_A^w = p\} = c_A^j + (\pi_{CC} + \epsilon_{CC,A}) H_{CC,A}^j \times N_A^j$$

$$Q_{1,A} = f(h_A^j)$$
$$Q_{2,A} = f(h_A^j, H_{CC,A}^j) \times N_A^j$$

In each period, individuals gain utility from consumption of a private good (c_A) and household goods. There are two different types of household goods: $Q_{1,A}$ and $Q_{2,A}$. $Q_{1,A}$ represents value of goods produced at home such as a meal or a clean house. $Q_{2,A}$ serves as child's qualities which are valued by the parent: such as the child's kindness, honesty or self-discipline. Parents enjoy $Q_{2,A}$ in addition to $Q_{1,A}$ while individuals without a child only gain utility from $Q_{1,A}$. ϵ is a vector of preference shocks containing per period shocks to utility of having a child $\epsilon_{ch,A}$ and utility of being married $\epsilon_{mar,A}$. Ω_A^j comprises of the values of state variables of individual j in period A. h_A^j represents housework hours of individual j, π_{CC} represents hourly cost of child care and $\epsilon_{CC,A}$ is shocks to the cost of child care. $H_{CC,A}^j$ is market hours of child care. Household goods are produced using housework hours. However, parents can use both housework hours and formal child care in the child quality production function. I assume that only formal child care enters the production function. This implies that any other type of child care such as care given

by grandparents do not have a role in household good production [5]. The problem of the single individual is therefore to find a combination of employment, fertility and child care decisions which maximizes his/her utility. Finally, $V_A^j(\Omega_A^j)$ is the the value function for individual j at state Ω_A^j when j is single. The transitory shocks to child care costs, and preference shocks are distributed as follows:

$$\epsilon_{CC,a} \overset{i.i.d}{\sim} N(0, \sigma_{CC}^2)$$
$$\epsilon_{ch,a} \overset{i.i.d}{\sim} N(0, \sigma_{ch}^2)$$
$$\epsilon_{mar,a} \overset{i.i.d}{\sim} N(0, \sigma_{mar}^2)$$

I assume a static budget constraint which does not allow for consumption smoothing through savings over the life-cycle. Although, a model with endogenous savings and human capital would be more realistic, I have made the choice of focusing on the endogenous part-time and full-time human capital accumulation of women. Adding another source of dynamics to the model increases the state space and adds considerable computational burden to the solution of the model.

2.3.2 Couples at age A

Value of marriage is determined by solving a Nash bargaining problem in which the outside options are defined as values of remaining/becoming single of each partner. In solving the bargaining problem, this paper is similar to (Manser and Brown, 1980; McElroy and Horney, 1990), since the bargaining problem is solved as a solution to a Nash bargaining problem. The outside option (threat point) is given by the utility of an agent in case negotiations break. Therefore, the threat point in a household bargaining model is the value of divorce or the value of remaining single. The outcome of Nash bargaining is characterized by the solution to the following maximization problem:

$$\max_{\{c_A^j, \Psi_{mar}\}} (U(c_A^m, Q_{1,A}, Q_{2,A}, \epsilon) - V_A^m(\Omega_A^m))^\theta (U(c_A^w, Q_{1,A}, Q_{2,A}, \epsilon) - V_A^w(\Omega_A^w))^{(1-\theta)}$$

[5] Bick (2016), Gong and Breunig (2017), and Chan and Liu (2018) are among the papers that model different forms of child care. However, these models do not estimate the degree of substitutability between different types of child care. Furthermore, Chan and Liu (2018) finds that the impact of informal care on test scores are negative.

$$
\begin{aligned}
s.t. \qquad & h_A^j = 17 - l_A^j, \qquad j = m, w \\
\sum_{j=m,w} & NI^j + y_{f,A}^m l_A^m + y_{f,A}^w l_A^w \times 1\{l_A^w = f\} + y_A^w l_A^w \times 1\{l_A^w = p\} \\
& = \sum_{j=m,w} c_A^j + (\pi_{CC} + \epsilon_{CC,A}) h_{CC,A} \times N_A \\
& G_A = f(h_A^m, h_A^w) \\
& Q_{1,A} = f(G_A) \\
& Q_{2,A} = f(G_A, H_{CC,A}) \times N_A
\end{aligned}
$$

In the Nash product, $V_A^j(\Omega_A^j)$ is the value of being single for individual j. θ determines the bargaining power of each spouse. G_A is a composite good produced at home with the housework hours of men and women. The composite good will be used in production of household goods $Q_{1,A}$ and $Q_{2,A}$. By solving the above maximization problem, optimal transfers and optimal choice within marriage can be found. I denote by $W_A^j(\Omega_A)$, $j = m, w$, the value functions for both partners corresponding to the optimal choices of the couple obtained from Nash bargaining. These value functions include the optimal transfers between spouses through their individual incomes and individual consumption.

2.3.3 Singles at age $a < A$

Single individual's problem at age $a < A$ is to maximize the instantaneous utility as well as the expected discounted value of life-time utility. If individual j meets a potential partner, they can decide to marry which affects their value functions at age $a+1$. For $a+1 = A$, this was explained in Section 2.3.2. For $a + 1 < A$, the Nash bargaining problem is described in Section 2.3.5. The individual's problem in period a is characterized as follows:

$$
V_a^j(\Omega_a^j) = \max_{\Psi_{single}^j} U(c_a^j, Q_{1,a}^j, Q_{2,a}^j, \epsilon) + \delta \begin{cases} E[V_{a+1}^j(\Omega_{a+1}^j|\Omega_a^j)], & \text{if stays single} \\ E[W_{a+1}^j(\Omega_{a+1}|\Omega_a)], & \text{if gets married} \end{cases}
$$

$$
\begin{aligned}
s.t. \qquad & h_a^j = 17 - l_a^j \\
& y_{f,a}^j l_a^j \times 1\{l_a^j = f\} + y_{p,a}^w l_a^w \times 1\{l_a^w = p\} = c_a^j + (\pi_{CC} + \epsilon_{CC,a}) H_{CC,a}^j \times N_a^j \\
& Q_{1,a} = f(h_a^j) \\
& Q_{2,a} = f(h_a^j, H_{CC,a}^j) \times N_a^j
\end{aligned}
$$

δ is the discount factor. If j decides to marry the match, then the problem will involve calculations of future expected values of getting married [6]. Therefore, expected future values of life-time utility for single individuals include the expectations from future possibilities of getting married.

2.3.4 Marriage Market

In each period a, individual j meets a potential partner with probability ω. When a meeting occurs, the characteristics of the potential partner are determined by a random draw from the distribution of potential partners. These characteristics of the potential partners are discretely uniformly distributed. I assume that individuals always meet a potential partner of the same age. This assumption is made due to the computational purposes, to avoid including age of the partner as a variable in the state space. Therefore, the characteristics of a potential spouse of a woman, only includes education and current stock of children of the partner because age of men are enough characteristics to learn about work experiences of men. However, vector of characteristics for potential spouse of a man includes full-time and part-time experience levels of the woman.

2.3.5 Couples at age $a < A$

As for $a = A$, value of marriage in period a is determined by solving a Nash bargaining problem in which the outside options are defined as values of remaining/becoming single of each partner. The outside options in period $a < A$ also include the possibilities of possible future marriages. Following Mazzocco (2007) I assume a no commitment model in which individuals cannot commit to allocation of future resources. The outcome of Nash bargaining is characterized by the solution to the following maximization problem:

$$\max_{\{c_a^j, \Psi_{mar}\}} \left(U(c_a^m, Q_{1,a}, Q_{2,a}, \epsilon) + \delta \begin{Bmatrix} E[V_{a+1}^m(\Omega_{a+1}^m|\Omega_a^m)], & \text{if single} \\ E[W_{a+1}^m(\Omega_{a+1}|\Omega_a)], & \text{if married} \end{Bmatrix} - V_a^m(\Omega_a^m) \right)^{\theta}$$
$$\left((U(c_a^w, Q_{1,a}, Q_{2,a}, \epsilon) + \delta \begin{Bmatrix} E[V_{a+1}^w(\Omega_{a+1}^w|\Omega_a^w)], & \text{if single} \\ E[W_{a+1}^w(\Omega_{a+1}|\Omega_a)], & \text{if married} \end{Bmatrix} - V_a^w(\Omega_a^w) \right)^{(1-\theta)}$$

[6] The expectations are taken over the transitory shocks and are calculated using Monte Carlo Integration.

$$
\begin{aligned}
s.t. \qquad & h_A^j = 17 - l_A^j, \qquad j = m, w \\
& y_{f,A}^m l_A^m + y_{f,A}^w l_A^w \times 1\{l_A^w = f\} + y_A^w l_A^w \times 1\{l_A^w = p\} \\
& = \sum_{j=m,w} c_A^j + (\pi_{CC} + \epsilon_{CC,A}) h_{CC,A} \times N_a \\
& G_A = f(h_A^m, h_A^w) \\
& Q_{1,A} = f(G_A) \\
& Q_{2,A} = f(G_A, H_{CC,A}) \times N_a
\end{aligned}
$$

The solution to the above problem, entails all possibilities of future marriages and future values of remaining single. Considering the possibilities of future marriages and divorces, optimal transfers and optimal choice within marriage will be determined. The marriage decision of individual j at age a, affects the value functions at age $a+1$. If individual j decides to get divorce, his value function in period $a+1$, will be a single individual's value function and if decides to stay married, his value function in period $a+1$ will be a married individual's value function. For period $a+1 = A$, the calculation of single value functions and married value functions were explained in Sections 2.3.1 and 2.3.2, respectively.

2.4 Functional Forms

2.4.1 Preferences

The instantaneous utility function is:

$$
\begin{aligned}
U_a = \ & \alpha_c \, c_a + \alpha_{q1} \, Q_{1,a} + (\alpha_{q2} \, Q_{2,a} + \alpha_{ch} + \epsilon_{ch,a}) \times N_a + \epsilon_{mar,a} \times 1\{married\} + \\
& \alpha_f \times 1\{l_a^w = f\} + \alpha_p \times 1\{l_a^w = p\} + \alpha_{nw} \times 1\{l_a^w = o\}
\end{aligned}
$$

α_c and α_{q1} represent marginal utility of consumption and household goods. α_{q2} represents marginal utility from child's quality. α_{ch} is the direct utility from having a child. $\epsilon_{ch,a}$ and $\epsilon_{mar,a}$ are per period shocks to utility of having a child and being married. $\alpha_f, \alpha_p, \alpha_{nw}$ are direct utility/disutility from working full-time, part-time and not working. I assume that marginal utility of consumption and home production for men and women are the same.

2.4.2 Household Production

Singles: Single individuals without a child produce the household good using housework hours:

$$Q_{1a}^{j} = \lambda h_a^j$$

λ represents marginal productivity of housework hours. When a child is present in the household, housework hours can be used not only to produce the household good, but also contribute to production of child's quality which is enjoyed by the mother/father.

$$Q_{2a}^{j} = \lambda\Big((h_a^j)^{\gamma} + (H_{CC_a^j})^{\gamma}\Big)^{\frac{1}{\gamma}}$$

I assume a Constant Elasticity of Substitution (CES) production technology to estimate the degree of substitutability between housework hours and formal child care. γ determines this degree of substitutability.

Couples: When individuals are married both husband's and wife's housework hours are spent on production of a composite good (G_a).

$$G_a = \alpha_m h_a^m + \alpha_w h_a^f$$

Blundell et al. (2018) estimate the degree of substitutability between housework hours spent on child care of mothers and fathers and find that the two inputs are substitutable. I also assume that housework hours of men and women are perfect substitutes. Therefore, production of this composite good depends only on the marginal productivity of husband's (α_m) and wife's (α_w) housework hours [7]. This composite good is an input into production of household's goods.

$$Q_{1a} = \lambda G_a$$

Similar to the case of single individuals, when a child is present the production function takes the following CES functional form:

$$Q_{2a} = \lambda\Big(G_a^{\gamma} + (H_{CC_a})^{\gamma}\Big)^{\frac{1}{\gamma}}$$

The only difference between the production of household goods of single and married individuals is that the inputs into single individual's production function is the individual's housework hours. On the other hand, married individuals use the composite good as an input into the production function.

One limitation of this framework is that I refrain from modelling child development which implies that parents only gain utility from per period child quality. In this setting

[7] Thoresen and Vattø (2019) develop a static model of labour supply and child care of both fathers and mothers.

the decision to use child care or spend time with the child at home does not affect the future cognitive or non-cognitive quality of the child. Recent papers that model child care decisions and its impact on children's outcomes are (Bernal, 2008), Griffen (2018) and Del Boca et al. (2014) however these papers do not model life-cycle labour supply of mothers. Griffen (2018) develops a life-cycle model of labour supply, child care and child development decisions but does not model fertility or marital decisions.

2.5 State Space

The state space of a single man comprises of education, full-time experience, stock of children (N_a^m), wage shocks, child care costs' shocks ($\epsilon_{CC,a}$), and shocks to utility of having children ($\epsilon_{ch,a}$).

$$\Omega_a^m = \{S^m, X_{f,a-1}^m, N_a^m, \epsilon_{f,a}^m, \epsilon_{ch,a}, \epsilon_{CC,a}\}$$

State space for a single woman, contains all the above variables as well as her part-time experience and shocks to her part-time wage.

$$\Omega_a^w = \{S^w, X_{f,a-1}^w, X_{p,a-1}^w, N_a^w, \epsilon_{f,a}^w, \epsilon_{p,a}^w, \epsilon_{ch,a}, \epsilon_{CC,a}\}$$

When married, the state of a couple, in addition to the union of the above state variables, includes shocks to utility of marriage ($\epsilon_{mar,a}$). Each partner receives the same marriage and child preference shock. The number of children in the household at the time of marriage is equal to $N_a = max\{N_a^w, N_a^m\}$.

$$\Omega_a = \left\{S^m, S^w, X_{f,a-1}^h, X_{f,a-1}^w, X_{p,a-1}^w, N_a, \epsilon_{f,a}^m, \epsilon_{f,a}^w, \epsilon_{p,a}^w, \epsilon_{ch,a}, \epsilon_{mar,a}, \epsilon_{CC,a}\right\}$$

Individuals with a college degree, enter the model at $a = 22$ and those without a college degree enter the model at age $a = 18$. Since education is exogenous, its value remains the same in the entire life-cycle. I assume that individuals have no previous labour market experience at the age that they finish schooling implying that initial part-time and full-time experiences are zero. The evolution of state variables over the life-cycle depends on fertility and employment decisions. The choice of hours of child care and marital decisions also affect the state variables, however, only through affecting employment and fertility decisions.

2.6 Empirical Implementation of the Model

To make the model computationally feasible, I make four assumptions. First, men only work full-time but can choose to work different hours within full-time employment. This

assumption is not very restrictive as the observed proportions of non-working and part-time employed men are low in the data. Secondly, I assume a static budget constraint which does not allow for consumption smoothing through savings over the life-cycle. Although, a model with endogenous savings and human capital would be more realistic, I have made the choice of focusing on the endogenous part-time and full-time human capital accumulation of women. Adding another source of dynamics to the model increases the state space and adds considerable computational burden to the solution of the model. The third assumption is that the individual's total time endowment is spent on home production and labour market work. This assumption is made to reduce the size of the choice sets. Fourthly, to avoid tracking number of children and to reduce the size of the state space, I assume that individuals can have only one child. Working hours of men and women are $l_a^m \in \{7, 9\}$ and $l_a^w \in \{0, 3, 5, 7, 9\}$ hours per day, respectively. 0 represents not working, 3 and 5 are part-time working hours and 7 and 9 are full-time working hours. Hours of child care are $CC \in \{12, 7, 0\}$.

3 Data

The data used in this study are taken from 30 waves (1968 to 1997) of the Panel Study of Income Dynamics (PSID). PSID starts collecting labour market information of individuals for the previous year from 1969 onwards. Therefore, the effective years of data are 29 periods (1968 - 1996). Following year 1997, individuals have been interviewed biennially. Since in my model each period is defined as a year, I do not use the collected data from 1997 onwards.

3.1 Sample

PSID consists of a core sample, a sample of low income households known as SEO (Survey of Economic Opportunity sample), a Latino sample (first interviewed in 1990 or 1992), and an immigrant sample (first interviewed in 1997). These samples are endogenously selected based on their income, ethnicity or immigration status. I drop these oversampled individuals to overcome any potential biases resulting from sample selection. My sample is restricted to household residents who are either head or wife and have been interviewed at least 3 times between 1968 and 1997. Since I model individuals aged 18 to 50, all the descriptive statistics and subsequent analyses are only reported for a sample of 18 to 50 years old. The unit of observation, therefore, are 18 to 50 years old men and women who were surveyed for at least 3 periods.

My unbalanced sample of PSID consists of 4,298 men and 4,600 women with women

Table 1: Summary statistics for men and women

	Male		Female	
Variable	Percent	No.	Percent	No.
College	47.84	2,056	44.50	2,047
Below College	52.16	2,242	55.50	2,553
Single	6.894	5,036	7.047	5,498
Married	70.67	51,626	68.91	53,762
Divorced	22.44	16,389	24.04	18,757
Proportion with a child	75.10	51,608	78.18	58,296
Proportion without a child	24.90	17,110	21.82	16,269

College graduates is defined as individuals having more than 12 years of schooling and the remaining individuals are classified as below college education. Data Source: PSID (waves 1968-1997).

representing 52 percent of the sample. Around 44 percent of women and 48 percent of men in the sample have schooling above 12 years of education and I classify them as college graduates (Table 1). Around 70 percent of individuals in the sample are married, 7 percent are single and about 23 percent are divorced. Around 75 and 78 percent of men and women in the sample are observed with at least on child. To obtain data on costs and hours of child care, I use Child Development Supplement (CDS) of the PSID. In 1997, PSID collected data on a sample of children born between 1984-1997. 2,394 families were surveyed about the child care arrangements used for their 3,563 children. I match the CDS sample to my main sample of PSID using the Family Identification Mapping System (FIMS), which maps parents of these children to the core sample of PSID. I can match 1,079 children to their parents in my sample providing information on hours and cost of child care used by 1,029 mothers and 1,004 fathers [8].

3.2 Part-time Employment - definition and prevalence

The Kernel density of hours of work of men and women shows that hours of work are clustered around certain hours and women are more likely to work less hours and to stay out of labour market (Figure 1). The left tail of the density of hours of work for women is thicker and many women tend to work between 10 to 35 hours. Based on this figure, I define part-time employment as those working 10 hours or more but below 35 hours per week [9]. Those working between 0 to 10 hours are categorised as out of labour market.

[8] Table C.1 in the appendix shows the differences between the matched CDS-PSID with the rest of the PSID sample.

[9] Francesconi (2002) and Blank (1994) also use the same definition for part-time employment.

The remaining women work 35 hours or more and are classified as full-time employed. PSID is collected annually, therefore data on annual hours of work might not necessarily reflect part-time employment. This is because the beginning and end of an spell cannot be identified from the data. Therefore, those not working for half a year and being full-time employed in the second half of the year are considered as part-time workers [10].

Figure 1: Kernel density estimates of hours of work, men vs women

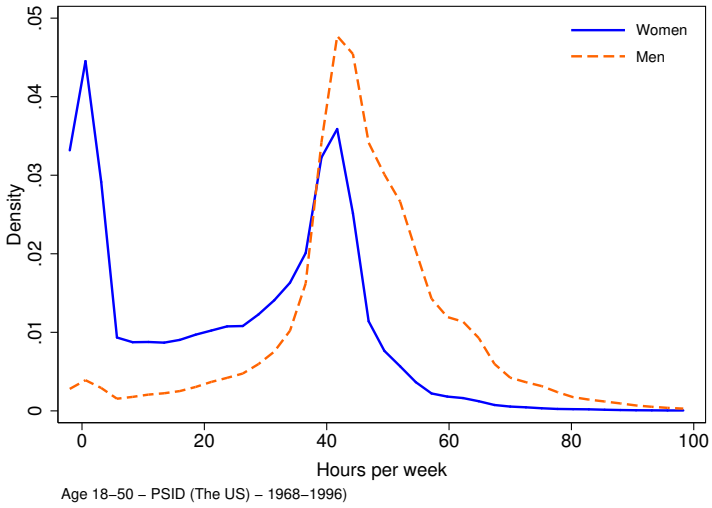


Table 2 gives evidence on how family formation and parenthood explain the prevalence of part-time employment in the data. We can see that employment patterns of men and women are very similar when they don't have a child with their full-time employment around 70 percent and part-time employment of around 20 percent. When married, women reduce their labour supply along both the intensive and extensive margins of labour supply. Among married non mothers only 58 percent work full-time which is about 18 percent lower than single non-mothers. The proportion of part-time employed married non-mothers is also about 10 percent larger than single non-mothers. Oppositely married non fathers are more likely to work with 84 percent of them being in full-time employment. Therefore, by the time that women start to have children, there will be already large differences in their labour supply behaviour compared to men.

Married women's labour supply decreases even more when they become mothers with 40 percent of married mothers not working and among those employed, 47 percent working part-time. Oppositely married fathers work more and longer with only 2 percent of them being out of the labour market. Mothers and fathers labour market behaviour is completely different when they are single (divorced or never married). Single mothers participation

[10] In labour supply models there is no distinction between not working and unemployed individuals. It is a common assumption in modelling labour supply that everyone who seeks jobs finds a job immediately.

rate is 28 percent higher than Married mothers and they are less likely to work part-time. Single fathers' labour supply behaviour is also different compared to married fathers, they participate less in the labour market and also work fewer hours.

3.3 Part-time Employment and Wages

It is well-known in the literature that part-time employed individuals receive lower wages compared to those working full-time, which is known as part-time pay penalty (e.g. see Hirsch (2005) in the US and Manning and Petrongolo (2008) in the UK). Figure 2 shows the difference between median log hourly wages of part-time and full-time working women between 1968 and 1996 [11]. We can see that the hourly wages of part-time employed individuals between 1968 and 1997 were around 30 percent lower than those working full-time. The observed pay penalty is lower when I take into account college education but still part-time workers earn on average around 20 percent less than full-time workers. Such wage differences could be attributed to different occupations of part- and full-time employed individuals, differences in the process of human capital or discrimination against part-time workers. This paper tries to understand whether skills and work experiences obtained by working part-time is similar to the those obtained while working full-time. I intend to do this to understand whether choosing to work part-time to spend more time at home and with children has long-term consequences on future wages and employment of women.

3.4 Child Care and Parental Employment

I use the matched CDS and PSID sample to construct child care usage of mothers by their employment status. Child Development Supplement of the PSID reports 9 different child care arrangements used by families since the birth of the child. Only a few mothers use more than four types of arrangements, therefore, I construct the child care cost and hours using the first 4 types of arrangements, retrospectively. Since in many states children attend schools at the age of 5, I only construct hours and cost of child care from the birth of the child until the child turns 5 years old [12]. CDS reports various types of child care which can be categorized into formal and informal types of child care. In line with the model, I only report the statistics related to formal child care since government subsidies target formal child care usage. Informal child care is defined as care provided by a relative in the child's home or in the relatives' home. Care that is provided by non-relatives in

[11] I would like to thank Alan Manning and Barbara Petrongolo for sharing their Stata code so that I could plot graphs similar to the Part-time Penalty graph in their paper.

[12] The age that a child must be in kindergarten in the united states varies across states. In 1998, the must entry age was between 5 to 8 years old. See Table 3 in (Datar, 2006).

Table 2: Employment by marital status - parents and nonparents

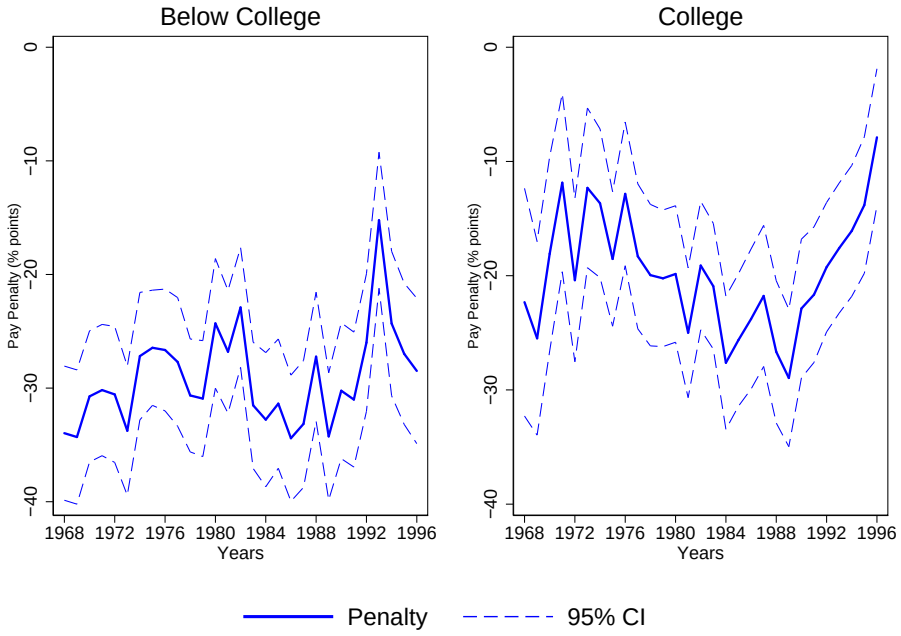
Marital Status		Not Working	Part-time	Full-time	Total
Single Non-mothers	% of row	4.826	24.00	71.18	100
	% of total	0.360	1.791	5.313	7.465
	No.	218	1,084	3,215	4,517
Married Non-mothers	% of row	14.44	27.52	58.04	100
	% of total	1.932	3.680	7.762	13.37
	No.	1,169	2,227	4,697	8,093
Married Mothers	% of row	40.18	28.04	31.78	100
	% of total	26.98	18.83	21.35	67.16
	No.	16,328	11,394	12,917	40,639
Single Mothers	% of row	22.78	22.81	54.41	100
	% of total	2.733	2.737	6.529	12.00
	No.	1,654	1,656	3,951	7,261
Single Non-fathers	% of row	3.677	18.34	77.98	100
	% of total	0.343	1.709	7.265	9.316
	No.	183	913	3,881	4,977
Married Non-fathers	% of row	2.051	13.04	84.91	100
	% of total	0.277	1.761	11.47	13.51
	No.	148	941	6,126	7,215
Married Fathers	% of row	1.982	8.114	89.90	100
	% of total	1.404	5.746	63.67	70.82
	No.	750	3,070	34,016	37,836
Single Fathers	% of row	7.568	14.08	78.36	100
	% of total	0.481	0.895	4.981	6.357
	No.	257	478	2,661	3,396

Part-time employment is defined as those working 10 hours or above but less than 35 hours. Full-time employment is defined as individuals working 35 hours or more. Out of labour force are those working below 10 hours. Single individuals could be either divorced, separated or never married. Data Source: PSID (waves 1968-1997).

or out of child's home including head-start program, child care center, and before or after school program are classified as formal care.

Table 3 reports hours and costs of child care used by parental employment status. We can see that the hours of child care used varies by employment status of mothers rather than fathers. Part-time employed mothers on average use fewer hours of child care than full-time workers, and non-working mothers use even less hours. However, part-time and non-working mothers use more expensive child care compared to full-time working mothers and there are large variations in the observed costs of child care. We can see that

Figure 2: Part-time pay penalty for women - by education



Part-time pay penalty is defined as the difference between median hourly wages of full-time and part-time workers. Part-time employment is defined as working between 10 and 35 hours and full-time as working 35 hours or above. All wages are CPI adjusted to 1984 US dollars. Source: PSID (wave 1968-1997).

Table 3: Hours and Cost of Formal Child Care

	Not Working		Part-time		Full-time	
	mean	sd	mean	sd	mean	sd
			Mothers			
Hours in Care per day	0.395	1.340	1.864	2.780	3.602	3.784
No.	1718		1552		1484	
Hourly Cost of Care	4.206	8.416	4.057	13.97	2.646	3.504
No.	350		742		949	
			Fathers			
Hours in Care Per Day	1.210	2.581	1.427	2.626	1.889	3.064
No.	98		415		4050	
Hourly Cost of Care	2.560	2.691	2.479	2.780	3.480	9.989
No.	27		155		1762	

Part-time employment is defined as those working 10 hours or above but less than 35 hours. Full-time employment is defined as individuals working 35 hours or more. Out of labour force are those working below 10 hours. Data Source: PSID (waves 1968-1997).

the variation in child care cost of part-time and non-working mothers is translated into variation in full-time working fathers' cost of child care. This could imply that families with higher income fathers could spend more on child care and that is the reason for observing large variations in child care cost used by non-working and part-time employed

mothers. This high variation in the cost of child care is not observed for single mothers and actually the variation in cost of child care is larger for full-time working single mothers who depending on own income could spend more on child care expenditures (See Table C.4 in the appendix).

Since the number of hours that the child spends in formal child care is related to mothers' employment, I categorize its usage into 3 different states which correspond to mothers' employment status. I define full-time child care usage when mothers use more than 7 hours of formal daily child care, part-time child care is defined as when mothers use child care but the child spends less than 7 hours in formal care. Lastly, no child care is when mothers do not use any child care. Table 4 reports how this constructed child care usage variable corresponds to mother's employment status. In general only 12 percent of mothers use full-time formal child care and among them around 73 percent are full-time employed mothers. Around 60 percent of mothers don't use formal child care but only 21 percent of these mothers are full-time employed. This table in general shows that although many mothers don't rely on formal child care, they are more likely to use it when they are working and more likely to use more hours of formal child care when they are working full-time.

Table 4: Formal Child Care Usage by Mother's Employment Status

		Formal Child Care			
Employment Status		Full-time	Part-time	No Child Care	Total
Full-time	% of Col	73.30	34.29	21.13	31.22
	% of Row	29.78	28.98	41.24	
	No.	442	430	612	1484
Part-time	% of Col	21.89	44.26	29.86	32.65
	% of Row	8.51	35.76	55.73	
	No.	132	555	865	1552
Not Working	% of Col	4.81	21.45	49.02	36.14
	% of Row	1.69	15.66	82.65	
	No.	29	269	1420	1718
Total	% of Row	12.68	26.38	60.94	100.00
	No.	603	1254	2897	4754

Part-time employment is defined as those working 10 hours or above but less than 35 hours. Full-time employment is defined as individuals working 35 hours or more. Out of labour force are those working below 10 hours. Full-time child is defined as formal hours of child care being 7 hours or more and part-time any hours between zero and 7 hours. Data Source: PSID (waves 1968-1997).

The patterns in the data suggest that the reduction in labour supply of women along the intensive and extensive margins of labour supply is associated with marriage and to a

larger degree with motherhood. One explanation for working less hours of married mothers is specialisation in household good production which becomes even more important when there is a child in the household. The high cost of child care could deter mothers from working and gaining work experience to the extent that even the loss of current wage and the lower expected future wage, does not push women into employment. In the next section, I estimate the model using the observed patterns in the data and use the estimated parameters to show how subsidised child care, affects female labour supply.

4 Estimation

McFadden (1989) proposes to use Method of Simulated Moments in estimating models that require numerical integrations. I use the following method of moment estimator:

$$argmin \qquad g(\theta)' W g(\theta)$$

The simulated method of moments searches for the values of θ (a vector that contains all the unknown parameters) that minimize the distance between the moments calculated from the simulated data and the moments calculated from the actual data. W are the weights, which are the inverse of the estimated variances obtained from the actual data, divided by the number of individuals that contribute to each moment. $g(\theta)$ is defined as:

$$g(\theta) = \frac{1}{N} \sum_{i=1}^{N} g_i(\theta) = [\bar{m}_1 - \mu_1(\theta), ..., \bar{m}_k - \mu_k(\theta)]$$

where $(\bar{m}_1, .., \bar{m}_k)$ corresponds to the data moments, and $(\mu_1(\theta), .., \mu_1(\theta))$ are the corresponding model moments. N denotes the number of individuals in the sample.

The model is estimated using the Panel Study of Income Dynamics 1968-1997.

4.1 Model Fit

In this section I show how the model captures the patterns observed in the data (Figures in Appendix D). I calculate moments at different ages ranging from 18 to 50 which are conditioned on various life-cycle outcomes such as fertility and marital status.

Employment and Wages: Figures D.1-D.6 show how the model fits the employment patterns of single and married mothers compared to non-mothers. The model does a very good job in matching the life-cycle employment patterns of women. In general, single women are more likely to work compared to married women and they are also more likely

to work full-time. Motherhood is associated with a reduction in labour supply and this observed decrease is larger for married mothers compared to single mothers. The change in labour supply due to motherhood is observed in both intensive and extensive margins of employment.

Figures D.7- D.12 show the employment parents of below college and college graduates by their marital status. The model captures the observation in the data that college graduate women have higher extensive and intensive margins of labour supply and are unlikely to be out of the labour market. However, the model overstates the proportion of non-working women from lower education backgrounds. In terms of work experience, the model captures the feature of data that as part-time and full-time experiences increase, the employment in the same sector increases and women with higher work experience are less likely to be out of the labour market. Figures D.13-D.18 show that the model can generate these patterns.

Figures D.19 - D.26 show that the the model does a good job in fitting wages of both full-time and part-time employed women by age and marital status. The average wages with respect to part-time and full-time experiences also match the data well but the return to part-time experience of high school graduate women are understated. The variance in full-time and part-time wages also exhibit the right patterns and are reported in Figures D.27 - D.30. Figures D.31 - D.35 show that the model does a good job in replicating first and second moments for male wages but understates the wages of college graduate men.

Fertility and Marital Status: The model does a good job matching fraction of married, divorced and also the flows to marriage and divorce. However, the fraction of married individuals in the beginning and towards the end of the life-cycle are understated (Figures D.36 - D.39). With respect to fertility, the model fits the fraction of single and married men with kids but individuals start to have kids earlier than the time observed in the data (Figure D.40).

Child Care Take Up and Cost: Table D.5 reports the variation in child care usage by employment status of women. Full-time working single mothers use more hours of child care compared to non-working mothers. However, for part-time working single mothers, very few use child care when we compare these fractions with the data. For married mothers, we can see that they purchase more child care when they are employed, however, here I again cannot match the patterns observed in the data that married non working mothers do not purchase formal child care. Table D.6 shows the model fit for the distribution of child care cost. In general, the estimated mean and variance of child care cost are higher than the observed moments in the data. One explanation for the low observed cost of

child care in the data is that PSID child care cost data is not very well reported and the problem with its values have been reported by Lee and Seshadri (2019). The mean hourly estimated child care cost is lower for single mothers compared to married mothers which is due to lower household income of single mothers compared to married mothers. However, the model cannot match the fact that married mothers who work less use more expensive child care compared to non-working mothers.

5 Parameter Estimates

In this section I report the estimated parameters of the model and also discuss which features of the data help in identifying those parameters. Since the model is estimated using Simulated Method of Moments, a formal identification of its parameters is not possible. In the discussion about identification of the parameters it is important to mention that various features of the data help in identifying a single parameter. In this section I discuss the most relevant features that can contribute to identifying a parameter.

Wages and Employment: Tables 5 and 6 report the estimated parameters. The estimated male wage equation shows that in the first year of the life-cycle, one year of full-time experience increases male hourly wages by 5%. The return to experience exhibits a concave form, such that with 20 years of experience the return to full-time experience reaches its peak and diminishes gradually afterwards. Male college graduates experience a 20% higher hourly wage. The larger intercepts of log hourly wages of men and full-time working women shows the difference in wages that cannot be explained by experience, education, or dynamic heterogeneity. The intercept for men's full-time wage is about 20 percentage points higher that that of women and even when the college wage premium is taken into account the gap remains at 14 percentage points. This difference in the intercepts can be attributed to factors which are not specifically modelled such as selection of men into higher paid occupations or gender discrimination in the labour market. The return to full-time experience of men is twice as large as the return to full-time experience of women and the estimated concavity degree of full-time experience is estimated to be larger for men than women. As a result as women gain more full-time experience, the difference in return to full-time experience of men and women decreases.

The estimated part-time and full-time wage equations for women demonstrate two important results. First, there are differences between the intercepts of part-time and full-time log hourly wages of women but my estimates do not suggest that the return to part-time and full-time human capital are different. This difference in the intercepts can be interpreted as part-time wage penalty and for a full-time employed woman with no experience and

Table 5: Log Houtly Wage Parameters

Model Parameters	Description	Estimated Value	Standard Error
Wage parameters (Full-time Employment, Male)			
$\beta^m_{0,full}$		1.5705	(0.0022)
$\beta^m_{1,full}$	Return to full-time experience	0.0497	(0.0001)
$\beta^m_{2,full}$	Dec/inc return to full-time experience	-0.0012	(0.0000)
$\beta^m_{3,full}$	Return to education	0.1986	(0.0017)
ϵ^m_f	Variance	0.8564	(0.0030)
Wage parameters (Full-time Employment, Female)			
$\beta^w_{0,full}$		1.3840	(0.0020)
$\beta^w_{1,full}$	Return to full-time experience	0.0325	(0.0000)
$\beta^w_{2,full}$	Dec/inc return to full-time experience	-0.0002	(0.0000)
$\beta^w_{3,full}$	Return to part-time experience	0.0332	(0.0001)
$\beta^w_{4,full}$	Dec/inc return to part-time experience	-0.0008	(0.0000)
$\beta^w_{5,full}$	Return to College	0.2514	(0.0011)
ϵ^w_f	Variance	0.3148	(0.0012)
Wage parameters (Part-time Employment, Female)			
$\beta^w_{0,part}$		1.2493	(0.0028)
$\beta^w_{1,part}$	Return to full-time experience	0.0396	(0.0002)
$\beta^w_{2,part}$	Dec/inc return to full-time experience	-0.0031	(0.0000)
$\beta^w_{3,part}$	Return to part-time experience	0.0334	(0.0002)
$\beta^w_{4,part}$	Dec/inc return to part-time experience	-0.0002	(0.0000)
$\beta^w_{5,part}$	Return to College	0.3692	(0.0023)
ϵ^w_p	Variance	0.3774	(0.0017)

without a college degree is about 1.15 dollars per hour and for college graduates is about 1 dollar. The differences in intercepts for full-time and part-time wages are also estimated by Keane and Wolpin (2010) and Francesconi (2002) using The National Longitudinal Survey of Youth 1979 in the United States. Francesconi (2002) finds differential returns to part-time and full-time experiences but my estimates do not point to that direction.

Second, the parameters on part-time wage equation full-time wage experience when employed part-time together with the concavity degree shows that if mothers have a few years (less than 3 years) of full-time experience, the return to full-time experience is almost equal to the return to part-time experience. Therefore, for mothers with a few years of human capital switching between part-time and full-time jobs is less costly. However, as women get specialised in the full-time sector switching into a part-time job becomes more costly. The same pattern is observed for full-time employment such that as a woman gains more experience in the part-time sector, the return to her employment in full-time sector decreases. These estimates suggest that switching from full to part-time employment is less costly when women have lower work experience but as they gain more experience in a specific sector changing between sectors becomes more costly.

The wage distribution parameters $(\beta^w_{0,k} - \beta^w_{5,k})$, $(\beta^m_{0,full} - \beta^m_{3,full})$, and $(\epsilon^j_f, \epsilon^w_p)$ are identified

Table 6: Parameters: Preferences and Household Production

Model Parameters	Description	Estimated Values	Standard Errors
Preference parameters			
α_c	Marginal utility of consumption	0.2024	(0.0028)
α_{q1}	Marginal utility of household good	0.2200	(0.0042)
α_{q2}	Marginal utility of child quality	0.5143	(0.0048)
α_{ch}	Marginal utility from having a child	0.0632	( )
ϵ_{ch}	Variance in utility of having a child	0.3517	(0.0095)
α_{full}	Utility Full-time	2.4889	(0.0215)
α_{part}	Utility Part-time	-0.6912	(0.0074)
α_{NoWork}	Utility Not working	-1.9046	(0.0109)
Household Production			
α_m	Marginal productivity of housework hours (married men)	0.3424	(0.0022)
α_w	Marginal productivity of housework hours (married women)	0.6576	( )
λ	Marginal productivity of housework hours	4.5829	(0.0036)
γ	Degree of substitutability between child care and housework hours	0.7074	(0.0023)
Marriage			
ω	Probability of meeting a potential partner	0.2173	(0.0033)
ϵ_{mar}	Variance in utility of marriage	14.3340	(0.1160)
Child Care Cost			
π_{CC}	Log Hourly child care cost	3.1412	(0.0095)
ϵ_{CC}	Variance of child care cost	1.5253	(0.0081)
δ	Discount factor (not estimated)	0.954	-
θ	Bargaining weight in Nash product (not estimated)	0.5	-

using the first and second moments of wages conditional on work experiences and education together with employment choices conditional on life-cycle choices such as fertility and marital decisions at different ages.

Preference Parameters: Table 6 reports preferences and household production parameters estimates. The estimated marginal utility of consumption (α_c) and marginal utility from household goods (α_{q1}) are 0.2024 and 0.22, respectively. These estimated parameters are such that an additional unit of household goods gives about 10 percent larger utility than an additional utility from consumption. This result implies that women who have lower returns to employment, such as women from lower education backgrounds or women with lower work experience participate less in the labour market compared to the higher educated women. Marginal utility of child quality (α_{q2}) is 0.5143, which is about 2.5 times larger than marginal utility of household goods. This shift in preferences upon having a child shows the shift in preferences of women to stay home and spend time with the child when becoming mothers. This estimated shift implies that even more income is needed to compensate for the time spent by the parents with the child. Therefore, educated mothers and/or mothers who have more work experience participate more in the labour market

compared to lower educated and/or mothers who have less investment in the labour market. The utility of having a child is estimated to be positive and at 0.063 and the shock to utility of having a child is 0.35.

Various features of the data help in identifying the preference parameters and among them are changes in proportions of part-time, full-time and non-working women across the life-cycle conditional on fertility, marital decisions, and education. Consider the case that marginal utility from household goods (α_{q1}) is larger than marginal utility from consumption (α_c), in this case we should observe in the data that lower educated women with similar work experiences participate less in the labour market compared to higher educated mothers. This is because their time in the labour market gives less consumption compared to higher educated mothers' time. This difference in employment patterns helps in identifying the relative importance of household good compared to consumption and as the parameter estimates indicate, household goods give individuals higher utility compared to consumption. Similar arguments holds for identification of marginal utility of child quality (α_{q2}). Consider the case that marginal utility of child quality (α_{q2}) is larger than marginal utility of household good (α_{q1}), in that case we should observe in the data that women drop out of the labour market or start working part-time upon having children. Since educated mothers have higher returns to employment, the drop in their intensive and extensive margins of employment upon having a child should be smaller. In the data I observe these patterns and the proportions of mothers having a child together with employment choices help in identifying marginal utility of household good and child quality.

Production Function Parameters: Marginal productivity of housework hours of single individuals (λ) is 4.58. Marginal rate of technical substitution between housework hours of men (α_m) and women (α_f) is estimated at 1.93 implying that 1 hour of housework hours of men can be substituted by 1.93 housework hours of women. This estimate is a reflection of higher wages of men compared to women which results in women's specialization in household production. Since men earn higher wages they have a higher opportunity cost of home production and therefore 1 hour of their work at home needs to be compensated with more housework hours of women.

The decrease in intensive and extensive margins of employment of married women compared to single women together with the fraction of married individuals identifies the marginal productivity of household production of men compared to women. However, only relative productivity of these two inputs are identified and I assume that $\alpha_m + \alpha_f = 1$. Consider the case that women's housework hours is more productive than men's housework hours, in this case we should observe in the data that women switch to part-time work or

stop working upon marriage because their relative wages compared to their spouse is lower and we also should observe that this switching is less prevalent for higher educated women because they have higher wages. In this case we should see in the data that a large fraction of individuals in the data get married because there are gains from this specialisation and upon marriage women, and specially lower educated women, start to work less. When having a child, the reduction in married mothers' labour supply compared to single mothers should be more salient. This observation is because single mothers require some income to purchase formal child care, therefore they need to keep their attachment to the labour market to pay for the cost of child care. On the other hand, married mothers can reduce their labour supply and purchase child care with the spouse's income.

The degree of substitutability between child care and housework hours (γ) is estimated at 0.70 implying an elasticity of substitution of 3.3. This estimate indicates that housework hours and child care hours are close substitutes. The large substitutability implies that a relative decline in the cost of child care, keeping the opportunity cost of home production (wages) constant, should increase the use of child care and decrease housework hours (or increase labour supply). The degree of substitutability between formal child care and housework hours is identified using the estimated child care cost and employment patterns of women together with the choice of child care. If child care and housework hours are substitutable and child care is expensive, we expect to observe the following patterns in the data: To observe that mothers work less than non-mothers because although child care and housework hours are substitutable, mothers cannot easily substitute child care with housework hours because child care is expensive. In addition to differences in labour supply of mothers, we expect to see that working mothers, who have higher income, purchase more hours of child care because they can afford to pay for its cost. To the contrary, those not working or working part-time should purchase less formal child care. The variation in the use of child care by employment status of mothers should be more salient when mothers are single because they do not have the partners' income to finance the cost of child care.

Marriage Parameters and shocks Probability of meeting a potential partner (ω) is 21 percent implying that one on in 5 meetings results in marriage. The variance in utility of marriage (ϵ_{mar}) is estimated to be 14.3. This high variance in utility of marriage, increases the risk to marriage to the extent that negative marriage shocks have large effects on utility of being married. However, marriage is still an attractive option because of production of public good and the gain from specialization in its production. Many features of the data contribute to estimating the probability of meeting and the variance in utility of marriage such as employment patterns after marriage, flows to marriage and divorce, and fractions

of married and divorced individuals at different ages.

Cost of Child Care: π_{CC} and ϵ_{CC} report the estimated mean and variance of cost of child care. One hour of child care is estimated to cost 23 dollars on average which is larger than an hour return to both full-time and part-time employment of a woman without a college degree and no work experience. Therefore, women with lower work experience and education might prefer to stay home and take care of their children. Therefore, at this cost of child care reducing labour hours and increasing house work hours can be expected as long as the discounted expected future wages, due to lower work experience, do not deter women from spending more time in home production. Child care take-up and the first and second moments of cost of child care at different employment states conditional on marital status together with employment patterns after having a child help in identifying the mean and variance of child care.

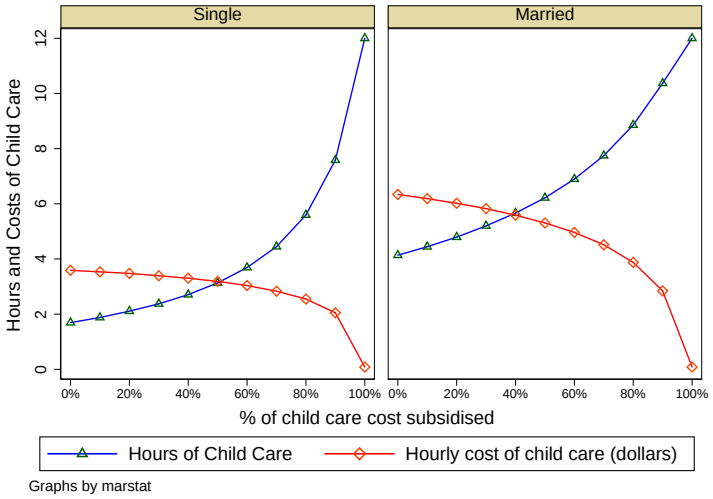
6 Policy Experiments: Child Care Cost Subsidies

Child Care policies around the world vary substantially. For example, Sweden offers child care subsidies to all mothers and the amount of subsidies vary by mothers' income. Governments can subsidise a proportion or the entire costs of child care. In this section, I evaluate the impact of various child care subsidies on child care take-up, employment and wages of women.

Child Care Take-up: Figure 3 shows that as proportion of child care cost subsidised by the government increases, its take-up increases. A 10 percent decrease in the cost of child care increases child care take-up by 10.1 percent implying that price elasticity of child care demand is elastic. This result can be explained by the fact that child care is an input into household production function. However, its estimated high cost of $23 per day (3.14 in log dollars) makes it unaffordable. As child care gets cheaper more households can afford to purchase it and therefore its usage increases.

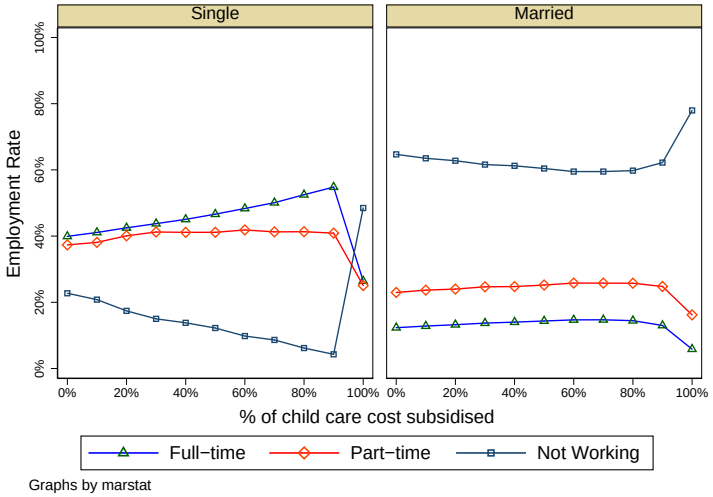
Employment: The estimated large elasticity of substitution of 3.3 between market hours of child and housework hours in the production function implies that the two inputs are close substitutes. Nevertheless, the high cost of child care in the market prevents households from substituting it with housework hours. Child care subsidies facilitate this substitution and one would expect to observe an increase in mothers' labour supply as child care gets cheaper. The left panel in Figure 4 shows that a 10 percent decrease in the cost of child care increases employment rate of single mothers by 2.5 percent which is well below the child care

Figure 3: Child care subsidies and child care take-up - Women



take-up at the 10 percent subsidy level. So, why do mothers use subsidised child care but do not increase their labour supply? Child care as an input into the production function increases household production and when gets cheaper more mothers use it. However, mothers do not participate in the labour market because their housework hours can be used in production of other household goods; i.e. Q1 in the model.

Figure 4: Employment Rate by Marital Status



As child care becomes cheaper (below 100%) single mothers work more, and the increase in employment is observed along both the intensive and the extensive margins of employment. However, a fully subsidised child care decreases labour supply. This is because at lower levels of child care subsidies mothers still need to pay for a fraction of child care

to finance their child care expenses. When child care is fully subsidised, all mothers can enjoy child care at no cost and can spend their entire time in household production (Q1 and Q2 in the model). Therefore, mothers with lower productivity in the labour market, drop out of the labour market which explains the lower participation rate compared to the benchmark model. This result implies that at 0 percent child care subsidy (in equilibrium) some mothers participated in the labour market to finance the child care cost to increase the household production (Q2 in the model).

The right panel of Figure 4 shows similar patterns for the impact of subsidies on the intensive and extensive margins of employment of married mothers with the difference that the increase in both margins are significantly lower compared to single mothers. This difference is due to the presence of husband's income. Married mothers have income of the husband to pay for the child care expenses; therefore, they do not need to increase their labour supply to pay for the remaining cost of child care. As child care costs get cheaper, mothers use more subsidised child care because it is an input in the production function and increases the household production. However, this does not necessarily lead to an increase in labour supply. Mothers spend their time in household production which has a higher marginal utility compared to marginal utility of private consumption. The threshold for the reduction in labour supply of married mothers is lower than single mothers. While single mothers reduce their labour supply when child care costs are fully subsidised, any subsidies above 80% is associated with a reduction in labour supply of married mothers.

Figure 5: Employment rate by education

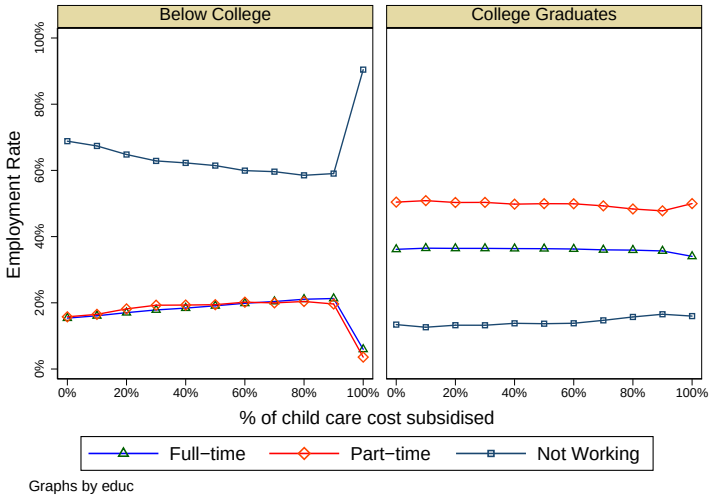


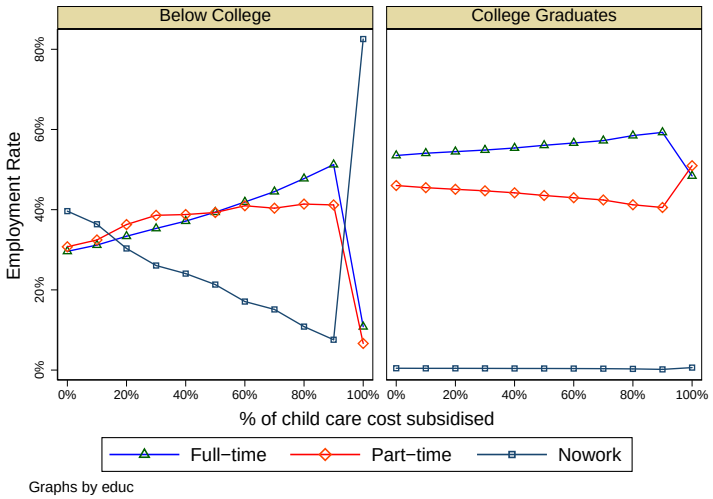
Figure 5 shows that education also plays a role in how women respond to child care policies. Lower educated mothers are more responsive to subsidies compared to higher educated mothers. At lower levels of subsidies, the increase in labour supply is mostly

along the extensive margin of employment. However, as subsidies become more generous the increase in labour supply is observed in both employment margins. College graduate mothers work more hours as subsidies increase but since all mothers in the benchmark model are employed, there is no impact on their employment rate.

Figure 6 shows the change in employment rates of single lower educated mothers compared to single higher educated mothers. Child care subsidies, increase employment rate of lower educated single mothers but at the lower levels of subsidies, the increase in labour supply is mostly in part-time employment. As subsidies get more generous, they also increase hours of work of single mothers from lower educated backgrounds. Similar patterns are also observed for higher educated mothers but the increase in labour supply is observed only along the intensive margin since all married mothers in the benchmark model were employed in the first place.

The results of these policy experiments imply that elasticity of labour supply with respect to child care are very sensitive to mothers' own income and also households' income. College graduate mothers are less sensitive to subsidies because of mothers relative higher wage and college graduate married mothers are the least sensitive because of their own high income and the existence of fathers' income. To test whether husbands' income plays a role in these results, I reduce the husbands' income to zero and do the same policy experiments. The results are reported in Figure A.1 in Appendix 0. As expected, when there is no husband's income, married mothers also respond to child care subsidies.

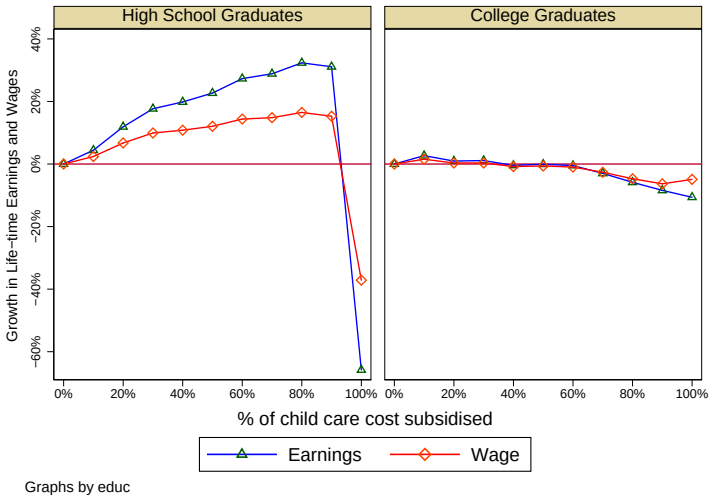
Figure 6: Employment Rate by education - single women



Wages and income: Figure 7 shows how life-time income and earnings of women from different education levels are affected by subsidies. Child care subsidies, if not fully sub-

sidised, increase both wages and earnings of lower educated mothers. This is because, lower educated mothers were unable to purchase child care due to their lower relative wages compared to college educated mothers. Child care subsidies allow these mothers to participate in the labour market and accumulate human capital by reducing employment costs. The increase in human capital translates into higher life-time wages and income for lower educated mothers. Full subsidies however have the opposite effect, as they decrease employment and therefore negatively effect human capital and wages. For college graduates the effect of subsidies on wages and employment are close to zero and even negative when subsidies are above 60 percent. We observe this because any subsidy above 60 percent, decrease employment rate of college graduates, which decreases human capital and wages of mothers (See the right panel of Figure 5).

Figure 7: Growth in life-time income and wages - Women



Marriage and divorce: Figure 8 shows that child care subsidy programs also affect the proportion of divorced individuals. Child care subsidies allow the household good (Q2) to be produced at a cheaper price. This increases the value of household good (Q2) of both married and single individuals. When subsidies are below 100 percent, mothers need to participate in the labour market to pay for the non-subsidised part of the child care cost. While, married mothers can finance the non-subsidised child care cost using husbands' income and specialise in household production. The existence of some child-care cost leads to gain from specialisation within marriage, i.e. a higher public good produced at home which can be enjoyed by both spouses. Therefore, when child care cost is not fully subsidised, the value of marriage exceeds the value of single-hood decreasing the proportion of divorcees. On the contrary, when child care is free, non-working mothers

can also benefit from free child care. This decreases the gains from specialization and the proportion married falls below the equilibrium rate.

Figure 8: Child Care Subsidies and Marital Status

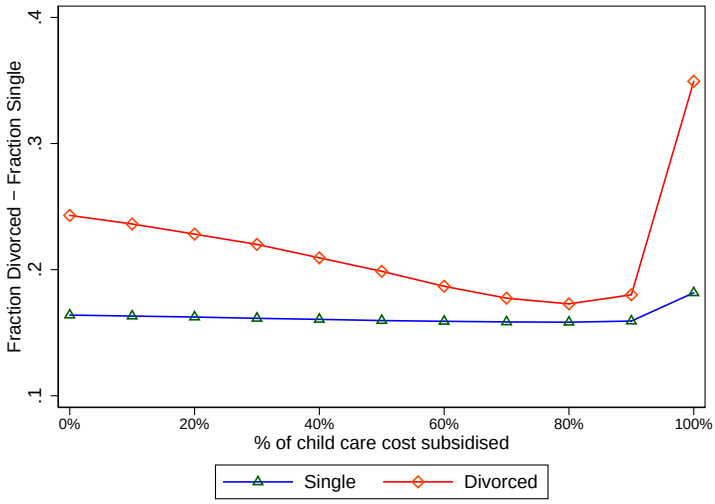
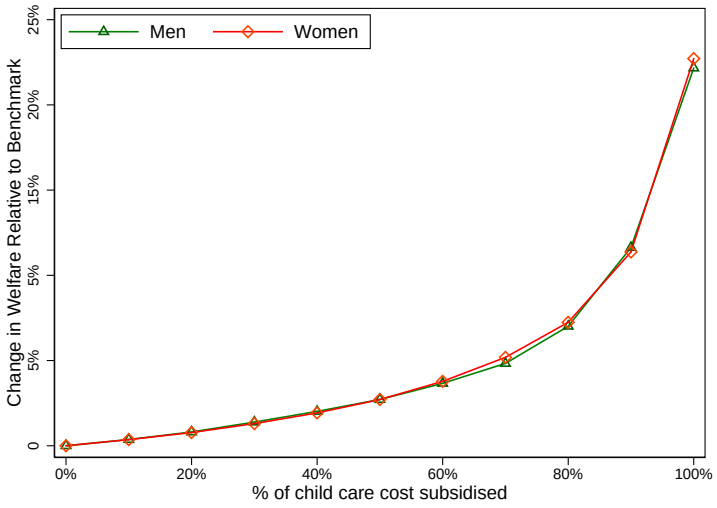


Figure 9 shows the growth in welfare associated with different child care subsidies for men and women. The welfare is defined as the expected life-time utility of men and women in the beginning of their life-cycle. We can see that child care subsidies are welfare improving and that they improve welfare of both women and men. The increase in welfare follows a similar pattern to child care take-up. This implies that welfare increases because individuals are using cheaper child care and since child care is an input into the production function, it contributes to the production of household good which in turn increases utility and therefore welfare.

7 Conclusion

I develop and estimate a dynamic model of employment, fertility, marital, and child care decisions in order to evaluate the impact of child care subsidies on various life-time outcomes of men and women. In the model, labour supply, fertility, and marital decisions are endogenously determined. Household decisions are modelled in a Nash bargaining framework, where outside options are specified as spouses' value of making decisions as single agents. I estimate the parameters of the model using 1968-1996 waves of PSID. My estimations suggest that the returns to part-time employment is lower than the return to full-time employment but for reasons other than the differential returns to part-time and full-time human capital. My estimates show that part-time and full-time wages differ in levels suggesting that part-time jobs might be concentrated in lower paid occupations.

Figure 9: Child Care Subsidies and Welfare



I show that the time spent by parents with the child and housework hours are close substitutes. I conduct several policy experiments to understand the implications of such substitutability on child care choices of women. I empirically document that parents use more child care as it gets cheaper but this higher child care take-up does not necessarily translate to higher female labour supply. The increase in labour supply is observed among single lower educated mothers, while married mothers and those with higher education levels' response is insignificant. Single mothers participate more in the labour market only when the cost of child care is not fully subsidised. This indicates that their higher labour supply is due to the fact that they need higher income to be able to finance the remaining cost of child care. Married mothers do not participate more because they can use the husbands' income to finance these costs.

I further show that child care policies have implications for marriage markets. Partially subsidised child care programs increase the gains from specialization in marriage. Households finance the cost of child care using husbands' income while mothers specialize in household production. The increase in production of public good leads to an increase in fraction married. However, when child care is fully subsidised, there is no need for the income of husband and no gain from specialization which results in an increase in the fraction of divorcees.

To conclude, in this paper I model various decisions made in the households, including part-time, full-time employment, marital decisions and fertility decisions. However, in the interest of tractability I refrain from modelling several other dimensions of household decision making process. First of all, I do not model child development. Therefore, the decisions made in the household regarding child care does not depend on considerations

of parents regarding child development. Secondly, I do not model savings and wealth formation which could affect the decision of individuals to work. Lastly, my estimates represent 1968-1997 data in which wages and proportion of female college graduates were different than today's US. Therefore, the estimated parameters are expected to be different if recent US data were used.

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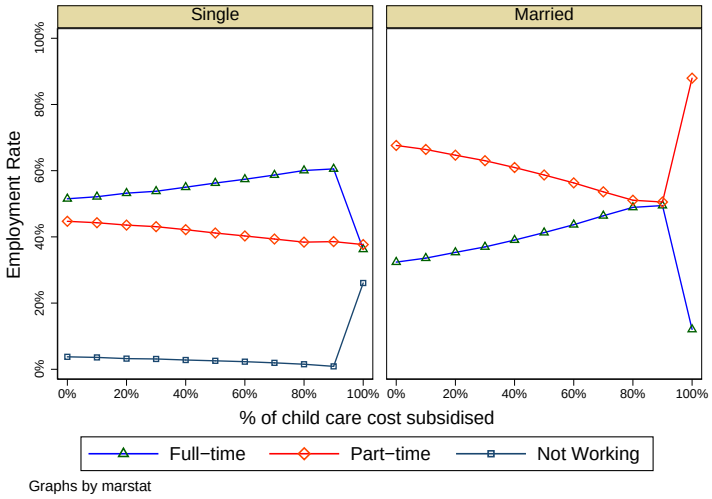
Appendices

A Employment Rate: setting men's income to zero

One of the results in the paper was that married women's employment rates do not respond to changes in child care subsidies because of the existence of husband's income. This could create an income effect, resulting in married mothers to respond less to child care subsidies. In this section, I set husband's income to zero to study the labour supply responses of married mothers in response to variation in child care subsidies. The first observation from this policy experiment is that in the baseline estimates (where there are no child care subsidies) almost all married mothers work. The second observations is that as we increase the amount of child care subsidies, married mothers work more hours resulting in a decrease in the fraction of part-time working mothers and an increase in full-time employment rates. These results indicate that when fathers work, there are less incentives for mothers to participate and also they work less because of income effects.

Figure A.1: Employment Rate by Marital Status



B History of Child Care Policies in the US

This section gives a brief overview of the US child care policies after World War II. Parents face different child care options: nurseries, kindergartens, care by relatives, and care by non-relatives. Up to early twentieth century, most of the child care was provided by relatives in the US. During the second World War, congress passed the Lanham Act, in 1941, to provide funds for child care of working mothers. The Act was motivated by the increase in employment rate of mothers whose employment was encouraged by Rosie the Riveter campaign. The Lehman Act was the only universal child care policy adopted in the history of the US child care policy which did not target women based on their income. However, its funding was withdrawn in 1946 after the end of the WWII (Herbst, 2017).

In 1965, motivated by War on Poverty program of President Johnson, a comprehensive child care program, known as Head start, was adopted which targeted children from low income families. Its pilot program started as a summer school to prepare children from low-income families for elementary school. Thereafter, it was expanded to a full school year in 1966 and started offering services to children aged 0-3 in 1977. In 1994, Early Head Start program was adopted which provided services to pregnant women and infants and toddlers (Learnings and Knowledge Center, 2017).

In 1977, the Comprehensive Child Development Act was passed by bipartisan vote in the congress. The Act proposed an allocation of $2.1 billion for a national childcare program. which would have offered low-income families free child care services while families from higher income families would have faced progressive costs based on their income (Dinner, 2010). However, the bill, despite the support from both the House of Representatives and the Senate, was vetoed by President Nixon. Several other child care policies were proposed afterwards, including Act for Better Child Care Services (ABC), which were vetoed or did not pass by the congress (Palley and Shdaimah, 2014, pg. 51-60).

Between 1986 and 1996, there were 4 different programs in the US providing child care assistance to low income families. Aid to Families with Dependent Children (AFDC) was a program adopted in 1935 which provided financial assistance to low (no) income families with children. Following the family support Act of 1988, families who were eligible for AFDC became automatically eligible for child care assistance and those families who were no longer eligible for AFDC and could not afford to pay for child care received Transitional Child Care (TCC) assistance. Omnibus Budget Reconciliation Act of 1990, approved of two different types of child care: At Risk Child care (ARCC) and Child Care and Development Block Grant (CCDBG). The former targeted families who were at risk of needing assistance and the latter offered child care assistance to families whose income fell below 75 percent

of median income of the state (Michel, 2017).

In 1996, after ratification of Personal Responsibility and Work Opportunity Act (PRWORA), AFDC was replaced by Temporary Assistance for Needy Families (TANF). The above 4 different child care policies were also put into a single block grant: Child Care and Development Fund (CCDF). According to PRWORA, if families do not have access to child care, they should be exempt from work requirement criterion for welfare eligibility. However, in practice, many families with children younger than 13 ,who are eligible for child care services under federal law, fail to receive them under state law. The states can reduce the child care service requirement age and lower the income eligibility ceiling to receive subsidies (Herbst, 2008). According to Mezey et al. (2002) only 14 percent of federally eligible children received child care in 2000. Hence, the US is falling behind other OECD countries in assisting families to balance work and family by failing to provide them with adequate child care. While many high and middle income families can afford to pay for child care, the low income families who are not eligible for child care subsidies need to rely on relatives for child care. The need for child care in the US is hence an ongoing debate.

C Supplementary Graphs and Tables

Table C.1 shows the differences between the CDS and Non-CDS sample. CDS sample has about 50% more college graduates compared to the non-CDS sample. This difference is because women in the CDS sample are from a younger cohort, who have children aged 0 to 12 years old. Women in younger cohorts are more likely to attend college. Parents in the CDS sample are also more likely to be married because they have young children. Mothers must work more.

Table C.1: CDS and Non-CDS sample differences

		Non-CDS		CDS	
Sex	Variable	Percent	No	Percent	No
Female	College	40.2%	1436	59.6%	611
	Single	7.1%	4521	6.8%	977
	Married	66.0%	42008	81.6%	11754
	Divorced	26.9%	17090	11.6%	1667
Male	College	45.2%	1491	56.6%	565
	Single	6.8%	3941	7.4%	1095
	Married	68.1%	39628	80.7%	11998
	Divorced	25.1%	14608	11.9%	1781

Table C.2: Employment by marital status - Men and Women

Gender	Marital Status		Out of LM	Part-time	Full-time	Total
Female	Married	% of total	28.77	22.49	29.07	80.33
		% of row	35.82	27.99	36.19	100
		No.	17,523	13,695	17,706	48,924
	Single	% of total	3.133	4.591	11.94	19.67
		% of row	15.93	23.34	60.72	100
		No.	1,908	2,796	7,273	11,977
Male	Married	% of total	1.692	7.575	74.79	84.06
		% of row	2.013	9.012	88.97	100
		No.	912	4,082	40,302	45,296
	Single	% of total	0.854	2.667	12.42	15.94
		% of row	5.355	16.73	77.92	100
		No.	460	1,437	6,693	8,590

Table C.3: Two step labour market transition patterns, women vs men (10<part-time<35)

Year t		Year t+1 Not Working	Part-time	Full-time	Row Totals
			Women		
Not Working	% of total	25.72	5.072	1.420	32.22
	% of row	79.85	15.74	4.406	
	No.	14,261	2,812	787	17,860
Part-time	% of total	4.784	14.96	7.295	27.04
	% of row	17.69	55.34	26.97	
	No.	2,652	8,296	4,044	14,992
Full-time	% of total	1.360	6.708	32.67	40.74
	% of row	3.338	16.47	80.20	
	No.	754	3,719	18,114	22,587
Column Totals		31.87	26.74	41.39	100.00
			Men		
Not Working	% of total	1.088	0.541	0.480	2.109
	% of row	51.60	25.66	22.74	
	No.	531	264	234	1,029
Part-time	% of total	0.660	3.505	5.630	9.794
	% of row	6.738	35.78	57.48	
	No.	322	1,710	2,747	4,779
Full-time	% of total	0.553	5.322	82.22	88.10
	% of row	0.628	6.042	93.33	
	No.	270	2,597	40,118	42,985
Column Totals		2.30	9.37	88.33	100.00

Table C.4: Child Care Usage by Employment Status of Parents

	Not Working		Part-time		Full-time	
	mean	sd	mean	sd	mean	sd
			Married Mothers			
Daily Hours of Child Care	0.394	1.325	1.849	2.770	3.636	3.788
Observations	1610		1436		1363	
Hourly Cost of Child Care	4.430	8.651	4.205	14.51	2.598	3.365
Observations	327		685		878	
			Single Mothers			
Daily Hours of Child Care	0.414	1.557	2.050	2.910	3.223	3.731
Observations	108		116		121	
Hourly Cost of Child Care	1.020	1.749	2.279	2.624	3.238	4.900
Observations	23		57		71	
			Married Fathers			
Daily Hours of Child Care	1.034	2.343	1.554	2.717	1.900	3.073
Observations	82		370		3895	
Hourly Cost of Child Care	2.875	3.042	2.542	2.845	3.516	10.14
Observations	19		144		1705	
			Single Fathers			
Daily Hours of Child Care	2.115	3.521	0.382	1.310	1.607	2.828
Observations	16		45		155	
Hourly Cost of Child Care	1.812	1.484	1.655	1.592	2.398	2.928
Observations	8		11		57	

Part-time employment is defined as those working 10 hours or above but less than 35 hours. Full-time employment is defined as individuals working 35 hours or more. Out of labour force are those working below 10 hours. Daily hours of child care is constructed by dividing hours of child care by 5 working days. Data Source: Matched CDS (wave 1997) and PSID (waves 1968-1997).

D Appendix: Model Fit

Figure D.1: Full-time Employment Rate - Singles, by age

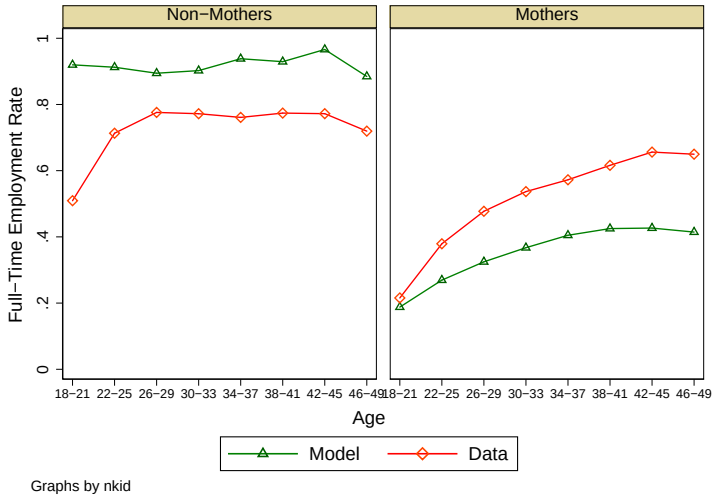


Figure D.2: Part-time Employment Rate - Singles, by age

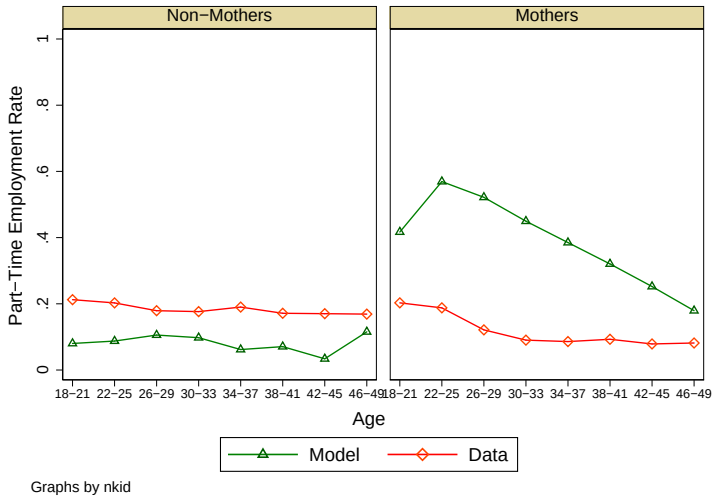


Figure D.3: Out of Labour Market Rate - Singles, by age

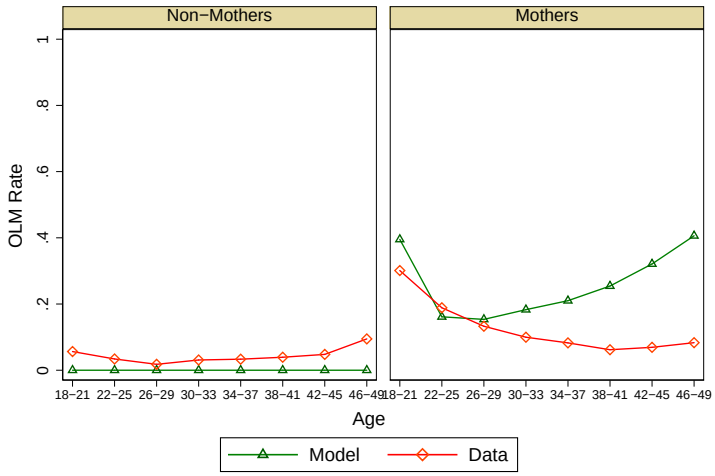


Figure D.4: Full-time Employment Rate - Married, by age

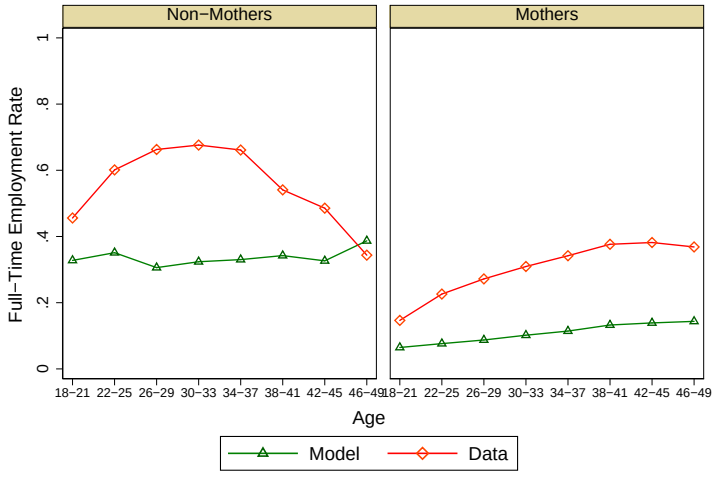


Figure D.5: Part-time Employment Rate - Married, by age

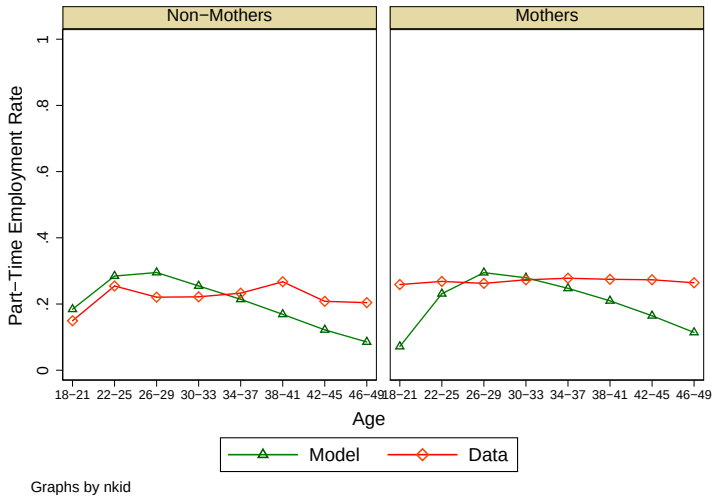


Figure D.6: Out of Labour Market Rate - Married, by age

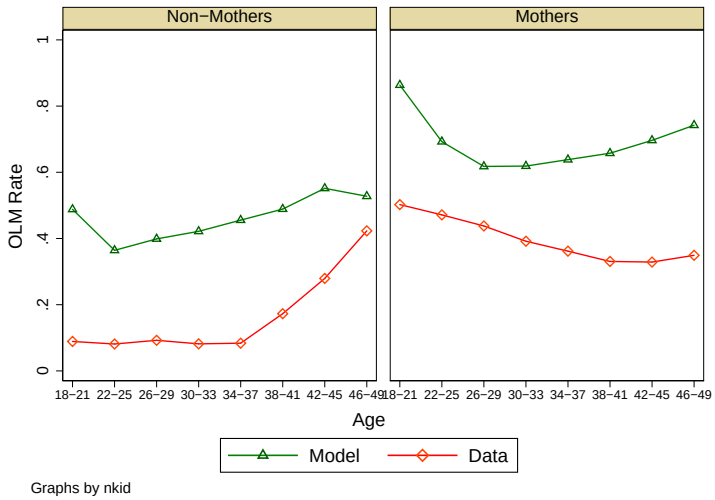


Figure D.7: Full-time Employment Rate - Singles

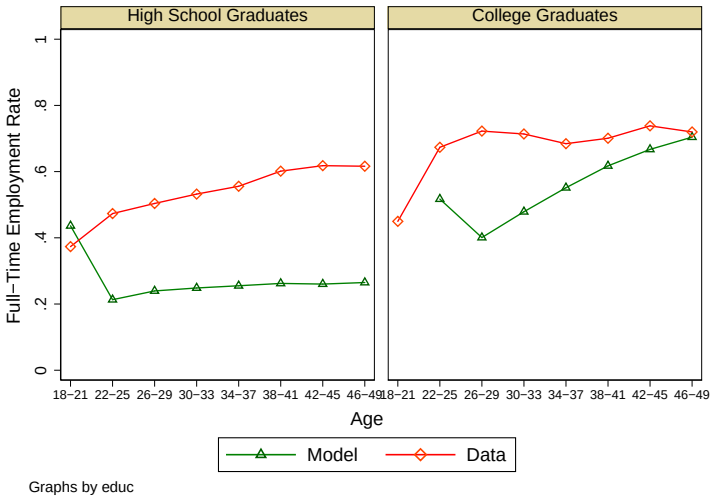


Figure D.8: Part-time Employment Rate - Singles

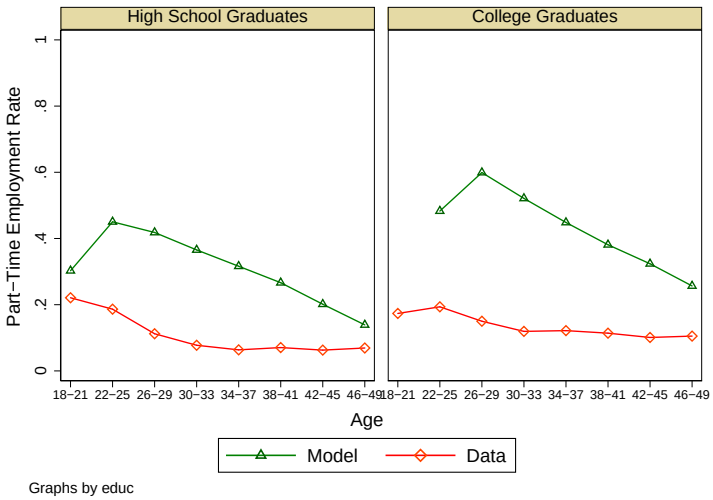


Figure D.9: Out of Labour Market Rate - Singles

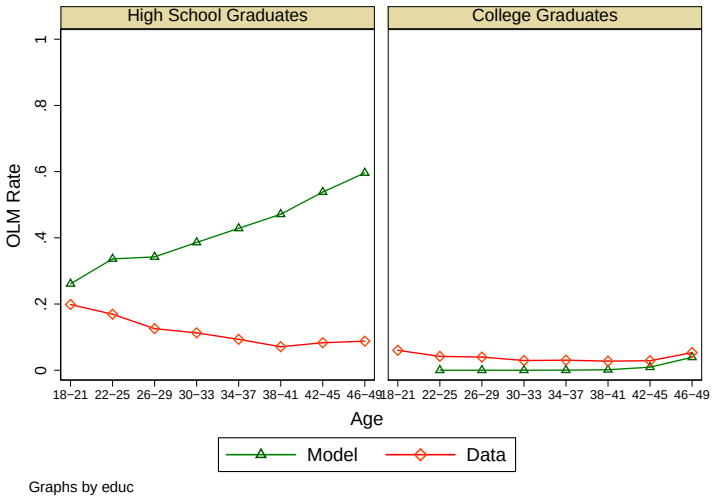


Figure D.10: Full-time Employment Rate - Married

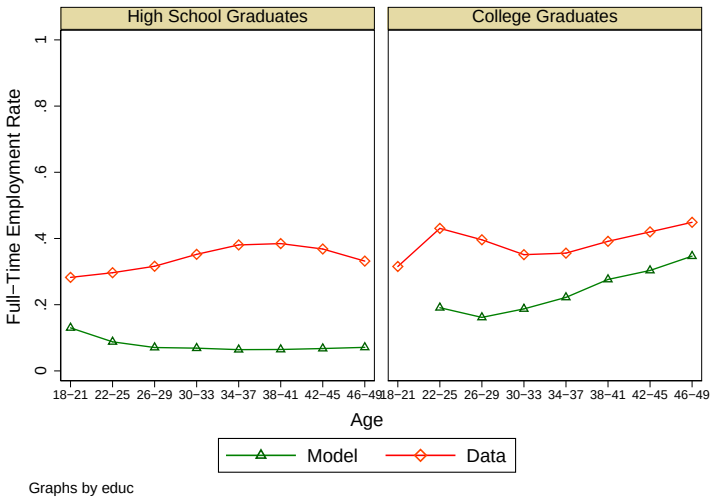


Figure D.11: Part-time Employment Rate - Married

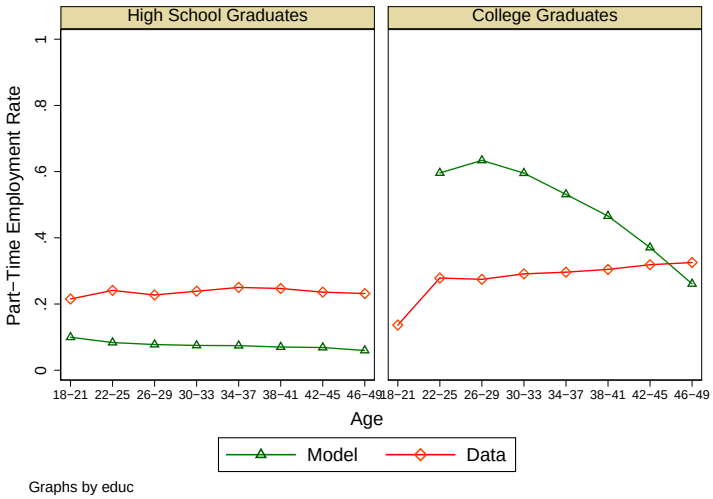


Figure D.12: Out of Labour Market Rate - Married

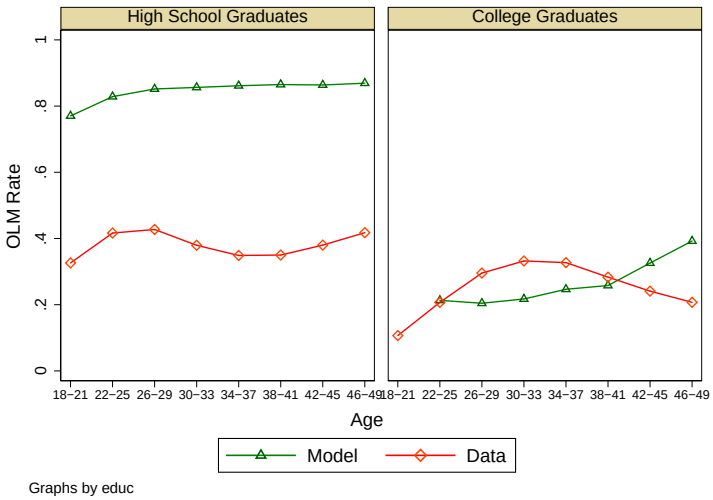


Figure D.13: Full-time Employment Rate (Women), by part-time experience

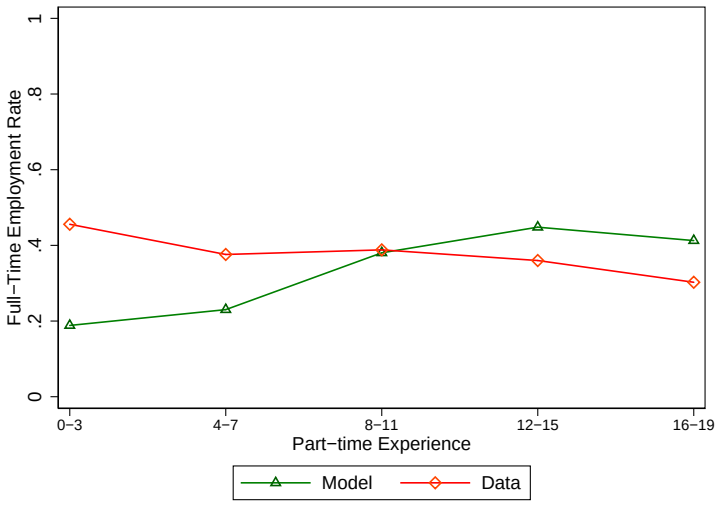


Figure D.14: Part-time Employment Rate (Women), by part-time experience

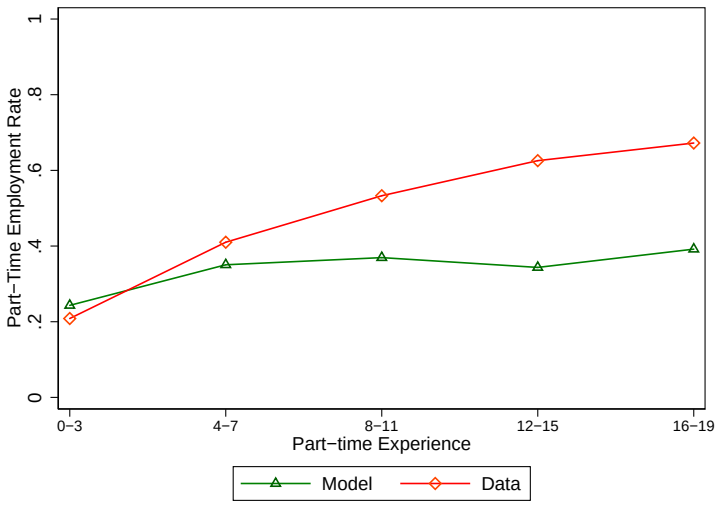


Figure D.15: Fraction Out of Labour Market (Women), by part-time experience

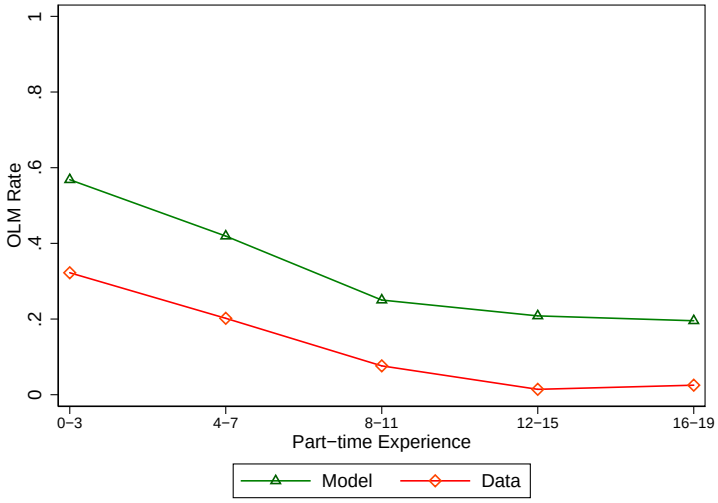


Figure D.16: Full-time Employment Rate (Women), by full-time experience

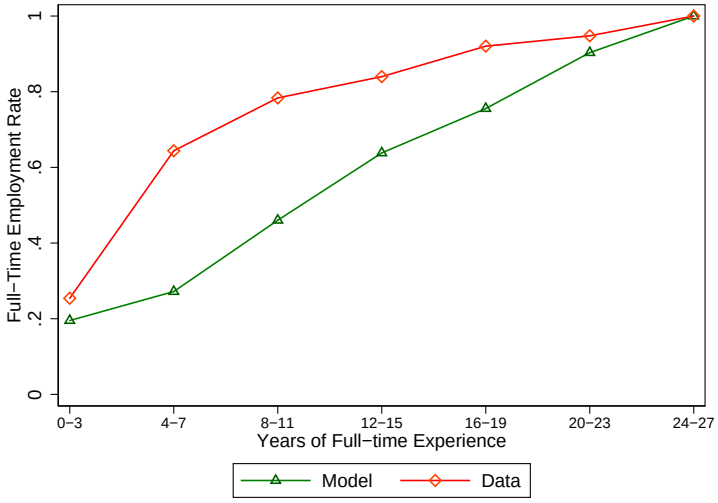


Figure D.17: Part-time Employment Rate (Women), by full-time experience

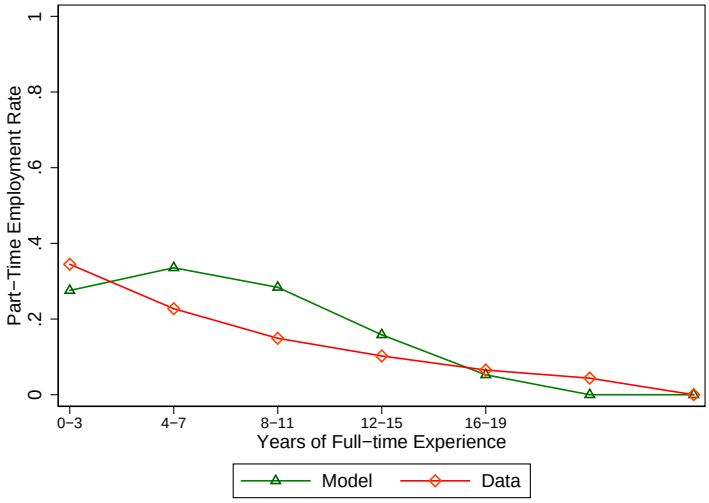


Figure D.18: Fraction Out of Labour Market (Women), by full-time experience

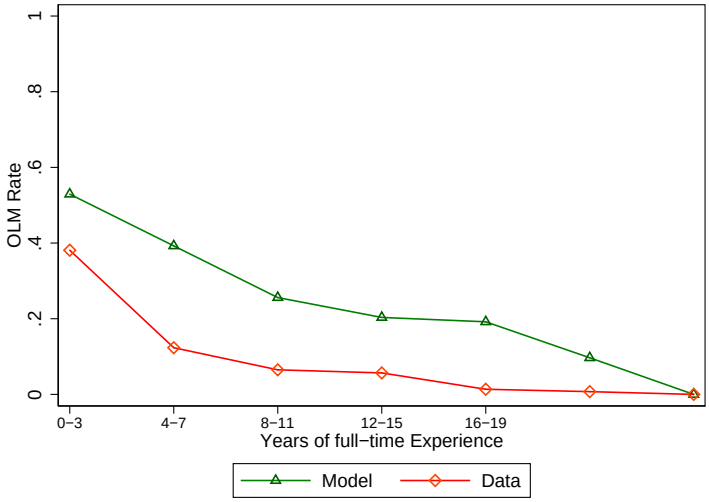


Figure D.19: Mean Log Wage - Full-time

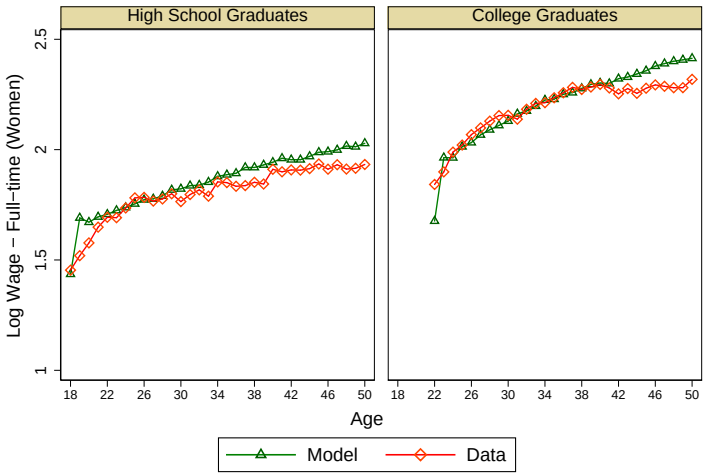


Figure D.20: Mean Log Wage - Part-time

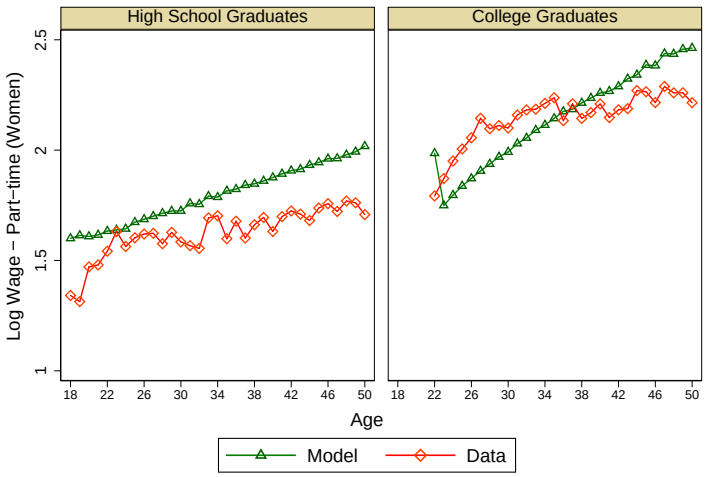


Figure D.21: Mean Log Wage - Full-time (Women), by full-time experience

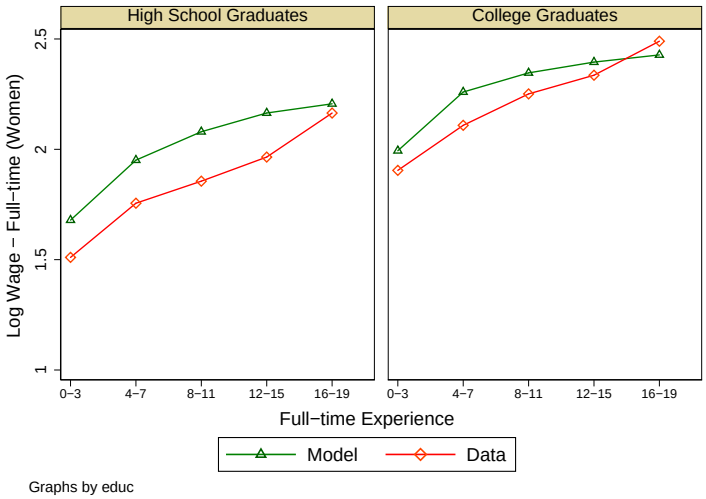


Figure D.22: Mean Log Wage - Part-time (Women), by full-time experience

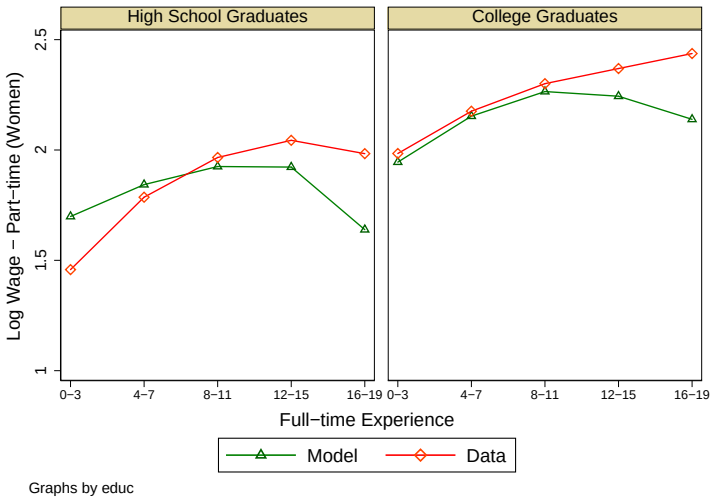


Figure D.23: Mean Log Wage - Full-time (Women), by part-time experience

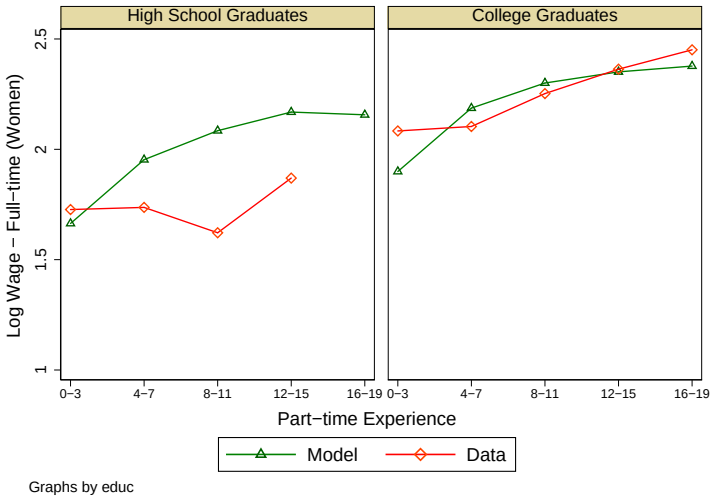


Figure D.24: Mean Log Wage - Part-time(Women), by part-time experience

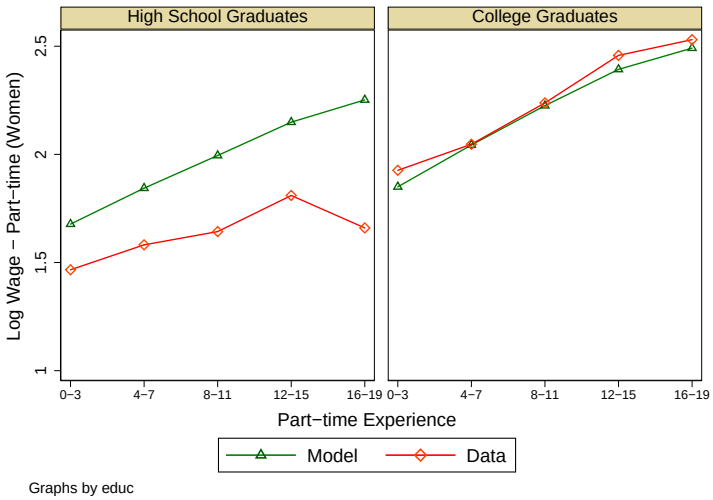


Figure D.25: Full-time Log Wage (Women)

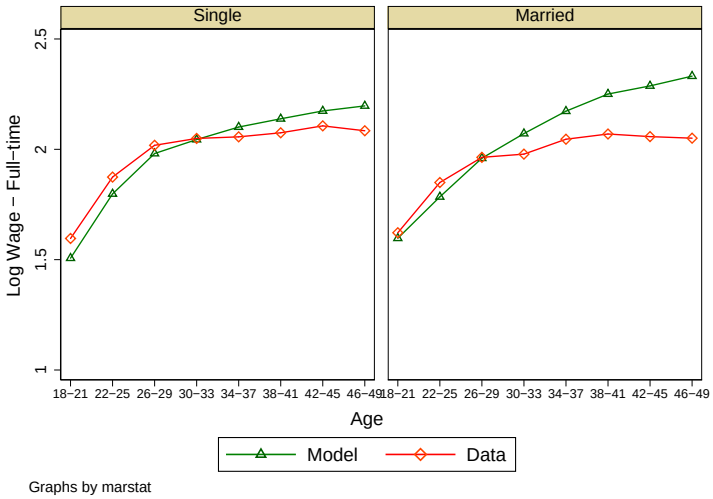


Figure D.26: Part-time Log Wage (Women)

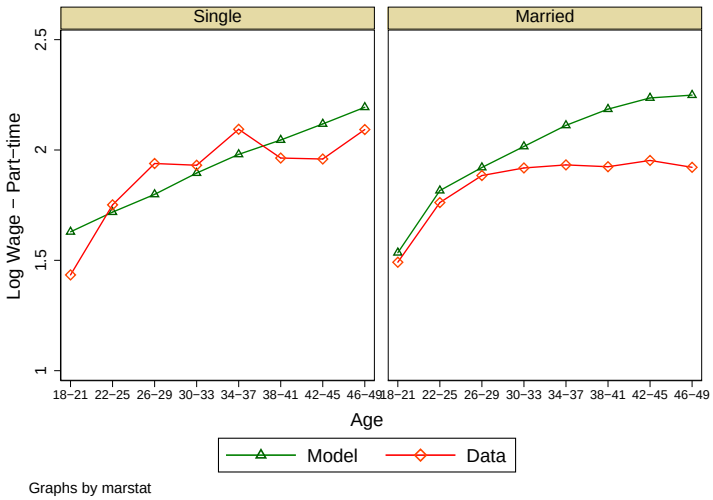


Figure D.27: Full-time Log Wage Squarred by education (Women)

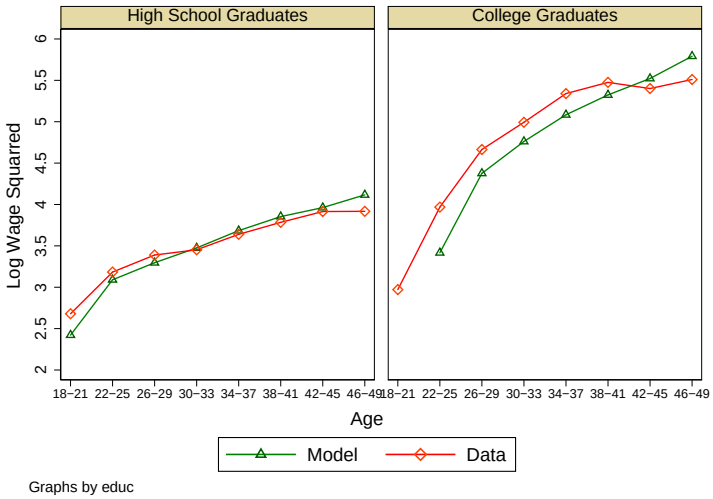


Figure D.28: Part-time Log Wage Squarred by education (Women)

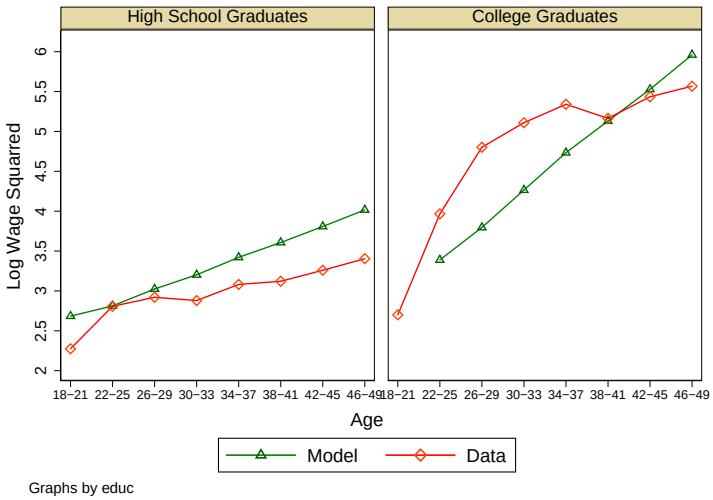


Figure D.29: Full-time Log Wage Squarred by marital status (Women)

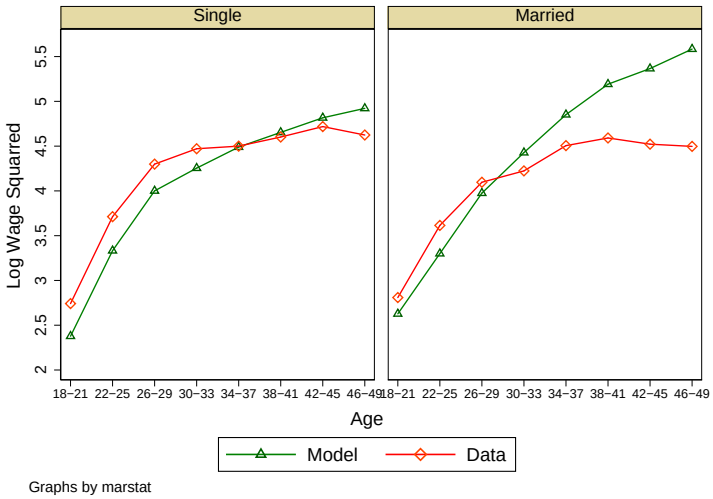


Figure D.30: Part-time Log Wage Squarred by marital status (Women)

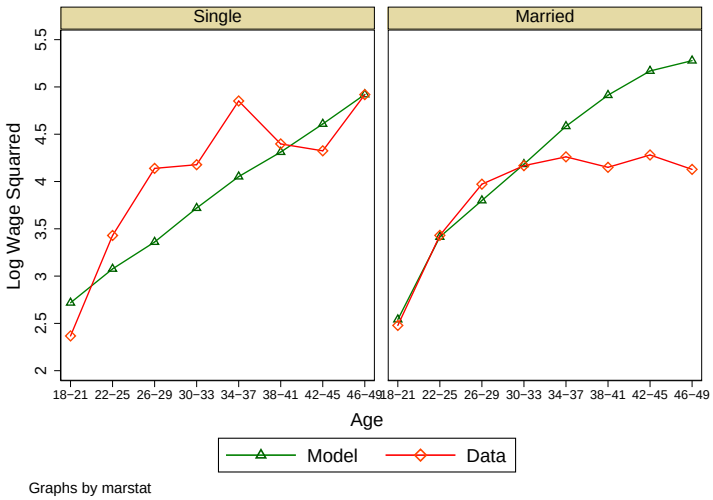


Figure D.31: Mean Log Wage - Full-time

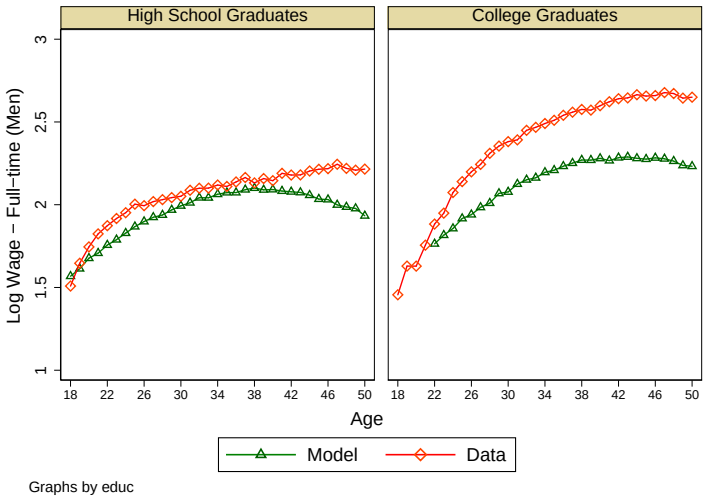


Figure D.32: Mean Log Wage - Full-time, Men

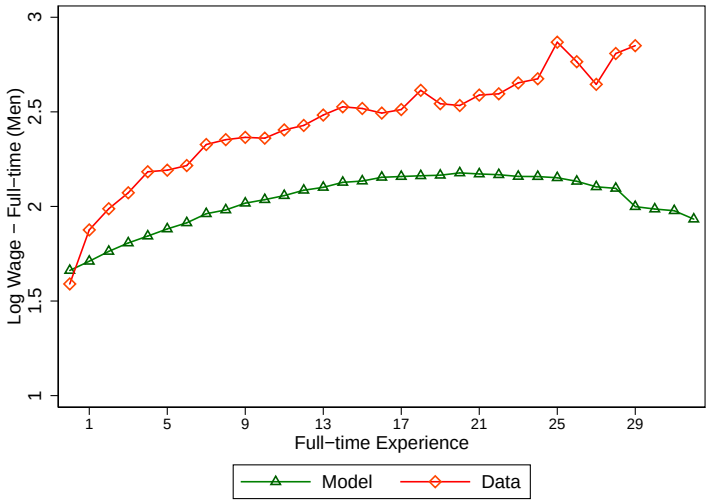


Figure D.33: Full-time Log Wage (Men)

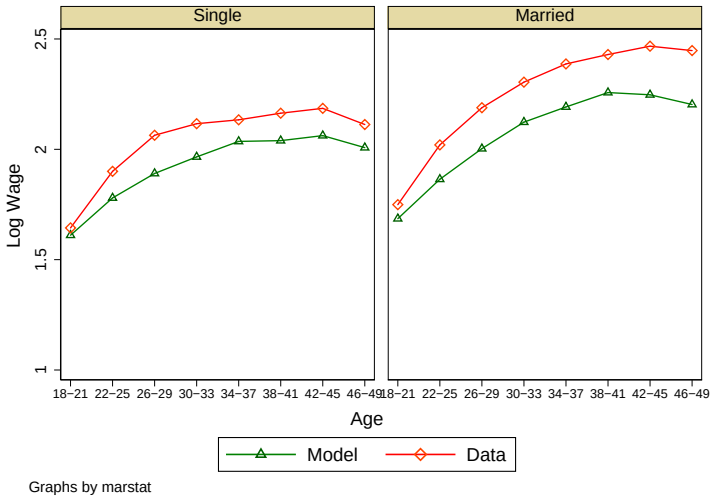


Figure D.34: Full-time Log Wage Squarred by education (Men)

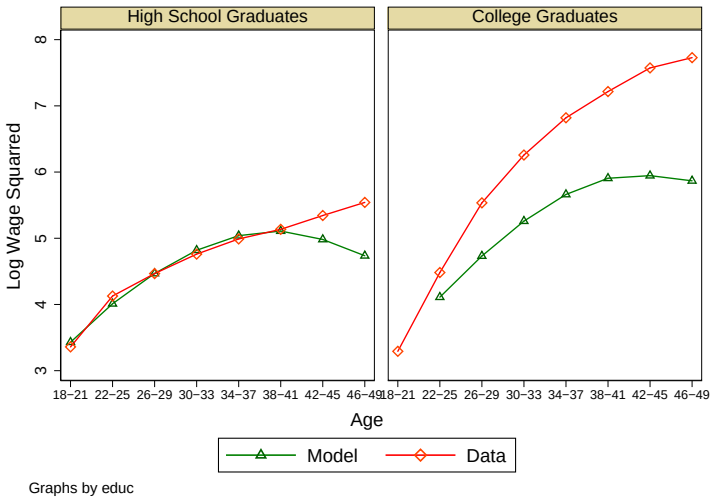


Figure D.35: Full-time Log Wage Squarred by marital status (Men)

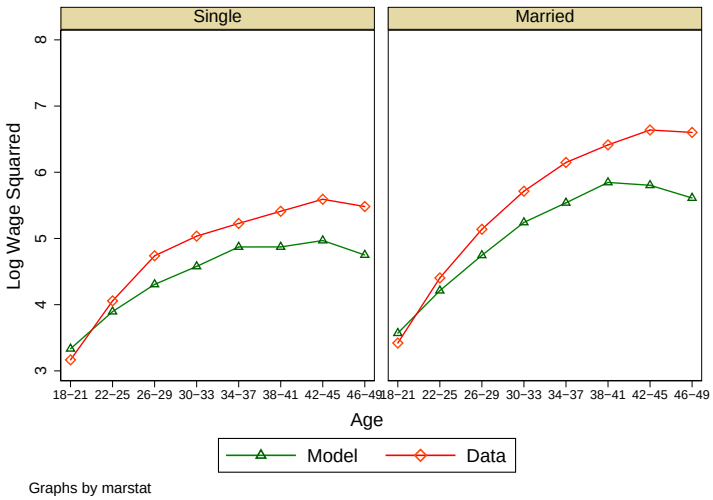


Figure D.36: Fraction Married, by age

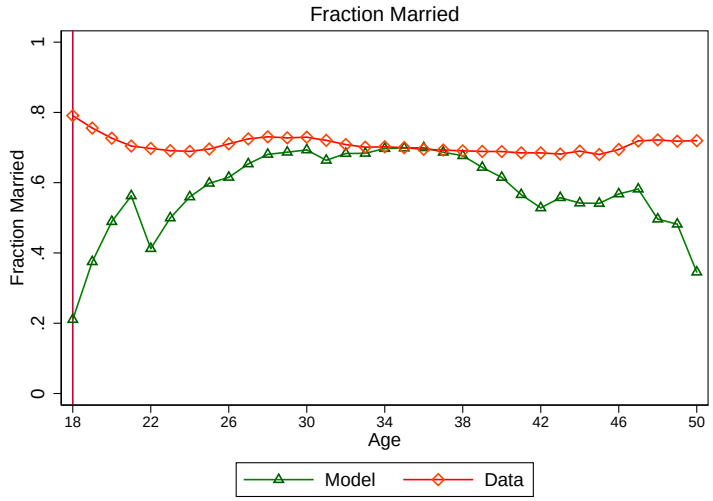


Figure D.37: Fraction Divorced, by age

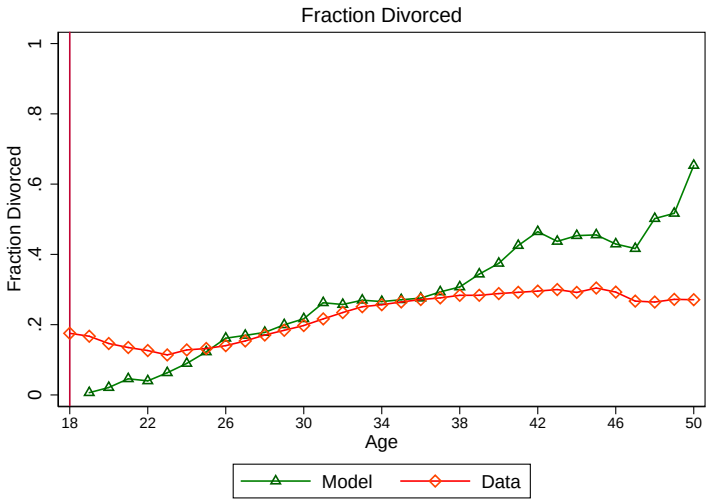


Figure D.38: Marriage Flows, by age

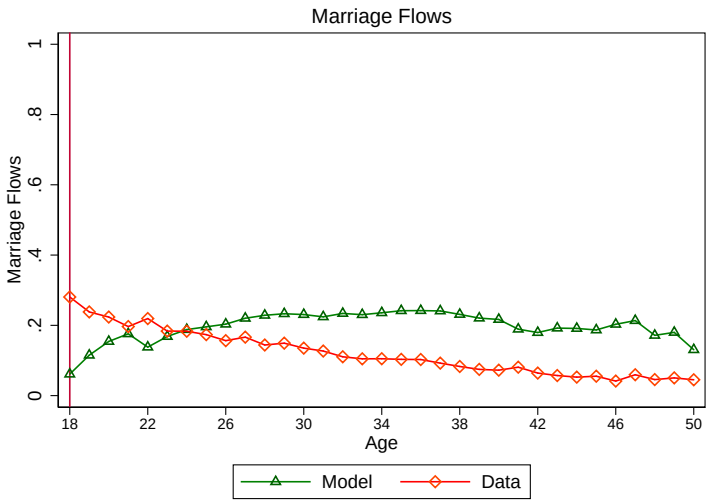


Figure D.39: Divorce Flows, by age

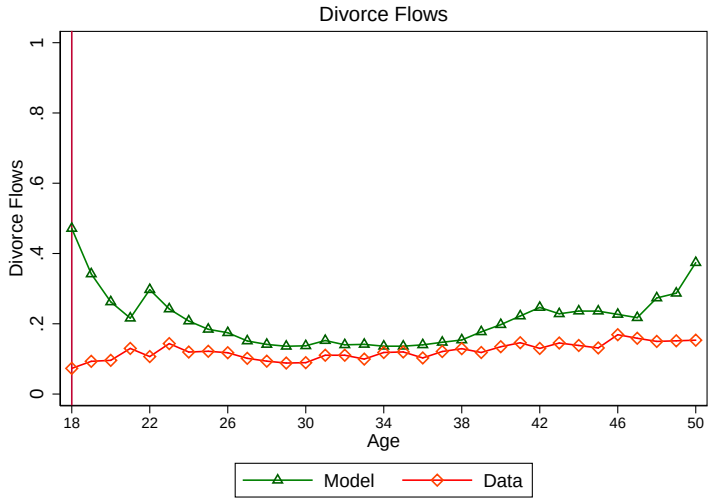


Figure D.40: Fraction having kids by marital status (Men)

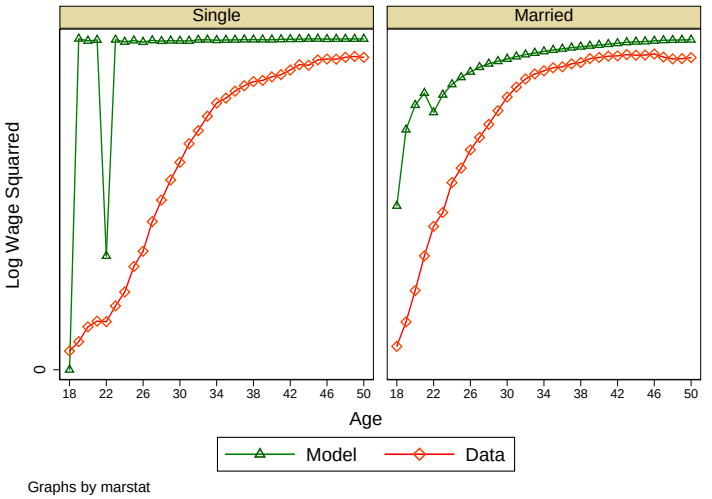


Figure D.41: Fraction having kids by marital status (Women)

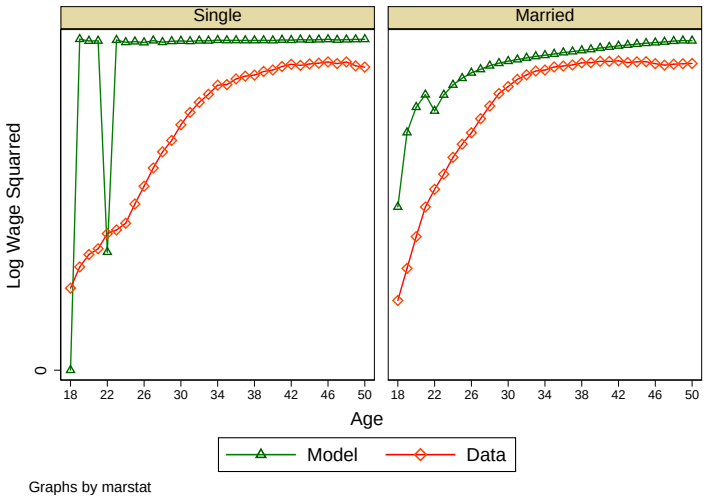


Table D.5: Child Care Hours - by gender and marital status

Gender	Marital Status	Employment Status	CChours	Model	Data
Women	Single	Full-time	No CCare	0.610	0.483
			Part-time	0.175	0.280
			Full-time	0.215	0.237
		Part-time	No CCare	0.909	0.548
			Part-time	0.030	0.339
			Full-time	0.061	0.113
		Not Working	No CCare	1.000	0.907
			Part-time	0.000	0.079
			Full-time	0.000	0.019
Men	Single	Full-time	No CCare	0.816	0.682
			Part-time	0.071	0.227
			Full-time	0.113	0.091
Women	Married	Full-time	No CCare	0.265	0.407
			Part-time	0.338	0.290
			Full-time	0.397	0.303
		Part-time	No CCare	0.507	0.558
			Part-time	0.168	0.358
			Full-time	0.325	0.083
		Unemployed	No CCare	0.690	0.821
			Part-time	0.075	0.162
			Full-time	0.235	0.017

Table D.6: Hourly cost of child care - by gender and marital status

Gender	Marital Status	Employment Status	Mean		Variance	
			Model	Data	Model	Data
Women	Single	Full-time	1.197	0.640	1.857	1.553
		Part-time	0.523	0.571	1.027	0.939
		Not-working	0.000	0.549	0.000	0.916
Men	Single	Full-time	1.150	0.756	1.938	0.984
Women	Married	Full-time	1.899	0.709	4.003	1.029
		Part-time	1.634	0.988	3.339	1.714
		Not Working	1.474	1.035	3.056	1.980