How do household time use decisions respond to policy changes? Evidence from Australia.

Joshua Clyne (zjq446)

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University of Copenhagen

Department of Economics

Lecturer: Thomas Damsgaard Tørsløv

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Abstract

This paper investigates household time use decisions over the life-cycle, focusing on the division of market work (MW) and domestic work (DW) among heterosexual couples, and its responsiveness to policy changes. A structural model is developed that interlinks human capital accumulation, gendered preferences and productivity estimates over DW and MW. The model is estimated using the Simulated Method of Moments to match the patterns of time use and wages from the Household Income and Labour Dynamics in Australia (HILDA) survey. The estimated model is used to investigate the effect of two counterfactual policy experiments: a permanent change in the relative wage among couples and the introduction of child-related transfers. The results suggest the division of DW within the household is unresponsive to these changes, while MW is more responsive.

Replication: Replication code that solves and simulates the model developed in this paper can be found on my GitHub page: https://github.com/clynejj/Public-economics-seminar-project-code.

Contents

1 Introduction

1.1 Motivation and outlook

Since the seminal contribution of Becker (1965), household allocation decisions over time and goods have been understood to involve a trade-off between market work (MW) and domestic work (DW). The arrival of children fundamentally influences this trade-off, impacting particularly female labour supply and human capital accumulation over the life-cycle.[1]

According to the canonical model of Becker (1991), women's biologically-determined advantage in the bearing and raising of children leads them to specialise in DW, while their husband focuses on MW. The family economics literature has since dispensed with this biological explanation of comparative advantage, with recent work identifying gender norms learned during childhood as an alternative explanation of the long-term gender earnings gap (Kleven, Landais, and Egholt Søgaard 2018; Andresen and Nix 2022). While much of this research has focused on identifying the effect of children on observed labour market disparities, such as quantifying child-penalties in labour supply and earnings, relatively less attention has been placed on quantifying and modeling the time use decisions of couples that takes place *within* the household. This is an important frontier for achieving gender equality. This paper seeks to answer the following question: how does household time use behaviour respond to policy changes?

The Household, Income, and Labour Dynamics in Australia (HILDA) survey provides a unique opportunity to quantify these within-household time use decisions. Importantly, HILDA collects time use data for all adult members of responding households, and it's panel dimension allows tracking of these time use decisions, along with wages and family composition, over the life-cycle. To the best of my knowledge, this is the only data set that combines these features [2]. Figure 1 shows the impact of the arrival of children on DW and MW decisions among heterosexual households in the HILDA sample. As Figure 1 illustrates, female DW and MW decisions are impacted by the arrival of children much more strongly than for their male partners.

In addition to the arrival of children, the relative wage among couples is another potentially important consideration when households decide on the division of MW and DW. Using HILDA data, Siminski and Yetsenga (2022) find a striking gender asymmetry in the division of household tasks among heterosexual couples. Even as women out-earn their male partners, they still tend to shoulder a greater share of domestic work. This asymmetry is illustrated in Figure 2. The analysis of Siminski and Yetsenga (2022) highlights the critical issue of endogeneity when

1. See for example the work of Adda, Dustmann, and Stevens (2017) document the career-costs of having children for women over the life-cycle.

2. The American Time Use Survey (ATUS), for example, relies on only one respondent from each household.

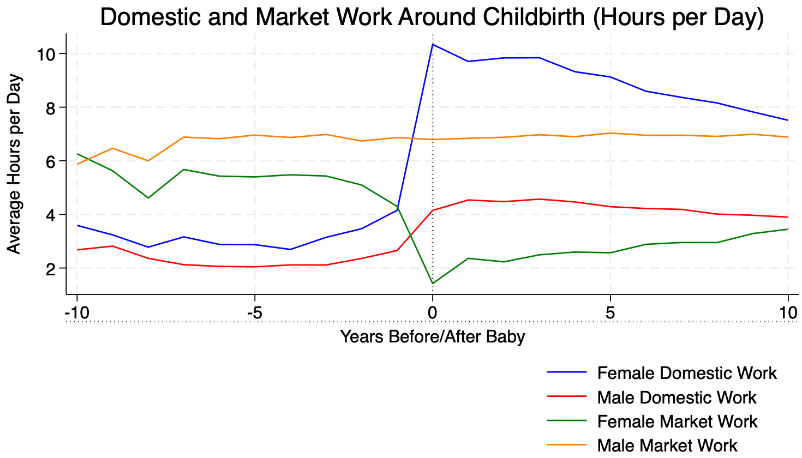
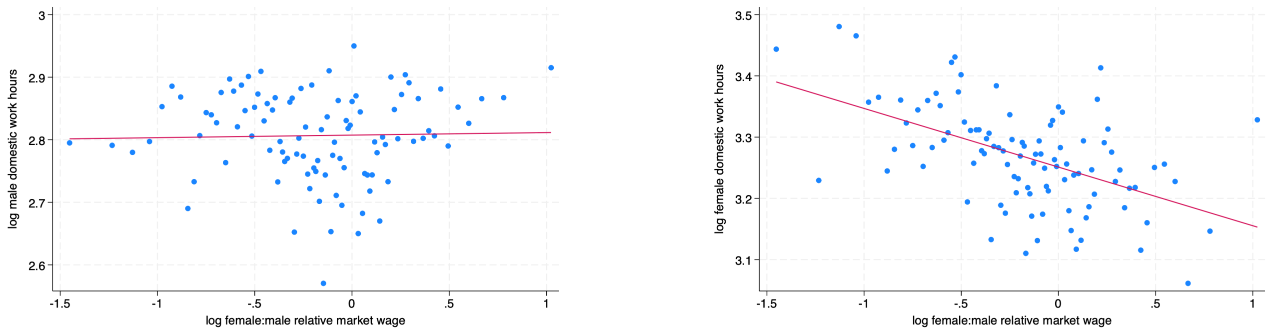


Figure 1: Event Study of the arrival of children on the DW and MW decisions of men and women in cohabiting heterosexual relationships. The figure shows average time use behaviour in a typical day, and it is produced from the HILDA sample described in section 2.

it comes to modeling household time use decisions. As the authors note in regards to their regression analysis: "wages are a function of decisions in the past to invest in human capital (especially time spent in market work)" and that this is "especially likely to affect women's wages and time use, since men typically work full time for most of their working age". Siminski and Yetsenga (2022) propose a Bartik-style intrumental variable (IV) approach to address this endogeneity concern, however, their results implementing this are mostly insignificant.[3]



(a) Male

(b) Female

Figure 2: The relationship between domestic work and relative wages among heterosexual couples, by gender. The regression results are produced for the HILDA sample described in Section 2, following the public replication code from Siminski and Yetsenga (2022).

To overcome this endogeneity issue, this paper develops a structural model of household time use that accounts for the dynamics between labour supply, human capital accumulation, and wages over the life-cycle. The model is fitted to moments from the HILDA sample to estimate parameters that govern preferences over work and consumption, and the productivity

3. The authors also do not devote great attention to defending exogeneity assumptions and similar considerations for causal analysis.

levels of household members. The estimated model is then used as a policy lab to investigate a counterfactual change in the relative wage between household members and the introduction of government transfers to households with children. The results suggest that the allocation of time to DW is largely unresponsive to these counterfactual policy changes. MW, on the other hand, is more responsive to policy changes, which is consistent with previous empirical findings.

The paper proceeds as follows. Subsection 1.2 reviews the relevant literature and the contributions of this paper. Section 2 describes the HILDA survey data that is used and the sample construction. Section 3 defines the life-cycle model that is developed to fit the patterns of time use behaviour seen in the data. Section 4 outlines the estimation strategy and presents the model fit. Section 5 presents the results from the counterfactual policy changes, and investigates the sensitivity to calibrated parameters as a robustness check. Finally, sections 6 and 7 conclude with a discussion of the caveats of the results and future directions.

1.2 Literature review and contributions of this paper

This paper contributes to several strands of literature. The first is a body of work that examines household labour supply decisions through the lens of dynamic economic models. Male labour supply has been extensively studied in a dynamic context, with emphasis on estimating its responsiveness to wages, taxes, and transfers.[4] Recently, there has been an increasing focus on female labour supply, particularly in relation to life events such as childbirth and their impact on career trajectories. Key contributions include Adda, Dustmann, and Stevens (2017), who highlight the significant career costs for women associated with having children over the lifespan, while Voena (2015) studies the effect of divorce laws on family labour supply, and Guner, Kaygusuz, and Ventura (2020) investigate the effect of child-related transfers on female labour supply. A central mechanism in this literature is the role of human capital accumulation and depreciation, particularly for women during career interruptions around childbirth, which affects both short-term labour supply and long-term earning potential.[5] This paper incorporates this channel by including endogenous human capital accumulation and depreciation when modelling household decisions over DW and MW.

This paper also relates to the literature on family decision-making, which has evolved from Becker's (1965) unitary model of household production to more sophisticated models that account for individual preferences and bargaining within households.[6] A key issue raised is

4. See the reviews of Keane (2010, 2011).

5. Keane and Wasi (2016) emphasise the importance of modelling human capital dynamics in understanding these patterns, while Jakobsen, Jørgensen, and Low (2022) explore the interplay between fertility decisions and labour supply in a dynamic framework.

6. See Chiappori and Mazzocco (2017) for a comprehensive literature review of the most popular static and dynamic models of household behaviour.

non-separability between utility and home production. As Browning, Chiappori, and Weiss (2014) note, “the [household] production function ... cannot be estimated independently of the utility function unless the home-produced commodities are independently observable” (85). Leveraging the HILDA survey’s unique data on time use behaviour of all adult household members, the model developed in this paper is able to separately estimate household utility parameters, which reflect preferences over MW and DW, and parameters in the household production function, which govern the productivity levels of household members with respect to MW and DW. To the best of my knowledge, this is the first paper to separately estimate parameters for these two channels.

This paper also builds on the insights from previous studies that investigate household time use behaviour. Recent contributions include Siminski and Yetsenga (2022), who document the relationship between the household division of labour and relative wages, while Low (2024) documents the gendered in-efficiency in the division of DW and MW within heterosexual couples and its consequences for marriage markets. Both of these recent studies do not, however, directly consider the effect of policy changes on the household division of labour, which is the focus of this paper. The study that is most similar to this analysis is that of Blundell, Pistaferri, and Saporta-Eksten (2017), who estimate a life-cycle model of family labour supply and time use, focusing on the complementarities between spouses’ time in the labour market and the effects of wage shocks. Their paper models household time allocation decisions over DW, MW and leisure as a consumption-smoothing device in the presence of income uncertainty. The model proposed in this paper abstracts away from including income shocks, and instead focuses on the dynamic feedback between the division of time use within households and human capital accumulation, with a focus matching the gendered differences in time use patterns upon the arrival of children (as seen in figure 1).

Another body of work identifies the role of social norms concerning gender roles in shaping labour market outcomes. The foundational contributions of Akerlof and Kranton (2000, 2010) introduced the concept of identity economics, drawing on insights from sociology and social psychology to demonstrate how identity, a sense of belonging to a social category, coupled with norms prescribing appropriate behaviour, affects economic decision making. They propose that deviations from prescribed norms, such as the expectation that “a man should earn more than his wife,” can entail significant psychological or social costs, influencing economic outcomes. The subsequent empirical evidence aligns with these predictions: studies such as Kleven, Landais, and Egholt Søgaard (2018) and Kleven, Landais, and Leite-Mariante (2023) document substantial long-term child penalties for women in terms of participation and earnings in the labour market, which are largely attributed to gender identities and norms ingrained during childhood. Moreover, the aforementioned recent studies investigating time use decisions within the household by Siminski and Yetsenga (2022) and Low (2024) also identify gender norms as a key explanatory factor. The difficulty with considering social norms is that they can arguably only be identified through surveys into preferences and beliefs. The model developed in this paper uses survey reports of time use *behaviour* (rather than attitudes), and therefore it cannot directly identify their effect. Instead, the influence of social norms are likely embedded within the estimated preference and productivity parameters. In this sense, the model is agnostic about the specific causes of observed behaviour; instead, it estimates what is likely to be the cumulative influence of norms, preferences, and productivity, such that the model fits the data. The parameter estimates are then used to isolate and predict behavioural responses to policy changes.

2 Data

This paper draws on data from the HILDA survey, which offers a unique combination of features that make it ideally suited for studying household time use decisions over time. HILDA is a longitudinal household survey that annually tracks approximately 10,000 households, which is designed to be a representative sample of the Australian adult population. The data provides information on time use for both MW and DW for all adult members of responding households. Additionally, the panel structure of HILDA allows for tracking individuals over time, mitigating concerns related to sample selection bias and measurement error in wage data. These features, as well as the sample selection approach, are outlined in the following sections.

2.1 Time use variables

The time use variables are drawn from HILDA's Self-Completion Questionnaire, where respondents report the amount of time they typically spend on various activities per week. Folowing the approach of Siminski and Yetsenga (2022), my measure of DW combines time spent on outdoor tasks, childcare, housework and household errands. Similarly, MW combines time spent on paid employment and commuting. By summing these components, aggregate measures of MW and DW are the focus analysis.

Unlike diary-based time use data, the HILDA survey captures stylised estimates, which respondents perceive as their time allocations in a typical week. While stylised estimates may exceed diary estimates on average, I argue that they better capture long-term patterns relevant for this analysis, in line with the approach laid out by Siminski and Yetsenga (2022).[7]

7. Several studies have shown that estimates of housework time based on stylised reports tend to exceed those based on diary data (e.g., Marini and Shelton 1993; Baxter and Bittman 1995; Bianchi et al. 2000; Juster et al. 2003). However, this discrepancy is not observed in comparisons between the HILDA survey and the 2006 Australian Time Use Survey (TUS), both of which are nationally representative of the Australian adult

2.2 Hourly wage variables

Hourly wages are calculated as the ratio of weekly earnings to self-reported weekly hours worked, which makes them subject to measurement error. Two main issues are missing wage values and noisy observations from misreported observations. To negate these issues, I implement a moving-median approach using a five-year window around each wage observation, following the approach described in Siminski and Yetsenga (2022). Extreme outliers in wages are also excluded.[8]

2.3 Sample construction

The sample consists of heterosexual cohabiting couples from HILDA waves 2 to 22, where both partners are aged from 25 to 55 and have non-missing time use data. After dropping observations with missing or implausible wage data, the sample comprises 45,337 couple-year observations from 7,649 unique couples. Descriptive statistics are provided in Table A.1, summarising key household characteristics.

3 Life-cycle model

This section describes the life-cycle model of household labour supply and home production that is used to investigate the behavioural response to policy changes. The model is formulated to be a parsimonious reflection of some important considerations in the decision-making process of households, which means it abstracts away from other factors. I discuss the implications of these choices in section 6.

3.1 The model

The model follows a unitary framework, where couples jointly choose how much each member should work in the labour market, $l_{j,t} \geq 0$, and on home production, $h_{j,t} \geq 0$, in each year $t = 1, \ldots, T$. Index $j \in \{f, m\}$ identifies female and male adult household members. The model period, $T = 8$, is chosen to track the time use behaviour of heterosexual couples over an 8 year period where they face potential fertility. For example, $l_{f,t} \in [0, 24]$ denotes how many hours the female works in the labour market per day, on average, during year t. Likewise, for men and home production.

population. For example, average domestic work time reported in HILDA (220.4 minutes/day) closely aligns with TUS estimates (224 minutes/day). Additionally, diary-based estimates, typically collected over 1-2 days, may reduce recall bias but still risk capturing noisy, day-specific variations in time use.

8. This includes the top and bottom 0.1% of wage observations.

Couples make their time use decisions taking three state variables into account. These are collected in $\mathcal{S}_t = \{K_{f,t}, K_{m,t}, n_t\}$, where $K_{f,t}, K_{m,t} \geq 0$ are the human capital of women and men, and $n_t \in \{0, 1\}$ is the presence of a child in the household.

Total time spent on working per day in a year is

$$T_{j,t} = l_{j,t} + h_{j,t} \tag{1}$$

which cannot exceed 24 hours,

$$T_{j,t} \leq 24. \tag{2}$$

Couples gain utility from market goods, C_t, and home-produced goods, H_t, through the composite good

$$Q_t = C_t^{\omega(n_t)} H_t^{1-\omega(n_t)} \tag{3}$$

where $\omega(n_t) = \omega + \omega_n n_t \in (0, 1)$ is the relative weight on market goods, which depends on the presence of a child, n_t, in each period.

Home production is a Constant Elasticity of Substitution (CES) function of the DW of both members,

$$H_t = \left(\alpha(n_t) h_{f,t}^{\frac{\sigma-1}{\sigma}} + (1 - \alpha(n_t)) h_{m,t}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} \tag{4}$$

where $\sigma \in (0, 1)$ is the elasticity of substitution and $\frac{\alpha(n_t)}{1-\alpha(n_t)} \in (0, 1)$ is the productivity in home production of females relative to males (her absolute advantage in home production). This is set to depend on the presence of a child, such that $\alpha(n_t) = \alpha + \alpha_n n_t$.

The utility function of household member j, which governs her preferences over work and consumption, is given by

$$u_j(Q_{j,t}, l_{j,t}, h_{j,t}, n_t) = \frac{Q_t^{1-\rho}}{1-\rho} - \nu_{j,l}(n_t) \left(\frac{l_{j,t}^{1+\frac{1}{\epsilon_{j,l}(n_t)}}}{1 + \frac{1}{\epsilon_{j,l}(n_t)}} \right) - \nu_{j,h}(n_t) \left(\frac{h_{j,t}^{1+\frac{1}{\epsilon_{j,h}(n_t)}}}{1 + \frac{1}{\epsilon_{j,h}(n_t)}} \right) \tag{5}$$

where the second term is the dis-utility from MW hours ($\nu_{j,l} > 0$) and the last term is the dis-utility from DW work hours ($\nu_{j,l}(n_t) > 0$), which are gender-specific and depend on the presence of a child, such that $\nu_{j,l}(n_t) = \nu_{j,l} + \nu_{j,l,n}(n_t)$ and $\nu_{j,h}(n_t) = \nu_{j,h} + \nu_{j,h,n}(n_t)$. Likewise, $\epsilon_j(n_t) > 0$ denotes the curvature of the dis-utility, which is also gender-specific and depends on the presence of a child, such that $\epsilon_j(n_t) = \epsilon_j + \epsilon_{j,n}(n_t)$. $\rho > 1$ is the constant relative risk aversion coefficient. The household utility function is the weighted sum of the individual utilities of both household members

$$U(T_{f,t}, T_{m,t}, Q_t, n_t) = \lambda u_f(T_{f,t}, Q_t, n_t) + (1-\lambda) u_m(T_{m,t}, Q_t, n_t) \tag{6}$$

where λ denotes the power level of the female within the household.

In each period, household members accumulate human capital, $K_{j,t}$, from participating in market work,

$$K_{j,t+1} = (1-\delta)K_{j,t} + \frac{l_{j,t}}{24} \tag{7}$$

which depreciates at rate $\delta \in [0,1]$. Wages $w_{j,t}$ are a function of the level of human capital

$$\log w_{j,t} = \gamma_{j,0} + \gamma_{j,1} K_{j,t}. \tag{8}$$

There is no saving in this model, so households consume all of their income in each period. The household budget constraint given by

$$C_t = w_{f,t} l_{f,t} + w_{m,t} l_{m,t} + \mathcal{C}(n_t) \tag{9}$$

where $\mathcal{C}(n_t) = n_t \chi$ is a government transfer to households with children.

A child can arrive randomly each period with probability p_n, and couples are limited to one child

$$p_{t+1}(n_t) = \begin{cases} p_n & \text{if } n_t = 0 \\ 0 & \text{else.} \end{cases} \tag{10}$$

The recursive formulation of the model for $t \leq T$ is given by

$$\begin{aligned} V_t(n_t, K_{f,t}, K_{m,t}) = \max_{l_{f,t}, h_{f,t}, l_{m,t}, h_{m,t}} & \; U(T_{f,t}, T_{m,t}, Q_t, n_t) + \beta \mathbb{E}_t \left[V_{t+1}(n_{t+1}, K_{f,t+1}, K_{m,t+1}) \right] \\ & \text{s.t. (1) - (10)} \end{aligned} \tag{11}$$

where β is the household's inter-temporal discount rate. There is no bequest motive, such that

$$V_{T+1}(K_{f,T+1}, K_{m,T+1}, n_{T+1}) = 0. \tag{12}$$

3.2 Solution method

The model is solved using backward induction, starting from the terminal period condition, implied by there being no bequest motive in equation (12):

$$V_T(n_t, K_{f,T}, K_{m,T}) = \max_{l_{f,T}, h_{f,T}, l_{m,T}, h_{m,T}} U(T_{f,T}, T_{m,T}, Q_T, n_T). \tag{13}$$

In the terminal period, the value function depends only on the immediate utility from choices of MW ($l_{j,T}$) and DW ($h_{j,T}$), subject to time constraints.

The solution begins by evaluating the terminal period value function on a grid of human capital values, $\overrightarrow{K} \times \overrightarrow{K}$, representing combinations of human capital for both household members. Using this as a starting point, the model iterates backward in time, solving for each prior period $t = T-1, \ldots, 1$:

$$V_t(n_t, K_{f,t}, K_{m,t}) = \max_{l_{f,t}, h_{f,t}, l_{m,t}, h_{m,t}} U(T_{f,t}, T_{m,t}, Q_t, n_t) + \beta \check{V}_{t+1}(K_{f,t+1}, K_{m,t+1}), \tag{14}$$

where $\check{V}_{t+1}(K_{f,t+1}, K_{m,t+1})$ is the interpolated value function from the next period. The optimisation is subject to the constraints that total hours worked do not exceed 24: $T_{j,t} = l_{j,t} + h_{j,t} \leq 24$ and hours are non-negative $l_{j,t}, h_{j,t} \geq 0$.

This process continues until the first period, solving the Bellman equation recursively at each step. The optimisation step is performed using numerical solvers on the given grid points for human capital.

4 Estimation Strategy

The model parameters are estimated in two-steps. The first step involves calibrating some parameters outside of the model, which are contained in the vector $\boldsymbol{\phi}$. In the second step, the remaining parameters are estimated within the model, which are contained in the vector $\boldsymbol{\theta}$. The sensitivity of the estimation results to calibrated parameters is then investigated, following the approach proposed by Jørgensen 2023.

4.1 Parameters set outside the model

The vector $\boldsymbol{\phi}$ contains parameters that are calibrated based on prior empirical findings or by assumption, rather than estimated within the model. These parameter estimates are shown in Table A.2.

The household inter-temporal discount rate β and the rate of human capital depreciation δ are taken from previous studies that estimate household labour supply decisions using structural models (Keane and Wasi 2016; Iskhakov and Keane 2021). The annual birth probability p_n is calibrated from the HILDA sample. To allow for some heterogeneity in initial human capital levels, the initial human capital levels of individuals $K_{f,0}, K_{m,0}$ are drawn from a uniform distribution. This setting could be improved upon by using data on educational attainment and other characteristics related to an individual's ability, as is done by Jakobsen, Jørgensen, and Low (2022). The power level within the household λ, is set to 0.5 to reflect an equal share of decision-making power within the household, following what is done by Jakobsen, Jørgensen, and Low (2022) and Eckstein, Keane, and Lifshitz (2019). Finally, the level of government transfers to households with children χ is set to zero by assumption. This is included in the baseline model to later investigate a counterfactual increase in government transfers to households with children.

4.2 Parameters estimated within the model

The remaining parameters, $\boldsymbol{\theta}$, are estimated using the Simulated Method of Moments (SMM), which was introduced by McFadden (1989). These parameters govern preferences, wage returns to human capital, and household production productivity, which are all estimated to match patterns in the HILDA sample.

The SMM estimator is given by:

$$\hat{\boldsymbol{\theta}} = \arg\min_{\boldsymbol{\theta}} g(\boldsymbol{\theta})' W g(\boldsymbol{\theta}), \tag{15}$$

where $g(\boldsymbol{\theta}) = m^{data}(\boldsymbol{\theta}) - m^{sim}(\boldsymbol{\theta})$ is a $J \times 1$ vector of differences between $J = 48$ empirical moments calculated from the HILDA sample and the same moments calcuated from the simulated data, for a given $\boldsymbol{\theta}$. In this case, there is over-identification and W is a $J \times J$ symmetric positive definite weighting matrix. To construct the simulated moments in m^{sim}, the model is solved for a given $\boldsymbol{\theta}$ and synthetic data is generated for $N^{sim} = 10,000$ households. These simulated observations are used to generate the same moments in the HILDA sample data. Practically, this involves passing the objective function to a gradient-free numerical solver.[9] Computational speed is the major constraint in this process. Solving and simulating the model once takes approximately 1.2 seconds. Therefore, the numerical solver is constrained in the amount of guesses of $\boldsymbol{\theta}$ it can evaluate, and is therefore highly sensitive to the initial values provided. Although the solution did converge to a minimum, it is not in general guaranteed that the solution is a global minimum.[10] Therefore, identification of model parameters comes primarily from inspecting the model fit, which is illustrated and discussed in Subsection 4.3.

The estimated parameters are shown in Table A.3. These parameters can be grouped as those relating to household preferences over MW and DW, wage returns to human capital, and the parameters in the home-production function.

The estimated dis-utility of DW is higher for women than men ($\hat{\nu}_{f,h} > \hat{\nu}_{m,h}$), which likely captures women's observed higher level of DW than men in all periods. The dis-utility associated with MW is the same for men and woman ($\hat{\nu}_{f,l} \approx \hat{\nu}_{m,l}$). This may also be expected given that men and women follow similar MW trajectories before childbirth. Upon the arrival of a

9. The criteria function in (15) is likely non-convex and non-differentiable, due to kinks in the value function induced by the random arrival of children. This is why I use the so-called 'nelder-mead' algorithm to find $\hat{\boldsymbol{\theta}}$, which was first proposed by Nelder and Mead (1965).

10. The current best parameter estimates were found after 13 hours of run-time.

child, both male and female dis-utility of MW increases ($\hat{\nu}_{j,l,n}, \hat{\nu}_{j,f,n} > 0$). But when it comes to DW, female dis-utility decreases ($\hat{\nu}_{f,h,n} < 0$) while male dis-utility of DW increases ($\hat{\nu}_{m,j,n} > 0$). This contrast likely captures the observed 'child-penalty' in DW around child-birth, as captured in Figure 1. Finally, it is worth noting that the household's relative weight on market goods in their utility $\omega(n_t)$ decreases upon the arrival of children, which may reflect the additional need for completing DW tasks when a child arrives. This may also be interpreted to reflect a preference for spending time at home with the child.

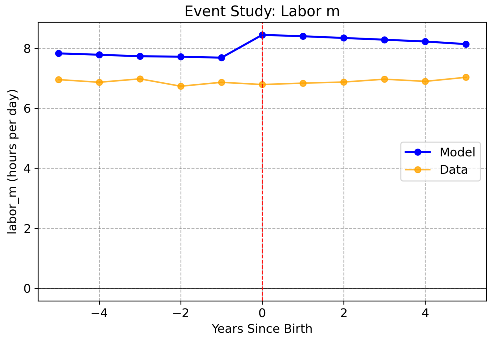
For the labour market parameters, the estimated wage profiles are similar across men and women, but men have a slightly higher baseline wage, ($\hat{\gamma}_{m,0} > \hat{\gamma}_{f,0}$), and return to human capital, ($\hat{\gamma}_{m,1} > \hat{\gamma}_{f,1}$). These values are similar to the wage profiles estimated by the dynamic labour supply models of Jakobsen, Jørgensen, and Low (2022) and Iskhakov and Keane (2021).

Parameters in the home production function may reflect the average productivity levels of individuals over DW and MW. The estimated parameters indicate that, under the assumed CES production function, women are, on average $\frac{\alpha(n_t=0)}{1-\alpha(n_t=0)} \approx 1.44$ times more productive at DW than men, and this increases to $\frac{\alpha(n_t=1)}{1-\alpha(n_t=1)} \approx 2.45$ upon the arrival of children. It is worth pointing out that the estimated parameters in this model, and in dynamic economic models more generally, do not hold a causal interpretation. The parameters are merely estimated such that the assumed model fits the data, and the model is a simplification of reality. Further discussion of results is returned to in Section 6.

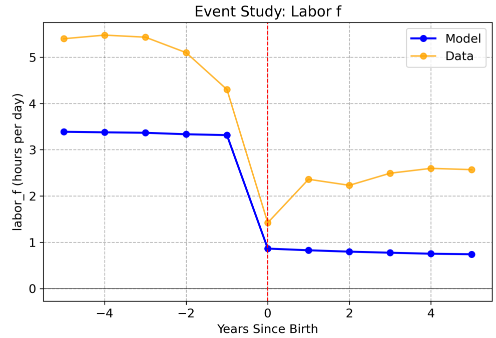
4.3 Moments matched

Figure 3 presents the model fit, by overlaying the targeted and non-targeted moments from the HILDA sample with the simulation results from the estimated model. As is clear in Figure 3, the model fit is not perfect. The targeted moments are the average patterns of MW and DW around childbirth, which are presented in 3a to 3d. Simulated male MW and DW is slightly higher than in the data in all periods, and female MW is too low prior to the arrival of children. Female MW also does not increase strongly enough in the years proceeding childbirth. Given the computational challenges that arise during the estimation of parameters, it is difficult to conclude whether the imperfect model fit may be overcome by using better initial guesses of $\boldsymbol{\theta}$ in the numerical solver, or whether some adjustments to the model are needed. Despite this imperfection, it is worth noting that the goal of the model is to capture the important patterns in the data. I argue that the estimated model is able to reasonably capture the trajectory of DW and MW for men and women, and it especially captures the direction of change around child-birth (i.e the 'child-penalty'). This makes the model useful, I argue, for understanding how household time use behaviour may interact with policy changes.

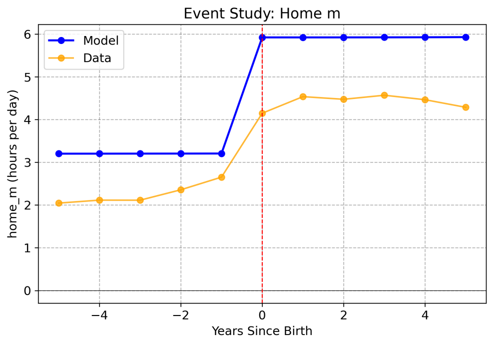
The non-targeted regression moments are presented in 3e and 3f. This allows for compar-



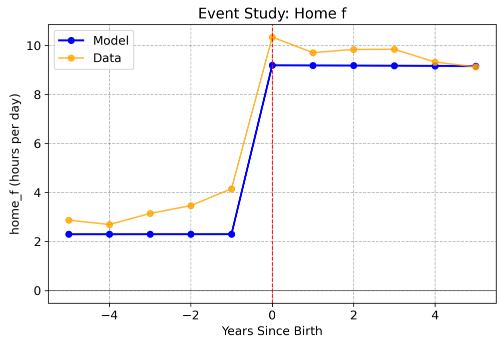
(a) Event Study: Male Market Work



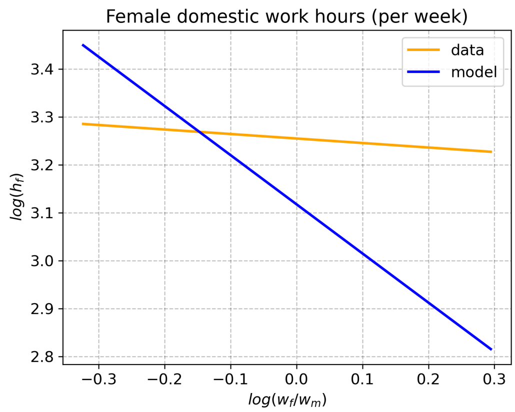
(b) Event Study: Female Market Work



(c) Event Study: Male Domestic Work



(d) Event Study: Female Domestic Work



(e) The relationship between female domestic work hours and the relative wage.

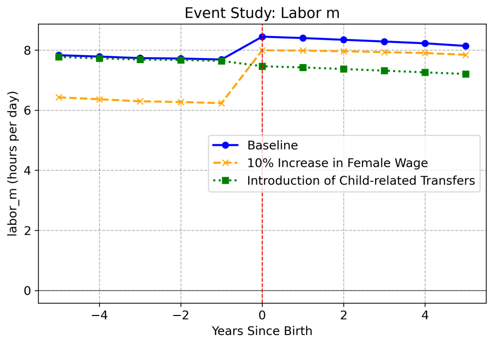
(f) The relationship between male domestic work hours and the relative wage.

Figure 3: Model fit plots for the targeted event study moments (3a to 3d) and the non-targeted regression moments (3e and 3f). The event study panels show the fit of the model to changes in market and domestic work before and after childbirth. The regression panels show the relationship between wages and domestic work.

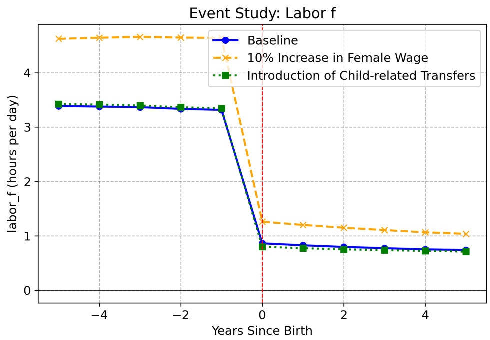
ison of the simulated model results with the reduced-form findings from Siminski and Yetsenga (2022) that are presented in Figure 2. Comparison of the simulated model to the regression results finds a steeper negative relationship between female DW and relative wages ($log(w_{f,t}/w_{m,t})$). Male DW work in the simulated model also has a negative relationship with relative wages, which is contrary to the findings from Siminski and Yetsenga (2022). The source of this discrepancy is not clear, however, extending the analysis to target more detailed moments for wage patterns may be a useful future extension to the estimation strategy.

5 Counterfactual policy reforms

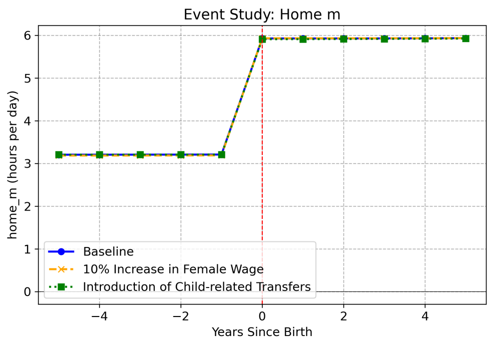
Simulated time use behaviour under the two counterfactual policy reforms is presented in Figure 4.



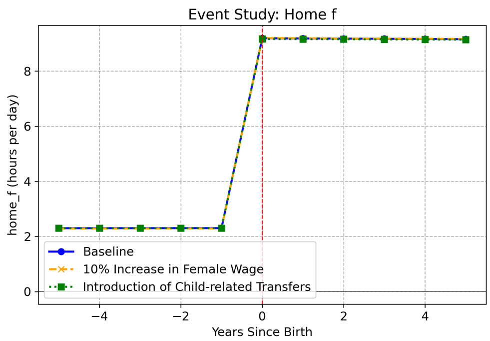
(a) Male Market Work



(b) Female Market Work



(c) Male Domestic Work



(d) Female Domestic Work

Figure 4: Event study results comparing the baseline scenario and two policy reforms. Panels show the effects on market and domestic work for males and females around childbirth.

5.1 A change to relative wages

The first counterfactual policy change introduces a permanent 10% increase in female wages in all periods (a 10% higher $\gamma_{f,0}$). As shown in Figure 4, this reform results in an increase in female MW across all periods, accompanied by a decrease in male MW. This shift likely reflects adjustments within the household to capitalise on the improvement in female wages, reflecting a substitution effect. However, the division of domestic work (DW) between men and women remains largely unchanged. Women do not reduce their time spent on DW, nor do men take on more DW, despite the observed changes in MW.

5.2 The introduction of government transfers to households with children

The second counterfactual policy reform introduces a government transfer (χ) for households with children, calibrated to 20% of average household income (calculated across all periods). Under this policy, male MW decreases slightly following the arrival of children, while female MW remains unchanged. This modest reduction in male MW could reflect an adjustment in household labor supply in response to the additional income, reflecting a possible income effect. Unlike the first reform, this policy does not alter relative wage incentives within couples, which may explain why no significant changes are observed in the division of MW nor DW.

5.3 Sensitivity to calibrated parameters

Two potentially important sets of assumptions are related to the role of power within couples and the human capital accumulation process. In line with the approach suggested by Jørgensen (2023), I investigate the sensitivities of the results to the setting of these parameter values.

The results are presented in Figure A.2. A 10% increase in the level of human capital depreciation (increasing δ from 0.1 to 0.11), does not result in any changes to the patterns of DW and MW. On the other hand, a 10% increase in the level of power of women within the household (increasing λ from 0.5 to 0.55) does reduce female MW and increases male MW in all periods. This makes sense since both men and women face dis-utility from engaging in MW, and now the dis-utility of women is given a higher weighting. DW, however, does not respond significantly. Male DW following the arrival of a child increases by approximately 12 minutes per day under this change, which can be viewed as relatively small in magntidue, particularly when compared to accompanying changes to MW. The results from this sensitivity analysis indicate that the central finding from the model, that the division of DW is unresponsive to policy changes, is likely insensitive to the calibrations of λ and δ.

6 Discussion

This study finds that the division of DW within the household is unresponsive to policy changes, while MW decisions are more responsive. This section discusses the implications of the results in the context of previous studies, and highlights important caveats.

6.1 Comparison to previous studies

The finding that DW choices are unresponsive to the policy changes considered aligns with aspects of Blundell, Pistaferri, and Saporta-Eksten (2017), who document the persistence of ingrained household roles in family time use decisions. Indeed, MW decisions are more sensitive to substitution effects, however, this is not relevant for DW. Women still shoulder a greater share of DW, even when they have a wage increase and take a greater share of MW. This finding is consistent with the reduced form evidence from Siminski and Yetsenga (2022), who find that women outperform men in DW, even when they are the higher earner. Given this pattern, it suggests that social norms about gender roles may play an important role in shaping the household division of labour.

A key addition of this model is its incorporation of human capital accumulation and depreciation, which captures the dynamic feedback between time use and long-term wage trajectories, particularly in the context of career interruptions following child-birth. The estimated wage returns to human capital are similar to the previous studies of Jakobsen, Jørgensen, and Low (2022) and Iskhakov and Keane (2021), which indicates that the estimated model likely achieves its goal of capturing the dynamic aspect of DW and MW decisions, including their implications for future wages.

This study is also the first to separately estimate parameters in the home production function, and preference parameters. While the estimated parameters themselves should not be interpreted causally, the findings indicate that women are on average more productive at DW than men, and this increases upon the arrival of children. Moreover, the utility parameters suggest that women find it relatively more costly than men to engage in MW upon the arrival of children, and face less dis-utility from DW. This finding likely has consequences for the marriage market. Since women in heterosexual couples face such a stark imbalance in the share of DW, this reaches a similar conclusion to Low (2024), who proposes that the gendered inefficiency of the household division of labour among heterosexual couples may be an explanation for observed declines in partnership rates.

6.2 Model limitations and extensions

The model developed in this paper is intended to be as simple as possible, such that it can match the patterns of MW and DW around child-birth. This means that it abstracts from several potentially important mechanisms. Some extensions may include:

1. **Assets and consumption:** The model assumes that households spend all of their labour income every period, which means that it ignores the effect of saving. Including household wealth (as a continuous state variable) and consumption (as a continuous choice variable)

would allow the model to capture the role of savings. Keane (2011), among others, have shown that including this channel may be important to capture income effects associated with policy changes. Including uncertainty in the income and/or asset return process would also bring this model closer to others at the research frontier (Iskhakov and Keane 2021; Blundell, Pistaferri, and Saporta-Eksten 2017; Jakobsen, Jørgensen, and Low 2022; Voena 2015).

2. **Fertility:** The model treats fertility as random. Enhancing it to account for multiple children and endogenous fertility decisions could provide richer insights. In particular, Jakobsen, Jørgensen, and Low (2022) identify a 'fertility multiplier effect' when measuring household labour supply responses to policy changes.

3. **Bargaining, partnership and separation:** The model treats the bargaining position of household members λ as constant. While the sensitivity of the results to λ is investigated, this is no substitute for a full limited-commitment bargaining model, that includes endogenous partnership and separation decisions (Chiappori and Mazzocco 2017).

4. **Education and ability:** Including measures of individual's education level, as well as endogenous education choices, may also improve identification of the human capital process and its interaction with DW and MW decisions.

Computational speed is the major constraint to implementing these additional mechanisms to the model. The 'curse of dimensionality' means that additional state and choice variables increases the time necessary to solve the model exponentially (Li et al. 2008). To improve speed, the Endogenous Grid-Point Method (EGM) that was proposed by Carroll (2006) may be applied, following the implementation described in Iskhakov et al. (2017).

6.3 Future directions

The counterfactual policy experiments were designed to test whether the household division of labour would respond to two hypothetical policy changes, as an illustration. The findings indicate that DW decisions remain largely unresponsive to these changes. However, these counterfactuals may not generalise to more specific reforms to child-care or parental leave systems that may be interesting for policymakers. Future studies could investigate time use responses to more targeted reforms. The study of Guner, Kaygusuz, and Ventura (2020), for instance, finds that household labour supply responses to child-related transfers that are conditional on market work elicit different labour supply responses than those that are unconditional. It may be interesting to investigate whether this is also true for DW decisions.

Additionally, these findings could be validated through reduced-form empirical methods, leveraging natural experiments or policy interventions. Combining the structural framework with reduced-form evidence would enhance the credibility of the model's predictions.

Future research could also extend the analysis by considering alternative household types, such as single-parent households and same-sex couples. Both of these cohorts are identifiable in the HILDA sample, and including them could provide a broader understanding of household time use decsions. For instance, the recent study of Andresen and Nix (2022) estimate the 'child-penalty' for homosexual couples, and find significant differences to heterosexual couples. This cohort is especially interesting as it may help to decompose the influence of social norms concerning gender roles within the household, which may apply differently to heterosexual versus homosexual couples.

7 Conclusion

This study provides a structural framework for understanding household time use decisions, focusing on the division of MW and DW. The findings reveal that DW remains largely unresponsive to the counterfactual policy changes that were implemented.

Despite decades of advancement of women's participation in the labour force, the division of labour at home is still starkly unequal. The results from this study suggest that household preferences surrounding the division of labor are deeply ingrained. While financial incentives alone may not be sufficient to address these disparities, future interventions that target social norms concerning gender roles that are learned during child-hood may be an important avenue for policymaking. As Low (2024) concludes: "the next frontier of gender equality may be teaching men, from a young age, to "lean in" at home".

A Appendix

A.1 Summary statistics

Variable	**Mean**	**SD**
Married	0.810	0.392
Unmarried	0.178	0.383
Age	42.499	10.488
Dependent children aged 0-4	0.239	0.427
Dependent children aged 5-9	0.214	0.410
Dependent children aged 10-14	0.207	0.405
Children (any age)	0.481	0.500
Relative wage	0.388	0.345
Market work hours (MW)	72.181	25.806
Paid employment hours	64.865	23.484
Commute hours	7.315	5.811
Domestic work hours (DW)	60.553	38.089
Housework hours	23.367	13.791
Errands hours	8.989	6.896
Childcare hours	20.316	27.785
Outdoor work hours	7.881	7.922

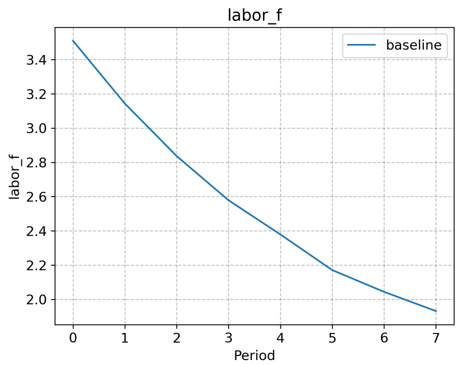
Table A.1: Summary Statistics for the sample of heterosexual couples in HILDA that is described in Section 2. The time use variables are reported at the couple level, and reflect the average time spent on each activity in a typical week.

A.2 Parameters set outside the model

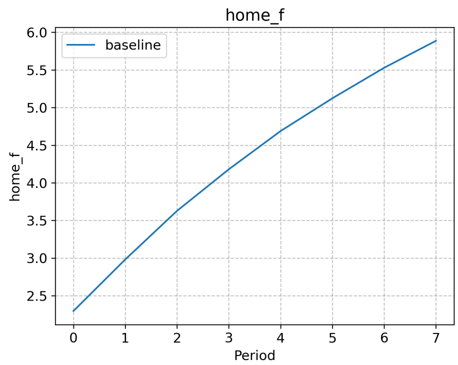
A.3 Parameters estimated within the model

A.4 Simulated behaviour

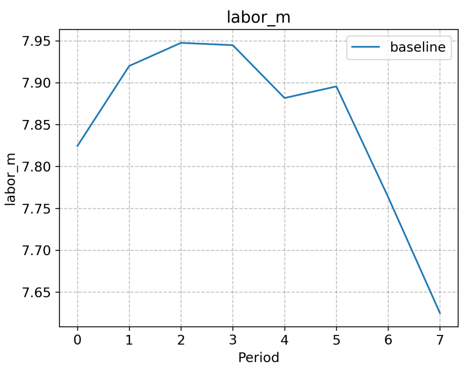
A.5 Sensitivity to calibrated parameters figures



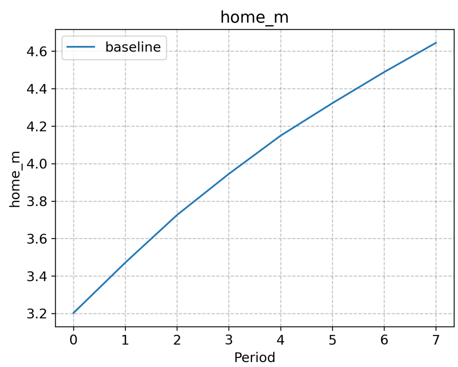
(a) Female Market Work (Labor)



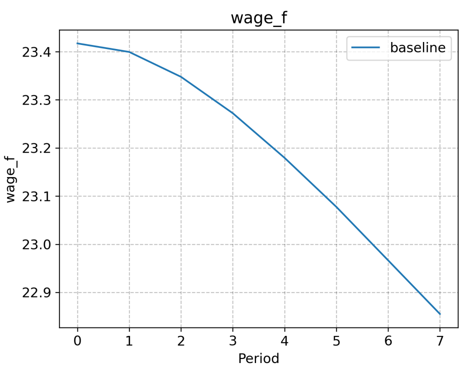
(b) Female Domestic Work (Home)



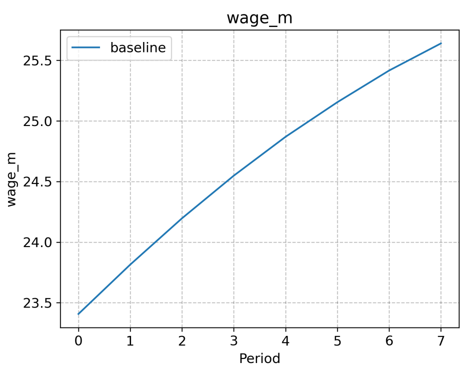
(c) Male Market Work (Labor)



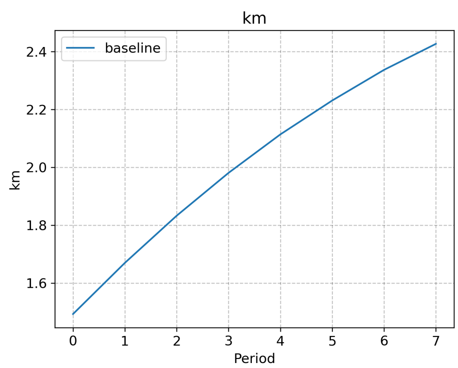
(d) Male Domestic Work (Home)



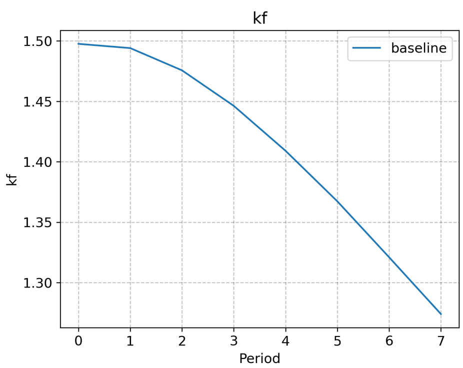
(e) Female Wages



(f) Male Wages



(g) Male Human Capital ($K_{m,t}$)

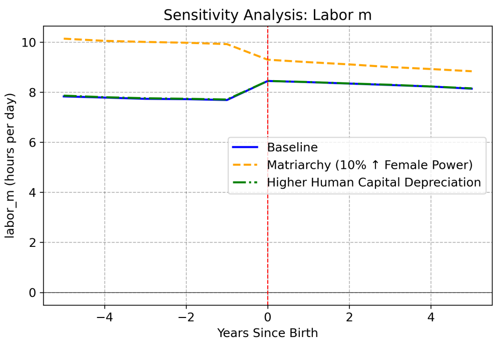


(h) Female Human Capital ($K_{f,t}$)

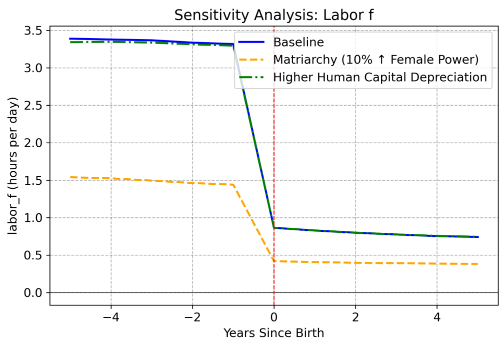
Figure A.1: Simulated behaviour profiles for various household outcomes from the estimated model.

Parameter	Value	Description and Source
β	0.968	Inter-temporal discount factor, from Iskhakov and Keane 2021
δ	0.100	Human capital depreciation rate, from Keane and Wasi 2016
p_n	0.087	Annual probability of birth, from HILDA.
$K_{f,0}, K_{m,0}$	$\sim \mathcal{U}(0,3)$	Initial human capital, by assumption.
λ	0.5	Power level of female household member, by assumption
χ	0.0	Child-related government transfer, by assumption.

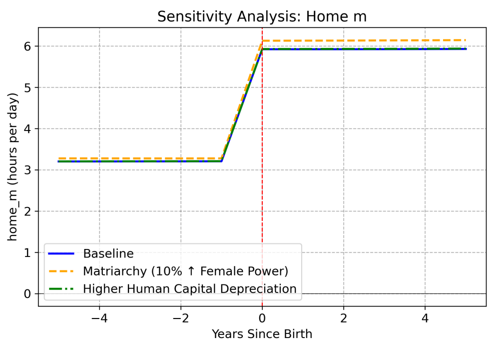
Table A.2: Parameters calibrated outside the model ($\boldsymbol{\phi}$).



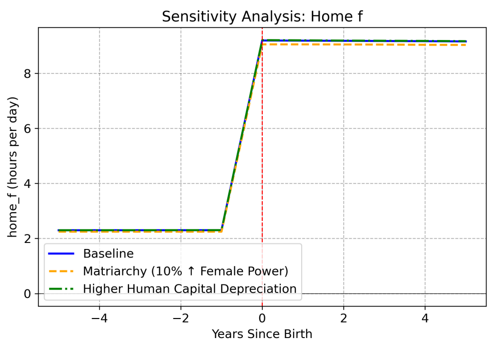
(a) Male Market Work



(b) Female Market Work



(c) Male Domestic Work



(d) Female Domestic Work

Figure A.2: Sensitivity Analysis: Comparison of baseline model with alternative parameter calibrations. The figures show the impact of a 10% increase in female power (increasing λ from 0.5 to 0.55) and a 10% increase in human capital depreciation (increasing δ from 0.1 to 0.11), relative to the baseline model, on labour and domestic work patterns around childbirth.

Parameter	Description	Estimate
Preference Parameters		
$\nu_{f,l}$	Female disutility of MW	0.002
$\nu_{f,h}$	Female disutility of home DW	0.002
$\nu_{m,l}$	Male disutility of MW	0.002
$\nu_{m,h}$	Male disutility of DW	0.003
$\nu_{f,l,n}$	Female disutility of MW with children	0.001
$\nu_{f,h,n}$	Female disutility of DW with children	-0.002
$\nu_{m,l,n}$	Male disutility of MW with children	0.002
$\nu_{m,h,n}$	Male disutility of DW with children	0.003
$\epsilon_{f,l}$	Female elasticity of disutility for MW	4.266
$\epsilon_{m,l}$	Male elasticity of disutility for MW	3.444
$\epsilon_{f,h}$	Female elasticity of disutility for DW	0.721
$\epsilon_{m,h}$	Male elasticity of disutility for DW	1.463
$\epsilon_{f,l,n}$	Change in female elasticity of disutility for MW with children	-1.200
$\epsilon_{m,l,n}$	Change in male elasticity of disutility for MW with children	0.013
$\epsilon_{f,h,n}$	Change in female elasticity of disutility for DW with children	1.442
$\epsilon_{m,h,n}$	Change in male elasticity of disutility for DW with children	0.205
ω	Relative weight on market goods, constant	0.501
ω_n	Change in relative weight on market goods with children	-0.131
Labour Market Parameters		
$\gamma_{1,f}$	Female wage return to human capital	0.089
$\gamma_{1,m}$	Male wage return to human capital	0.100
$\gamma_{0,f}$	Female wage constant	0.483
$\gamma_{0,m}$	Male wage constant	0.590
Home Production Parameters		
α	Female productivity in home production	0.590
α_n	Change in female productivity with children	0.121
σ	Elasticity of substitution in home production	0.310

Table A.3: Parameters estimated within the model ($\boldsymbol{\theta}$).

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