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Childbirth and Welfare Inequality: The Role of Bargaining Power and Intrahousehold Allocation

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Abstract

This paper investigates the impact of childbirth on wives' bargaining power and welfare by analyzing labor market responses and adjustments in intrahousehold resource allocation. Using data from the Japanese Panel Survey of Consumers (1993–2020) and employing an event study approach, we find that wives, relative to their husbands, experience a 38.59% decrease in private consumption and a 13.82% decrease in leisure right after the birth of the first child. We develop a collective bargaining framework to estimate the effects of parenthood on bargaining power, preferences for consumption and leisure, and productivity in producing public goods for both spouses. Our analysis reveals that the wife's bargaining power declines by an average of 34.3% within the first eight years after the first birth, while her preference for public goods increases more than her husband's. Additionally, the arrival of a child leads to a 12.2% decline in welfare for wives but a 7.0% increase for husbands. Counterfactual analysis suggests that if wives' bargaining power had remained unchanged after childbirth, their welfare would have increased by 21% compared to the baseline, and their welfare relative to their husbands' would rise from 75% to 82%.

Keywords: Child Penalty, Bargaining Power, Intrahousehold Allocation, Gender Gap, Welfare

JEL Codes: D13, J13, J16

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1 Introduction

The arrival of children significantly contributes to inequality between men and women in the labor market. Prior to parenthood, men's and women's earnings tend to follow similar trends. However, following the birth of the first child, women experience a sharp decline in their earnings, whereas men are largely unaffected. In the U.S., women experience a 20% drop in annual employment and a 31% drop in earnings after childbirth, and these negative effects persist in the long run (Kleven, 2022). Similar studies conducted in various countries highlight the decline in employment and earnings among women after having a child.[1] The effect of parenthood on women compared to men, often referred to as the child penalty (Kleven et al., 2024), constitutes a substantial proportion of the gender earnings gap.[2] Despite well-documented negative impacts of childbirth on both men's and women's behaviors, less is known about whether these behavioral changes are driven by shifts in constraints, preferences, or bargaining power.

Unlike many previous studies that treat women as single decision makers, this study investigates the implications of childbirth from the household perspective. Utilizing data from Japanese Panel Survey of Consumers (JPSC, 1993 – 2020), we examine the impact of childbirth on women's access to household resources, including private and public consumption and time allocation. We then develop and estimate a collective bargaining model to identify the impact of parenthood on women's bargaining power, preferences for private and public goods, and home productivity. With the model estimates, we further quantify the welfare implications of having children for couples and the resulting welfare disparities within the household. Finally, we compare the child penalty affecting women's labor market outcomes with the novel penalty identified in our study – the decline in women's bargaining power – to explore their respective influences on household behaviors and welfare.

There are three reasons for which considering women as part of the family would be more appropriate than considering them as single decision makers in evaluating their welfare. First, couples share resources, and marriage serves as a risk-sharing device (Blundell et al., 2016, 2018). Although the wife may experience a negative wage shock, it may be offset by the husband's earnings — a form of insurance mechanism. Therefore, the decline in the wife's consumption may be less pronounced due to the potential for smoothing through spousal earnings. Failing to account for this resource sharing may lead to an overestimation of the child penalty.

Secondly, the allocation of resources within a household is determined by each member's bargaining power (Calvi, 2020). Bargaining power represents the extent to which a member can influence household decision-making processes. The presence of a child can potentially diminish the wife's bargaining power by worsening her outside options in the event of divorce

[1] See, for example, Kuziemko et al. (2018) in the UK, Andresen and Nix (2022) in Norway, Rabaté and Rellstab (2022) in Netherlands, Kleven et al. (2019) in Denmark, and Meng et al. (2023) in China.

[2] Child penalties accounted for 80% of the total gender earnings gap in Denmark in 2013 (Kleven et al., 2019), and 70% in the U.S. in the 2010s (Cortés and Pan, 2023).

or non-cooperation through the following channels. Firstly, the wife often faces a wage penalty, leading to lower wages compared to her husband's, which has been recognized as a significant determinant of couples' bargaining power in many studies.[3] Additionally, in the event of divorce, the wife typically retains custody of the children and bears the majority of the childcare burden (Doepke and Kindermann, 2019). Moreover, the wife's likelihood of remarriage may decrease after childbirth, as divorced women with children are often stigmatized in the marriage market. Conversely, if a husband places a high value on having children and the wife has a comparative advantage in childcare, he may allocate more resources to her to incentivize her to remain in the marriage, thereby strengthening her bargaining power. These competing mechanisms imply that parenthood's impact on bargaining power — and consequently, within-household welfare inequality — remains theoretically uncertain.

Lastly, the shared consumption of public goods is one of the primary forces driving household formation, and children are an essential public good (Blundell et al., 2005). Furthermore, mothers typically attach great importance to their children (Björkman Nyqvist and Jayachandran, 2017). If a wife's preference for public goods increases after childbirth, she may willingly devote more time and resources to caring for the children at home. Additionally, the arrival of children creates a significant demand for home production, often leading to changes in comparative advantage and increased specialization between market work and home production within the household (Siminski and Yetsenga, 2022). Failing to account for the shift in both the preference for public goods and the comparative advantage between market work and home production may result in a biased estimate of the effect of childbirth on women's welfare.

In the first part of the paper, we document the behaviors of both wives and husbands surrounding the first birth. Using an event study design, we find that twenty years after the birth of the first child, women experience a significant decline in their weekly earnings by 63.25%. However, when we consider the combined weekly earnings of wives and husbands, family earnings decrease by only 19.20%, which is much smaller than the decline in women's individual earnings.

Furthermore, we find that wives experience a substantial 41.51% decrease in private consumption and a 9.58% decrease in leisure over the twenty years after childbirth, whereas husbands' private consumption is not affected and their leisure only drops by 4.74%. Consequently, the relative private consumption and leisure between wives and husbands decline by 38.59% and 13.82%, respectively, immediately after the birth of the first child. The difference in private consumption between couples is persistent in the long run, while the difference in leisure slowly recovers over time. This observed reduction in wives' relative private consumption and leisure may stem from a decline in their bargaining power within the household, as family resources shift toward the husband after childbirth. Alternatively, it could reflect a change in wives' preferences for public goods. We observe that couples allocate significantly more time and financial resources to public goods after the first birth, with wives' time spent on

[3] See, for example, Browning et al. (2013), Myong et al. (2021).

home production increasing by 175.81%, husbands' time rising by 113.77%, and expenditure on public goods growing by 5.9%. These findings suggest a pronounced shift in preferences toward public goods for both husbands and wives.

To disentangle changes in bargaining power from shifts in preferences for public goods, we develop a collective model (Chiappori, 1988, 1992) that captures the intrahousehold resource allocation. Households consist of two members, a wife and a husband, both deriving utility from private goods, leisure, and public goods. Children are viewed as a public good. Public goods are produced through home production, involving time inputs from both partners and public expenditure. The bargaining power of wives and husbands is measured by the Pareto weight, which is determined by factors including their relative age, relative wage, whether they have a child, and the age of the first child.[4] Fertility plays a role in our model in three ways. First, fertility shapes spouses' preferences for public goods and their relative productivity in home production. Second, fertility can directly affect the wife's bargaining power by altering her Pareto weight. Lastly, fertility affects the wife's wages. We estimate the model using the non-linear generalized method of moments (GMM) and intratemporal moments. This allows us to compare the Pareto weight, preferences for private goods, leisure, and public goods, and home productivity before and after childbirth, treating fertility decisions as given.[5]

Our estimation reveals an average decline of 34.3% in the wife's Pareto weight twenty years following childbirth. On average, around 28% of this decline can be attributed to the wage penalty. The remaining portion of the decline can be attributed to the direct effect of fertility, which may be driven by factors such as a decrease in the wife's outside options as she takes on more childcare responsibilities due to social norms. Furthermore, we find that the arrival of a child is accompanied by an increase in the preference for public goods, particularly among wives. The wife's preference for public goods rises by 24.6%, while the husband's preference rises by 7.5%. This increase is consistent with the observed surge in time and expenditure on public goods, which suggests that households prioritize the well-being of the child over individual consumption and leisure. Lastly, we observe that the husband's home productivity relative to that of wives increases by 37.9% after the first child's arrival. This suggests that husbands' role in home production becomes more important after they become fathers.

To calculate the welfare of husbands and wives in the collective model with public good production, we employ the Money Metric Welfare Indices (MMWI) proposed by Chiappori et al. (2024).[6] The MMWI measures the minimum expenditure required for an individual to achieve a certain level of utility when they solely provide public goods. Our analysis reveals that, on average, wives experience a decline in welfare equivalent to a 12.2% reduction in

[4]The cost of childcare may vary depending on the child's age, which can affect women's outside options.

[5]Our identification of Pareto weights, preferences, and home production efficiency relies solely on intratemporal moment conditions, and hence, we do not model the fertility decision.

[6]One limitation of the MMWI is that it quantifies only the monetary return of children (including investment and consumption values associated with time and monetary inputs in children), potentially overlooking non-pecuniary benefits and part of the long-term returns. See Section 7.3 for more discussions on this issue.

expenditure after childbirth. In contrast, husbands' welfare increases by 7.0%. Additionally, the ratio of the wife's welfare to the husband's drops from 92% before childbirth to 75% afterward, indicating a significant increase in gender-based welfare inequality within the household. This decline in welfare is particularly pronounced among mothers with higher levels of education and those who were employed during pregnancy.

Our findings on welfare align with the event study analysis on the subjective well-being measures of women using the JPSC. We observe that after childbirth, the likelihood of women reporting good physical health status declines by 39.6%. Additionally, life satisfaction drops by 5.1%, and happiness declines by 3.7% after giving birth. Furthermore, women experience a decrease of 4.3% in their self-reported standard of living following childbirth. These results collectively suggest that parenthood imposes substantial welfare costs on mothers. Moreover, we demonstrate a strong positive correlation between our estimated MMWI and these subjective well-being measures, reinforcing the validity of our approach.

To examine the welfare implications of drops in the wife's bargaining power and wage penalty, we consider three counterfactual scenarios. In the first scenario, we remove the negative effect of fertility on the Pareto weight, including the direct fertility effect and the indirect effect through a change in the relative wage between wives and husbands. In the second scenario, we eliminate the wage penalty faced by women, thereby affecting both the wife's bargaining power and labor market prospects. In the third scenario, we eliminate the wage penalty as well as the penalty on the bargaining power, i.e., we combine the first two scenarios.

Across all scenarios, we observe a positive change in the wife's welfare after childbirth compared to the baseline, though the underlying mechanisms differ. In the first counterfactual, where the wife's bargaining power remains unchange after childbirth, her private consumption and leisure rise relative to the baseline, while her working hours decrease. The negative effect of childbirth on her welfare is reduced from -12.16% in the baseline to -9.56% in the counterfactual (a 21% improvement). Meanwhile, the effect on the husband's welfare declines from 6.97% in the baseline to 1.79% in the counterfactual, indicating a reduction in within-household welfare inequality. In the second counterfactual, where the wife no longer faces a wage penalty, her time spent on paid employment increases, expanding the household budget and improving private and public consumption for both spouses. The welfare effect of parenthood improves from -12.16% to -1.78% for the wife and from 6.97% to 17.89% for the husband, suggesting that eliminating wage penalties has a minimal impact on reducing within-household welfare inequality. Finally, in the third counterfactual (which combines both channels), the wife's welfare increases by 0.50%, while the husband's welfare rises by 13.91% following the birth of the first child. Additionally, the wife's welfare relative to her husband's increases from 75% to 80%, indicating an alleviation of welfare inequality within the household.

The first contribution of this paper is to demonstrate the broader effects of childbirth beyond the labor market, particularly in the reallocation of household resources. Recent research on the child penalty has extensively documented the decline in a wife's wages, labor supply,

and earnings following the birth of children.[7] Building upon these studies, we present new empirical evidence that the presence of children influences more than just women's labor market outcomes – it also changes private and public consumption, as well as spouses' time allocation between leisure and home production within households.

The second contribution is that we identify a new mechanism through which childbirth can negatively affect women: the reduction in their bargaining power. Previous studies on collective models leverage detailed household consumption or time use data to recover preferences and bargaining weights of individuals, analyzing their effects on various household outcomes.[8] Three studies are closely related to our research. Calvi (2020) reveal that women's bargaining power declines with age using cross-sectional data from India, which helps explain the excessively high poverty rates and mortality risks for older women in India. The second relevant study is Lise and Yamada (2019), which uses the same JPSC dataset and finds that spouses' relative wages and expected wage growths at the time of marriage, along with relative wage shocks over time, influence spousal bargaining power. We extend their work by focusing on the periods surrounding the first birth and highlighting the negative effect of fertility on the wife's bargaining power on top of the effect of fertility on relative wages. Finally, Doepke and Kindermann (2019) examine a limited commitment model, emphasizing the unequal distribution of childcare responsibilities as a key driver of the decline in women's bargaining power after childbirth. Using consumption and time allocation micro-level data, we structurally estimate the Pareto weight, along with preferences for public and private goods, in each period before and after childbirth.

The final contribution of this paper is to quantify the welfare effects of parenthood, revealing the asymmetric impact on wives and husbands. In addition to the gender inequality in earnings and employment, we demonstrate gender inequality in welfare brought about by children. Our results show that the wife's welfare relative to the husband's declines from 91.9% to 75.3% after childbirth. Moreover, ignoring the change in women's bargaining power underestimates the welfare loss experienced by women due to childbirth by 21%. These findings underscore the importance of policies aimed at improving the bargaining power of women, which can reduce intrahousehold welfare inequality.

The remainder of the paper is organized as follows. Section 2 introduces the data. Section 3 presents the empirical patterns surrounding the first birth. We introduce the collective model in Section 4 and discuss the estimation process in Section 5. The estimation results are presented in Section 6. We analyze the effect of childbirth on individual welfare and conduct counterfactual analyses in Sections 7 and 8, respectively. Section 9 concludes.

[7] See Blau and Kahn (2017) and Cortés and Pan (2023) for comprehensive reviews in this literature.

[8] Examples of household outcomes include child poverty (Dunbar et al., 2013), women's mortality risk (Calvi, 2020), consumption inequality (Lise and Seitz, 2011), and spouses' adjustments in intrahousehold allocation (Lise and Yamada, 2019).

2 Data

2.1 Data and sample selection

Our dataset is the Japanese Panel Survey of Consumers (JPSC), which is a longitudinal study starting from 1993 till now. The respondents include single and married women who were born between 1959 and 1989, and it offers comprehensive information on labor market outcomes, time use, and consumption for women and their husbands.

Our study focuses on married couples with at least one child between 1993 and 2020.[9] We examine a time frame of five years before and twenty years after the birth of the first child. To ensure meaningful comparisons of changes experienced by these couples before and after childbirth, we limit our sample to couples who were observed for at least one year within the five years preceding the first birth and for at least one year within the twenty years following the first birth.[10]

The JPSC provides information about household consumption. The survey asked: *"How much expenditure did you pay this September?"* Women are required to report the total household expenditure and provide a detailed breakdown of how expenses are allocated among different household members.[11] The breakdown consists of five categories: (1) Expenses for the entire family, (2) Expenses for the wife, (3) Expenses for the husband, (4) Expenses for the child(ren), and (5) Expenses for others. We categorize (2) as private consumption for wives, (3) as private consumption for husbands, and (1), (4), and (5) as public consumption.[12] Our definition of public consumption encompasses not only expenditures directly related to child-rearing, but also a broader range of public expenditures within the household, such as utilities and furniture. Private consumption, on the other hand, includes items such as clothing, entertainment, and healthcare.

The second key piece of information is household time use, specifically how both the wife and husband allocate their time to various activities. The JPSC records how much time is spent by each person on the following activities: 1) Commuting; 2) Work; 3) Schoolwork (studies); 4) Housekeeping and childcare; 5) Hobbies, leisure, social interactions, etc.; and 6) Other activities such as sleeping, meals, and bathing. We categorize individual time into three categories: work time, leisure, and home production time. We define activities (1), (2), and (3)

[9] Our sample contains very few single mothers. As shown in Appendix A.1, in the original JPSC sample, only 1.4% of women are unmarried mothers, and only 7% of women divorce after having children. Therefore, we primarily focus on married couples.

[10] In our dataset, 89.36% of women have their first child within the first five years of their marriage.

[11] In Appendix A.2, we examine potential measurement errors related to husbands' private consumption, as the data are reported by their wives. We show that the wife's reports of her husband's spending are not significantly affected by factors such as who manages household income or the wife's time use, which suggests that potential measurement errors are unlikely to substantially affect our main findings.

[12] The JPSC survey collects respondents' answers from late September to October, which is why the survey only asks about household expenditure during that period. In another question, wives are asked about the total household expenditure on various items, such as food, house rent, land rent, home repair, utilities, clothing and shoes, healthcare, transportation, communication, education, culture, and entertainment. However, the survey does not specify the exact amount spent by individuals on these items.

as work time, activity (4) as home production time, and activities (5) and (6) as leisure. We convert time use during weekdays and weekends into weekly hours spent on these activities.[13]

The final piece of information is individual labor market performance, which includes their employment status and earnings. Earnings are reported as annual income before taxes for employees during the previous year. To ensure consistency across the sample, we convert both expenditure and earnings into weekly levels, with all monetary values expressed in Japanese Yen (in units of 1000) in 2013. Household earnings are the sum of the weekly earnings of the wife and husband. Hourly wage rates are calculated by dividing annual earnings by annual working hours.

We restrict our estimation sample to married couples with information on the variables discussed, as well as data on household demographic characteristics, including the ages and education of the wife and husband, the number of children, and household size.[14] The sample selection criteria is explained comprehensively in Appendix A.1. Our core estimation sample consists of 748 women and their husbands, corresponding to 8,751 couple-year observations.

2.2 Summary statistics

Table 1 presents the descriptive statistics for the variables used in the analysis. In our sample, the average age at marriage is 28 for wives and 30 for husbands. The average age at the birth of the first child is 31 for wives and 33 for husbands.[15] On average, households have 1.36 children, and the average household size is 3.64. Hence, the households in our sample are mostly nuclear families.

In terms of consumption patterns, the wife's average weekly private consumption is lower than the husband's (3310 yen vs. 6730 yen). Additionally, a larger proportion of total household expenditures is allocated to public goods compared to individual expenditures. On average, Japanese households allocate nearly 80% of their expenditures to public goods.

Regarding time allocation, wives spend 92.83 hours weekly on leisure, 51.86 hours on home production, and 22.21 hours on work and commuting. Husbands spend 94.81 hours on leisure, 9.29 hours on home production, and 63.40 hours on work and commuting. Both spend similar time on leisure, but wives do more home work while husbands spend more on work-related activities.

From the labor market perspective, wives generally have lower employment rates, hourly wages, and weekly earnings compared to husbands. Only 51% of women are employed compared to over 99% of men. The average hourly wage rate of wives is 1060 yen, which is only 62% of that of husbands. As a result, wives' weekly earnings amount to just 24% of husbands'

[13] Similar categorizations of time use can be found in Boerma and Karabarbounis (2021), Browning et al. (2021), and Lise and Yamada (2019).

[14] To mitigate the influence of extreme values, we winsorize the expenditure, time allocation, and wages, limiting them to observations between the 5% and 95% of the sample.

[15] In the full JPSC sample, the average age at first birth is 27 for wives, which is four years lower than the average age in our sample. This discrepancy stems from limiting our sample to households that appear both before and after the first birth. In the JPSC, 79.32% of wives entered the survey after the birth of the first child.

weekly earnings.[16]

Table 1: Summary Statistics (JPSC 1993-2020)

	Mean	SD		Mean	SD
Household characteristics			*Household expenditure (per week)*		
Wife's age	35.67	5.63	Wife's private expenditure	3.31	3.27
Husband's age	37.24	6.38	Husband's private expenditure	6.73	5.00
Wife's education level (years of schooling)	14.02	1.62	Public expenditure	41.08	17.13
Husband's education level (years of schooling)	14.27	2.12			
Fertility-related characteristics			*Marriage-related characteristics*		
Wife's age at first birth	31.02	3.35	Wife's age at marriage	28.21	3.38
Husband's age at first birth	32.58	4.37	Husband's age at marriage	29.73	4.27
Number of children	1.36	0.85	Household size (coresident)	3.64	1.22
Time use (hours per week): wife			*Time use (hours per week): husband*		
Wife's work time	22.21	22.76	Husband's work time	63.40	12.08
Wife's home time	51.86	26.98	Husband's home time	9.29	8.29
Wife's leisure	92.83	20.78	Husband's leisure	94.81	13.77
Labor market performance: wife			*Labor market performance: husband*		
Wife's employment status	0.51	0.50	Husband's employment status	0.99	0.09
Wife's hourly wages	1.06	0.65	Husband's hourly wages	1.70	0.87
Wife's weekly earnings	22.40	34.52	Husband's weekly earnings	94.75	53.73

Note: The table presents descriptive statistics for the household sample constructed from the JPSC dataset (1993-2020). The sample comprises married couples within the (-5, 20) periods relative to the year of the birth of the first child. The sample consists of 8751 household-year observations. All monetary values are reported in 2013 Japanese 1000 Yen. Standard deviations are included where available.

3 Event Study Analysis

In this section, we present the empirical patterns regarding spousal labor market outcomes, consumption, and time use around the time of the first birth. We use the event study approach, following the methodology outlined by Kleven et al. (2019). For each individual i with gender g in age k and year s at the event time t (t years after the birth of the first child), the outcomes Y_{ist}^g are modeled as functions of event time dummies, age dummies, and year dummies:

$$Y_{ist}^g = \sum_{\substack{j=-5 \\ j\neq -2}}^{20} \alpha_j^g \cdot \mathbf{I}[j = t] + \sum_k \beta_k^g \cdot \mathbf{I}\left[k = age_{is}\right] + \sum_y \gamma_y^g \cdot \mathbf{I}[y = s] + \nu_{ist}^g$$

The reference period for comparison is set as two years before the birth of the first child, i.e., $t = -2$. We choose two years prior rather than one year prior as the reference period because women are pregnant for nine months before giving birth, and may experience changes in behavior when pregnant. Since our sample excludes couples without children, the analysis essentially compares couples who already have a child with couples who have not yet had their

[16] In Appendix A.3, we examine the representativeness of the JPSC data by comparing the summary statistics with other surveys, including STULA and FIES, published by the Statistics Bureau of Japan. While the JSPC data is reported by wives, the other two surveys are reported by individuals themselves. The consistency between the JPSC and the other two surveys suggests that the wife's reported time use and expenditure are reliable.

first child.[17] In other words, we compare women of the same age in the same year who differ in when they had their first child. We predict the counterfactual outcome of not having a baby $\widetilde{Y_{ist}^g}$ using the age dummies and year dummies: $\widetilde{Y_{ist}^g} = \sum_k \beta_k^g \cdot \mathbf{I}\left[k = age_{is}\right] + \sum_y \gamma_y^g \cdot \mathbf{I}[y = s]$. The treatment effect $P_t^g \equiv \frac{\alpha_j^g}{\widetilde{Y_{ist}^g}}$ represents the percentage change in the outcome at event time t relative to the outcome of not having a baby ($\widetilde{Y_{ist}^g}$). This scale-invariant measure of treatment effect allows for comparability across different outcomes. In Appendix B.2, we report the coefficients of the event time, which represent the change in levels.

In Appendix B.1, we illustrate the well-documented patterns of child penalties in the labor market in Japanese contexts. As shown in Figure B.1, women experience an average decline of 63.25% in weekly earnings within twenty years after childbirth. Notably, this earnings decline remains relatively stable and persistent throughout the 20-year period following the first birth.[18] In contrast, husbands' earnings remain unaffected by childbirth. The women's earnings penalty can be attributed to three factors: labor force participation, hours of work, and the hourly wage (Kleven et al., 2019). In Figure B.2 and Figure B.3, we present the negative effects of childbirth for women on all three margins, while there are no significant effects for men.

When we combine the earnings of both spouses, the child penalty on total family earnings is considerably smaller. Over the twenty years following childbirth, family earnings decline by only 19.20%, as shown in Figure B.1, indicating that the impact on the woman's consumption may be lessened, as household income is shared between spouses. This finding suggests that the insurance mechanism within the family may play a role, whereby the husband's earnings can partially compensate for the woman's reduced income.

3.1 Individual consumption and leisure

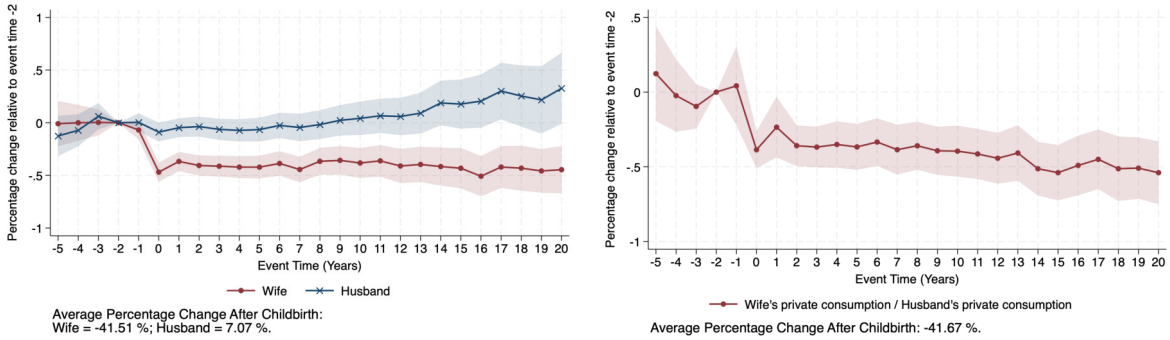
We investigate the impact of childbirth on private consumption and leisure, which are consumed by either husbands or wives. As shown in the left panel of Figure 1, wives experience a significant and persistent decline in private consumption immediately after the birth of their first child, with an average reduction of 41.51% over the 20-year period.[19] In contrast, the effect on husbands' private consumption is not statistically significant. The right panel of Figure 1 shows that the wife's private consumption relative to the husband's decreases by 38.59% in the first year after the first birth and declines by 41.67% over the twenty-year period.

Furthermore, the left panel of Figure 2 shows that wives experience a decline in leisure of more than 20% immediately after the birth of the first child, while men experience a smaller decline of about 10%. This decline recovers gradually over time; by the 20th year after the first birth, leisure levels for both husbands and wives return to their pre-birth levels. On average, wives experience a 9.58% decrease in leisure, compared to a 4.74% decrease among husbands

[17] Due to the absence of a never-treated group, we cannot control for individual fixed effects because the event time effect would not be point identified. For further discussion, see Borusyak et al. (2024).

[18] Notably, our analysis of earnings includes both working and non-working women, with non-working women having zero earnings, which helps avoid selection bias.

[19] All the event study figures report the 95% confidence interval.



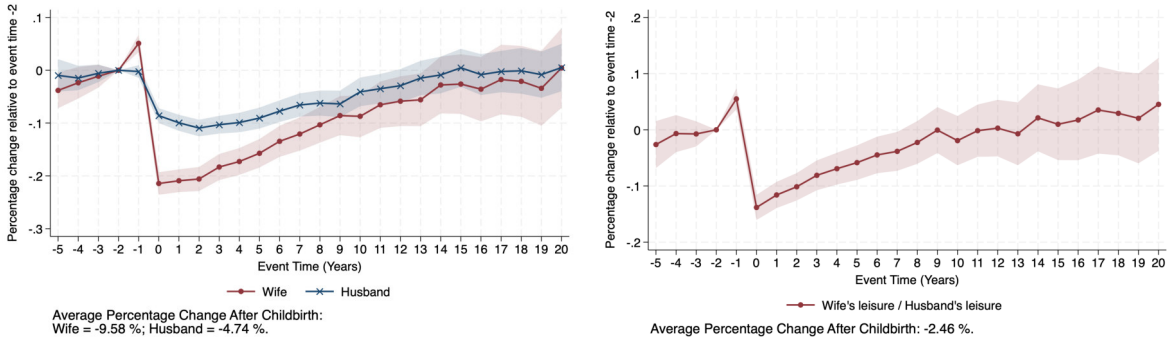
(a) Private consumption

(b) Wife's private consumption (relative to husband)

Figure 1: Private Consumption of Husbands and Wives

over the 20-year period. The right panel of Figure 2 indicates that the wife's leisure relative to her husband's decreases by 13.82% in the first year after the first birth and declines by 2.46% over the twenty-year period.

In Appendix B.3, we examine the heterogeneity in the response of a wife's private consumption relative to her husband's, as well as her leisure relative to her husband's, by dividing the sample based on the gender of the first child and the maximum number of children women have during the observed periods. Our results indicate that the effects on both relative consumption and leisure are more pronounced when the first child is a girl, which aligns with the son preference culture prevalent in Asia. Additionally, the effect of the first child on relative private consumption and relative leisure is slightly larger for women with two or more children compared to those with only one child, potentially because their outcomes incorporate the accumulated effects of having additional children.



(a) Leisure

(b) Wife's leisure (relative to husband)

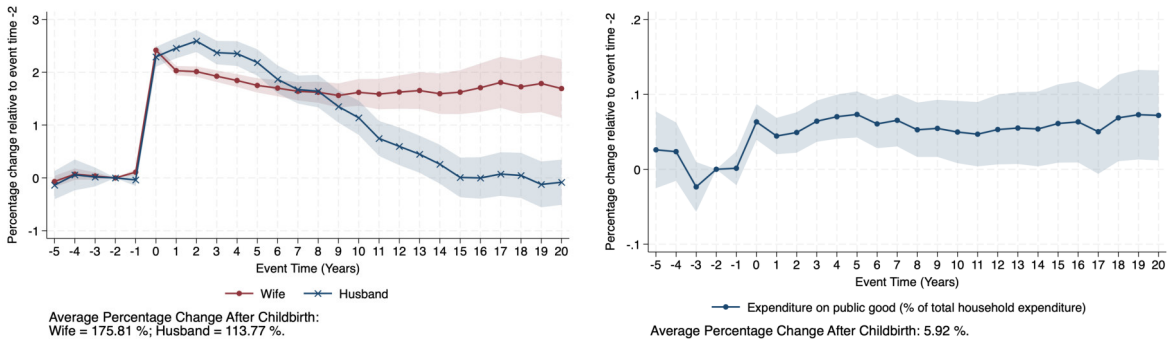
Figure 2: Leisure of Husbands and Wives

3.2 Public consumption and home time inputs

We also examine the impact of childbirth on time and monetary investments in public goods. As shown in the left panel of Figure 3, both wives and husbands increase their home production

time following the first birth, with increases of 175.81% for wives and 113.77% for husbands over the twenty years. Although husbands' initial increase in home production time is larger in percentage terms, it reverts to pre-birth levels twenty years after the first birth, whereas wives' home production time stabilizes at a higher level. Figure B.8 in Appendix B.2 indicates that wives' weekly home production time increases by an average of 32 hours twenty years after childbirth, much larger than the 4.44-hour increase observed for husbands. Therefore, the larger percentage increase in husbands' home production time during the initial periods is primarily driven by their low baseline levels of home production time before childbirth.

Moreover, the right panel of Figure 3 shows that the share of public expenditure in household total resources increases by 5.92% after the first birth. This suggests that the arrival of the first child leads to an increase in both the time and monetary inputs on public goods.



(a) Home production time (b) Public expenditures

Figure 3: Home Production Time and Public Expenditures

3.3 Summary of empirical patterns

To summarize, we have identified the following empirical patterns: (1) While women experience a wage penalty and a decrease in employment and working hours following the birth of the first child, the decline in family earnings is much smaller compared to the decline in women's earnings; (2) Following the first birth, there is a decrease in the wife's private consumption and leisure relative to the husband's; (3) Following the first birth, there is an increase in household expenditures on public goods and an increase in time spent on home production by both wives and husbands.

These patterns suggest that the arrival of a child can have a multifaceted impact on family life, including shifts in labor market outcomes and reallocation of resources between different types of goods and time allocation. Following the birth of their first child, wives tend to reallocate their time from leisure and paid employment to home production, whereas husbands primarily reallocate their time from leisure to home production, without a significant change in their working time.

Both spouses increase the time and monetary contributions to public goods, indicating an increase in preference for public goods over private goods. However, the decline in private

consumption and leisure is more pronounced for wives than for husbands. This disparity may stem from two potential factors: a decline in her bargaining power or a larger decline in her preference for private consumption and leisure compared to her husband's. Additionally, the differential increase in home production time between wives and husbands suggests a potential shift in their comparative advantage, that is, a change in the relative productivity in home production between spouses.

To disentangle the effects of childbirth on husbands and wives with respect to their bargaining power, preferences for private goods versus public goods, and productivity in home production, and to investigate how these factors influence consumption and time allocation, we develop a collective model in the next section.

4 A Collective Model of Intrahousehold Allocation

4.1 Model Setup

We develop a collective bargaining model following Lise and Yamada (2019). The household comprises two members, the wife (W) and the husband (H). The model considers four periods: the pre-birth phase ($t = 0$), followed by 0-2 years, 3-5 years, and 6-8 years after the birth of the first child ($t = 1, 2, 3$). Within a period, households make decisions regarding the wife's and husband's market work time, home production time, leisure time, private consumption, and joint public consumption.

In each period t, individual $j \in \{W, H\}$ derives utility from private consumption c_{jt}, leisure ℓ_{jt}, and a public good Q_t. The household's utility U_t is a weighted sum of the spouses' utilities

$$U_t = \mu_t u_t^W(c_{Wt}, \ell_{Wt}, Q_t) + (1 - \mu_t) u_t^H(c_{Ht}, \ell_{Ht}, Q_t)$$

where the wife and husband are assigned Pareto weights μ_t and $1 - \mu_t$, respectively, which reflect their bargaining power.[20] We assume that individuals have egoistic preferences. When allowing for Beckerian caring preferences, individuals care about their spouse's welfare, and thus μ_t should be interpreted as the relative importance of a household member (Lise and Seitz, 2011). The bargaining power is time-varying, and we consider the spouses' bargaining in a no-commitment environment.[21]

The public good Q_t is produced using market-purchased goods g_t and time spent on home production h_{jt} from both household members. Children enter the household utility through the

[20] In a fully-fledged model, a change in bargaining power could be driven by a change in the Pareto weight or a change in the outside option. We model the Pareto weight in a reduced-form approach by incorporating the potential factors influencing the outside option into the Pareto weight. Therefore, we use the terms "Pareto weight" and "bargaining power" interchangeably throughout the paper.

[21] In the literature on collective models, three common hypotheses of intra-household commitment are usually adopted: full commitment (Chiappori et al., 2018), limited commitment (Voena, 2015), and no commitment (Lise and Yamada, 2019). Previous studies have found strong evidence against the hypothesis of full commitment (Basu, 2006, Mazzocco, 2007, Theloudis et al., 2025). Since we focus on changes in intra-household resource allocations over time, we adopt the no-commitment framework and allow bargaining power to change every period.

public good Q_t.

$$Q_t = Q(h_{Wt}, h_{Ht}, g_t)$$

Individuals allocate their time to leisure ℓ_{jt}, market work m_{jt}, and home production h_{jt}. The time constraint per period is expressed as:

$$\ell_{jt} + h_{jt} + m_{jt} = T, \quad j \in \{W, H\}$$

The budget constraint within period t is defined as:

$$c_{Wt} + c_{Ht} + g_t = w_{Wt}m_{Wt} + w_{Ht}m_{Ht} + (1+r)a_t - a_{t+1}$$

where a_t and a_{t+1} are the assets in periods t and $t+1$, respectively, while w_{Wt} and w_{Ht} are the wages of the wife and the husband, respectively.

We also have the non-negativity constraints: $c_{jt}, g_t, \ell_{jt}, h_{jt}, m_{jt} \geq 0$. Wages follow a stochastic process: $\log w_{jt} = w(x_{jt}, \varepsilon_{jt})$, where x_{jt} is the observable characteristics of individual j in period t, and ε_{jt} is an i.i.d shock.

The household is assumed to maximize the expected, discounted, weighted sum of the spouses' period utilities:

$$\begin{aligned} U_0 = \max_{c_{jt}, \ell_{jt}, h_{jt}, m_{jt}, g_t} & E_0 \sum_{t=0}^{3} \beta^t [\mu_t u_t^W(c_{Wt}, \ell_{Wt}, Q_t) + (1-\mu_t) u_t^H(c_{Ht}, \ell_{Ht}, Q_t)] \\ s.t. \quad & \ell_{jt} + h_{jt} + m_{jt} = T, \quad j \in \{W, H\} \\ & c_{Wt} + c_{Ht} + g_t = w_{Wt}m_{Wt} + w_{Ht}m_{Ht} + (1+r)a_t - a_{t+1}, \\ & c_{jt}, g_t, \ell_{jt}, h_{jt}, m_{jt} \geq 0, \quad j \in \{W, H\}. \end{aligned}$$

where β is the discount factor.

We adopt the Constant Elasticity of Substitution (CES) preferences form for individual flow utilities:

$$u_t^j(c_{jt}, \ell_{jt}, Q_t) = \frac{1}{1-\sigma^j} [\alpha_{1t}^j c_{jt}^{\phi^j} + \alpha_{2t}^j \ell_{jt}^{\phi^j} + \alpha_{3t}^j Q_t^{\phi^j}]^{\frac{1-\sigma^j}{\phi^j}}$$

where α_{1t}^j, α_{2t}^j, and $\alpha_{3t}^j \equiv 1 - \alpha_{1t}^j - \alpha_{2t}^j$ capture the preferences for private consumption, leisure, and public goods for individual j at time t. ϕ_j is informative about the degree of complementarity between different goods. When $1 - \sigma^j < \phi_j$, private goods c_{jt}, leisure ℓ_{jt} and the public goods Q_t are direct substitutes.[22]

We adopt the following home production function:

$$Q(h_{Wt}, h_{Ht}, g_t) = [\pi_t h_{Wt}^\gamma + (1-\pi_t) h_{Ht}^\gamma]^{\frac{\rho}{\gamma}} g_t^{1-\rho}$$

[22] In Appendix C.1, we consider a special case of individual utilities, a CRRA specification with separable preferences, and show that in this case, changes in relative private consumption between husband and wife have a one-to-one mapping relationship with changes in their Pareto weights.

where the aggregated time input and monetary input are complements. ρ is the Cobb-Douglas productivity parameter for time input. The effective time input of married couples follows a CES form in individual inputs, with an elasticity of substitution given by $\frac{1}{1-\gamma}$. A smaller value of γ indicates greater complementarity between home time inputs from the wife and husband.

We normalize the home productivity of wives and husbands such that the sum of their productivities equals one. Therefore, the wife's home productivity is $\pi_{Wt} = \pi_t$ and the husband's home productivity is $\pi_{Ht} = 1 - \pi_t$. This normalization helps us identify the preference for public goods, as an increase in a wife's home production time could be due to an increase in her preference for public goods or an increase in her home productivity in absolute terms. Therefore, changes in the preference for public goods (α^j_{3t}) following childbirth could reflect a real change in people's preferences or simply be a result of a change in their home productivity that applies to both wives and husbands.

In the empirical specification of our parameters, we allow key parameters to vary over periods to capture the effects of fertility. Specifically, preferences (α^j_{kt}), Pareto weights (μ_t), and relative productivity (π_t) are modeled as functions of period dummies: 0–2 years after the first birth ($PostFirstBirth_{012}$, corresponding to $t = 1$), 3–5 years after the first birth ($PostFirstBirth_{345}$, corresponding to $t = 2$), and 6–8 years after the first birth ($PostFirstBirth_{678}$, corresponding to $t = 3$). Additionally, women's bargaining power is influenced by the relative ages and wages between the couples. We also allow individual preferences (α^j_{kt}) to vary based on their own age and education. The specific functional forms are detailed in Appendix C.2.

4.2 The Role of Children in the Model

In the model, fertility is treated as exogenous.[23] Consequently, we abstract from households' fertility decisions and focus on intrahousehold resource allocations prior to and following childbirth. Below, we clarify how childbirth is incorporated into our model.

First, the presence of children affects individuals' outside options, thereby influencing their bargaining positions within the household. This channel is captured by the $PostFirstBirth$ dummies in the Pareto weight equation.

Second, children impact how individuals derive utility from various goods. By allowing preferences to evolve with $PostFirstBirth$ dummies, we account for shifts in the marginal utility of each good as children grow older. In particular, changes in the preference for public goods, α^j_{3t}, reflect both the consumption and investment value of children.[24]

Third, the presence of children influences individuals' comparative advantage in home production, as mothers and fathers typically play different roles in caring for young chil-

[23] As discussed in Section 5.3, the identification of bargaining power does not rely on the assumption that fertility is exogenous. Even when fertility is endogenously determined, Pareto weights can be identified using the intra-temporal moment conditions.

[24] For example, if the wife allocates time to activities with children, it suggests she enjoys spending time with them; thus, the consumption value of children is reflected in her preferences for public goods. Conversely, if she invests time in children to enhance their human capital—whether out of altruism or exchange motives—this would also be reflected in her preferences for public goods.

dren. Therefore, we allow home productivity to vary with childbirth, again captured by the $PostFirstBirth$ dummies.

Lastly, children influence the wife's wages, as wages are modeled as a function of the age of the first child. Changes in wages due to children give rise to several effects: (1) the substitution effect, where the wife's wage rate reflects the opportunity cost of her time and influences her time allocation; (2) the income effect, where a decline in the wife's earnings impacts the household's budget constraint; and (3) the bargaining effect, where shifts in the relative wages of spouses affect the wife's Pareto weight. In the empirical model, wages are also specified as functions of the $PostFirstBirth$ dummies.

5 Estimation

In this section, we introduce the estimation strategy. We first estimate the wage function outside the model. Then, we estimate the rest of the parameters using non-linear Generalized Method of Moments (GMM). Lastly, we discuss the identification strategy for the key parameters.

5.1 Wage process

We first estimate the wage process independently of the main model. This separation is possible because we simplify the wage process by assuming it depends solely on potential experience (rather than actual experience) and the age of the first child ($PostFirstBirth$ dummies). Consequently, the model abstracts from the human capital accumulation process. The effects of human capital depreciation due to reduced labor supply, as well as the decline in wage rates resulting from changes in occupation, are captured in a reduced-form manner through the $PostFirstBirth$ dummies.

We estimate wages for spouses, including non-working wives. The relative wages of spouses are important determinants of their bargaining power. This holds true even for non-working wives, as variations in potential wages can influence their bargaining power (Blundell et al., 2007). Therefore, we need to estimate the potential wages for non-working wives. Since wages are observed on the truncated working sample, we use the Heckman two-stage method (Heckman, 1979) to correct for sample selection. The method involves a two-stage model, the working decision equation, and the wage equation, as described in Appendix C.3.

5.2 GMM

We adopt a parameter value of $\sigma^j = 1.5$ following Knowles (2013). Three sets of parameters remain to be estimated: (1) preference-related parameters, including individual preferences for private consumption (α^j_{1t}), leisure (α^j_{2t}), and the elasticity of substitution between different goods (ϕ_j); (2) home-production-related parameters, comprising relative productivity (π_t), the elasticity of substitution between different time inputs (γ), and the Cobb-Douglas productivity parameter ρ; and (3) the Pareto weight parameter (μ_t).

In the GMM estimation procedure, the marginal rate of substitution (MRS) relationships between different goods, where the ratio of marginal utilities for two goods equals the ratio

of their prices, serve as key moment conditions. These conditions are derived from the intra-temporal first-order conditions. The complete set of equations used in the estimation is outlined in Appendix C.4.

As in Lise and Yamada (2019), the GMM estimation incorporates two sets of instruments. First, the levels of consumption, hours, and wages from the previous year are employed as instruments for the current year's consumption, hours, and wages. Second, the preference shifters, productivity shifters, and observable distribution factors are used as instruments. In total, we estimate 37 parameters with 138 moment constraints.

Note that the MRS relationships hold true only when couples opt for interior solutions. However, when couples choose a corner solution, their relevant MRS relationships will not be used for the GMM estimation. The corner solution in work time is commonly observed in Japan where a significant proportion of women are not in paid employment. In such cases, we exclude the MRSs related to work decisions and instead focus on the MRSs of leisure, home time, private consumption, and public expenditure. We use the predicted wage (as discussed in the previous section) as the shadow price of time for non-working wives.

5.3 Identification of the Key Parameters

Within the model, there are four periods, and each period is characterized by six parameters: Pareto weights (μ_t), individual preferences for consumption and leisure (α_{1t}^W, α_{2t}^W, α_{1t}^H, and α_{2t}^H), and relative home productivity (π_t). In each period, we observe seven moments, including leisure time, home production time, private consumption for wives and husbands, as well as public expenditure.[25] As a result, we have more equations than parameters to identify all the parameters effectively.

It is important to note that our estimation is based solely on intra-temporal moment conditions. In other words, we utilize the moment conditions within a single period — either pre- or post-birth — to identify the parameters relevant to that period. This approach is justified because we can observe the asset levels at the start and end of each period (a_{t-1} and a_t). Given this information, the choices of consumption and time allocation are determined solely by the current period's parameters and are unaffected by parameters from previous or subsequent periods. In the subsequent discussion, we elaborate on how each moment condition in period t (from Appendix C.4) corresponds to key parameter estimates for that period.

Identification of relative home productivity: We begin by focusing on the most straightforward identified parameter, which is the relative home productivity of the wife compared to the husband, denoted as π_t. The key moment that is informative for the change in relative home productivity (π_t) is the moment condition (1), which represents the marginal rate of substitution (MRS) between the wife's and husband's home production time (h_{Wt} and h_{Ht}). Since we observe h_{Wt}, h_{Ht}, w_{Wt}, and w_{Ht} from the data (we predict w_{Wt} for non-working wives), we

[25] We also observe market work time, but it is not a new moment, given that it can be calculated by subtracting total time endowment from leisure and home production time.

can identify π_t from Equation (1).

$$\left(\frac{\pi_t}{1-\pi_t}\right)\left(\frac{h_{Wt}}{h_{Ht}}\right)^{\gamma-1} = \frac{w_{Wt}}{w_{Ht}} \tag{1}$$

Identification of individual bargaining power and preferences: Assuming that we have identified π_t, we are left with five parameters to identify, μ_t, α_{1t}^W, α_{2t}^W, α_{1t}^H, and α_{2t}^H. For the bargaining power μ_t, it is modeled as a function of the spouse's relative age, relative wage, and the age of the first child. The effects of relative age and relative wage on bargaining power are straightforward to identify, as they influence only bargaining power and not preferences. However, isolating the effect of children on bargaining power is more challenging, since the age of the first child also impacts preferences for private and public consumption for both husbands and wives.

The two key variations that inform changes in bargaining power (μ_t) are: first, the moment condition (2) regarding the MRS between the wife's and husband's private consumption (c_{Wt} and c_{Ht}); second, the moment condition (3) concerning the MRS between the wife's and husband's leisure (ℓ_{Wt} and ℓ_{Ht}).[26]

$$\left(\frac{\mu_t}{1-\mu_t}\right)\left(\frac{A_{Wt}\alpha_{1t}^W c_{Wt}^{\phi^W-1}}{A_{Ht}\alpha_{1t}^H c_{Ht}^{\phi^H-1}}\right) = 1 \tag{2}$$

$$\left(\frac{\mu_t}{1-\mu_t}\right)\left(\frac{A_{Wt}\alpha_{2t}^W \ell_{Wt}^{\phi^W-1}}{A_{Ht}\alpha_{2t}^H \ell_{Ht}^{\phi^H-1}}\right) = \frac{w_{Wt}}{w_{Ht}} \tag{3}$$

where $A_{jt} = [\alpha_{1t}^j c_{jt}^{\phi^j} + \alpha_{2t}^j \ell_{jt}^{\phi^j} + (1-\alpha_{1t}^j-\alpha_{2t}^j) q_t^{\phi^j}]^{\frac{1-\sigma^j-\phi^j}{\phi^j}}$.

Our data offers detailed insights into private expenditure and leisure for husbands and wives, facilitating a comprehensive understanding of resource allocation within households. By observing the full sharing rule, we can effectively identify bargaining power dynamics (Lise and Yamada, 2019). However, in our context, not only bargaining power may change after childbirth, but also individual preferences for consumption and leisure (α_{1t}^j and α_{2t}^j). As shown in Equation (2) (Equation (3)), the relative private consumption (leisure) between wives and husbands is affected by wives' bargaining power, as well as wives' relative preference for private consumption (leisure) to their husbands'. Since we only have two equations but five parameters, we need additional moment equations to help identify μ_t.

We further derive the MRSs between private consumption (c_{jt}) and leisure (ℓ_{jt}) for wives in Equation (4) and husbands in Equation (5). The moment conditions in these two equations only depend on the individual preferences for consumption α_{1t}^j and leisure α_{2t}^j.

$$\frac{\alpha_{1t}^W}{\alpha_{2t}^W}\left(\frac{c_{Wt}}{\ell_{Wt}}\right)^{\phi^W-1} = \frac{1}{w_{Wt}} \tag{4}$$

[26]These two variations are commonly used in the literature to identify women's bargaining power (Browning et al., 2013, 2021, Dunbar et al., 2013, Foerster, 2024, Gayle and Shephard, 2019).

$$\frac{\alpha_{1t}^H}{\alpha_{2t}^H}\left(\frac{c_{Ht}}{\ell_{Ht}}\right)^{\phi^H-1}=\frac{1}{w_{Ht}} \tag{5}$$

In addition, we utilize the MRSs between how individuals choose between private goods and public goods. The moment condition in Equation (6) illustrates the MRS between the wife's private consumption and public consumption, which depends on the wife's bargaining power μ_t, her preferences for private consumption α_{1t}^W and leisure α_{2t}^W:

$$\mu_t A_{Wt}\alpha_{1t}^W c_{Wt}^{\phi^W-1}=(1-\rho)G_t^{\frac{\rho}{\gamma}}g_t^{-\rho}D_t \tag{6}$$

where $A_{jt}=[\alpha_{1t}^j c_{jt}^{\phi^j}+\alpha_{2t}^j \ell_{jt}^{\phi^j}+(1-\alpha_{1t}^j-\alpha_{2t}^j)q_t^{\phi^j}]^{\frac{1-\sigma^j-\phi^j}{\phi^j}}$, $G_t=\pi_t h_{Wt}^{\gamma}+(1-\pi_t)h_{Ht}^{\gamma}$, $D_t=\mu_t A_{Wt}\alpha_{3t}^W q_t^{\phi^W-1}+(1-\mu_t)A_{Ht}\alpha_{3t}^H q_t^{\phi^H-1}$, and $\alpha_3=1-\alpha_1-\alpha_2$.

Similarly, the moment condition in Equation (7) reflects the MRS between a husband's private consumption and public consumption:

$$(1-\mu_t)A_{Ht}\alpha_{1t}^H c_{Ht}^{\phi^H-1}=(1-\rho)G_t^{\frac{\rho}{\gamma}}g_t^{-\rho}D_t \tag{7}$$

Here we have six equations (Equations (2) to (7)) to identify five parameters (μ_t, α_{1t}^W, α_{2t}^W, α_{1t}^H, and α_{2t}^H), so we have enough moment conditions to identify all the parameters. In summary, analyzing detailed information on public and private expenditures, along with time allocation decisions, enables us to distinguish between bargaining power and preferences.

Intuition for identifying the bargaining power Empirically, we observe that both spouses' time and monetary contributions to public goods increase after childbirth, indicating an elevated preference for public goods and a decreased preference for private consumption for both individuals. However, we observe a decline in the wife's private consumption but not the husband's, which could only be rationalized by a decline in the wife's bargaining power.

6 Main Results

6.1 GMM estimates

Table 2 presents the GMM parameter estimates. Notably, the estimation sample is restricted to a time period spanning five years before and eight years after the birth of the first child to ensure a more balanced panel.[27]

In terms of bargaining power, we find that both a higher relative wage and a lower relative age for the wife compared to the husband contribute to an increase in her bargaining power. Furthermore, the three $PostFirstBirth$ dummies, which capture the direct impact of different

[27]The event study employs age and year fixed effects to control for potential cohort compositional variations, whereas the structural model cannot account for this variation. Therefore, we restrict the sample to a more balanced panel to prevent our results from being driven by cohort-specific effects. Appendix D.1 provides the summary statistics of the restricted sample, and most of the moments are similar to those of the sample used in the event study analysis.

stages of the post-birth period on bargaining power, are all negative.[28] The negative impact of parenthood on a wife's bargaining power can be due to the deterioration of outside options for women, particularly in the event of a divorce, as they would then be solely responsible for taking care of the child. According to the Vital Statistics of Japan 2019, in divorces involving minor children, the wife retains custody of the child in 84.5% of cases. Furthermore, because child-support agreements are both uncommon and unenforceable, less than 20% of divorced mothers receive any financial support from their ex-husbands (Raymo et al., 2014). Therefore, based on social norms, women are primarily responsible for paying the childcare costs when divorced, which leads to a significant reduction in their outside option after childbirth. Additionally, the likelihood of remarriage may decrease for divorced women with children, which further deteriorates their outside option.

In addition, fertility has a negative effect on spousal preferences for private goods and leisure. Given that preferences for private goods, leisure, and public goods sum up to one, this suggests that fertility has a positive effect on the preference for public goods for both wives and husbands. This positive effect could indicate a genuine shift in the preference for public goods or could be a result of an absolute increase in home productivity.

Furthermore, the estimation indicates that wives with higher levels of education exhibit a stronger preference for private goods but a weaker preference for leisure. Conversely, husbands with higher levels of education have a weaker preference for private goods. Additionally, age has a positive effect on the preference for leisure for both wives and husbands, and a negative effect on the preference for private goods for husbands.

Our estimation also reveals that the coefficients of post-event time dummies in the wife's home productivity function are negative. The negative signs suggest that after childbirth, the wife's relative productivity in the home production of public goods decreases, while the husband's relative productivity in the home production of public goods increases. It is worth noting that the husband's average home production time before childbirth is only 3.5 hours per week, which increases to 12.3 hours (an increase of 250%) after childbirth. This suggests that the presence of children increases the importance of the husband's role in home production, and being a father makes husbands more productive in this domain.

Furthermore, we find that $1 - \sigma^W < \phi^W$ and $1 - \sigma^H < \phi^H$, which implies that for an individual, private consumption, leisure, and public good are viewed as direct substitutes. Additionally, the value $\gamma = 0.812$ indicates that a wife's home production time and a husband's home production time are complements.

To address concerns regarding the sensitivity of our estimates to functional form assumptions, we present two alternative specifications in Appendix D.3. In the first specification, we define the Pareto weight μ_t, spousal preferences α^j_{kt}, and home productivity π_t as functions of

[28] In Appendix D.2, we interact these $PostFirstBirth$ dummies with dummy variables indicating whether the woman has a college degree and whether the first child is a boy. The interaction terms do not yield significant results, which implies that the decline in bargaining power is widespread across households, regardless of these factors.

Table 2: GMM Parameter Estimates

	Estimate	(std. err.)		Estimate	(std. err.)
Wife's Pareto weights			*Wife's home productivity*		
$\beta_{\mu 1}$: $\log(\frac{\text{Age}_W}{\text{Age}_H})$	-0.702***	(0.141)	$\beta_{\pi 0}$: constant	0.340***	(0.040)
$\beta_{\mu 2}$: $\log(\frac{w_{Wt}}{w_{Ht}})$	0.557***	(0.015)	$\beta_{\pi 1}$: post first birth (0–2 years)	-0.641***	(0.026)
$\beta_{\mu 4}$: post first birth (0–2 years)	-0.685***	(0.061)	$\beta_{\pi 2}$: post first birth (3–5 years)	-0.638***	(0.029)
$\beta_{\mu 5}$: post first birth (3–5 years)	-0.522***	(0.057)	$\beta_{\pi 3}$: post first birth (6–8 years)	-0.628***	(0.033)
$\beta_{\mu 6}$: post first birth (6–8 years)	-0.328***	(0.055)			
Wife's preference for private goods			*Husband's preference for private goods*		
δ_{10}^W: constant	-0.556***	(0.186)	δ_{10}^H: constant	-0.277**	(0.114)
δ_{11}^W: wife's age	0.005	(0.005)	δ_{11}^H: husband's age	-0.007**	(0.003)
δ_{12}^W: wife's education	0.029***	(0.009)	δ_{12}^H: husband's education	-0.014**	(0.006)
δ_{13}^W: post first birth (0–2 years)	-0.227***	(0.042)	δ_{13}^H: post first birth (0–2 years)	-0.235***	(0.028)
δ_{14}^W: post first birth (3–5 years)	-0.345***	(0.046)	δ_{14}^H: post first birth (3–5 years)	-0.227***	(0.032)
δ_{15}^W: post first birth (6–8 years)	-0.462***	(0.056)	δ_{15}^H: post first birth (6–8 years)	-0.199***	(0.041)
Wife's preference for leisure			*Husband's preference for leisure*		
δ_{20}^W: constant	-0.838***	(0.099)	δ_{20}^H: constant	-1.573***	(0.078)
δ_{21}^W: wife's age	0.016***	(0.002)	δ_{21}^H: husband's age	0.010***	(0.002)
δ_{22}^W: wife's education	-0.019***	(0.005)	δ_{22}^H: husband's education	0.003	(0.004)
δ_{23}^W: post first birth (0–2 years)	-0.417***	(0.021)	δ_{23}^H: post first birth (0–2 years)	-0.154***	(0.017)
δ_{24}^W: post first birth (3–5 years)	-0.438***	(0.023)	δ_{24}^H: post first birth (3–5 years)	-0.130***	(0.020)
δ_{25}^W: post first birth (6–8 years)	-0.444***	(0.029)	δ_{25}^H: post first birth (6–8 years)	-0.075***	(0.024)
Consumptions complementarity			*Home production*		
ϕ^W	0.144***	(0.008)	γ: home production complementarity	0.812***	(0.018)
ϕ^H	0.113***	(0.009)	ρ: time's output elasticity in home production	0.091***	(0.005)

Notes: * 10% significance, ** 5% significance, *** 1 % significance.

the number of children rather than the age of the first child. Specifically, we replace the post-birth event time dummies with indicators representing the number of children in the household during a specific period. The three indicators, $Children_{1t}$, $Children_{2t}$, and $Children_{3t}$ correspond to households with one child, two children, and three or more children, respectively. Households without children serve as the reference group.

In the second specification, we adopt the approach used by Lise and Yamada (2019) for the specification of μ_t by including the following distribution factors: (1) the relative wage between the husband and wife at the time of marriage; (2) the relative wage growth within 10 years between the husband and wife, which is predicted at the time of marriage; (3) the household income at the time of marriage; and (4) the relative wage shock, which is calculated by the deviations between real wages and predicted wages. We deviate from Lise and Yamada (2019) in that we additionally include the post-birth period dummies to analyze the direct effect of fertility on the Pareto weight.

The negative effects of fertility on the wife's bargaining power consistently persist across all specifications examined. Additionally, we observe enduring effects of childbirth on both husbands' and wives' preferences for private consumption and leisure, as well as on the home productivity of wives.

6.2 Model fit

We simulate household behaviors using the estimated structural parameters and presents the goodness of fit for the estimation in Appendix D.4.[29] The results indicate that our model fits the data well in terms of consumption allocation and time use, both before and after the first birth.

To enhance our identification argument of bargaining power, we re-estimate the model under the assumption that women's bargaining power remains constant after childbirth. The estimation outcomes and the model fit are detailed in Appendix D.5. The estimated parameters from the restricted model fail to predict the wife's home production time and leisure time post-childbirth to match the data. By neglecting the loss of bargaining power, we disregard that the husband uses his power to assign more home production tasks to the wife, thereby crowding out her leisure time. Consequently, the shift in preferences alone is insufficient to fully explain the observed trade-off between home production time and leisure for the wife. This suggests that a change in women's bargaining power is essential in predicting changes in consumption and time allocations for wives and husbands.

To validate our estimated bargaining power, Appendix D.6 presents additional evidence based on women's retrospective assessments of their own efforts in the JPSC dataset. As shown in Figure D.5, women with lower bargaining power are more likely to perceive their effort and awareness to housework, their spouse, and their children's education as excessive, compared to those with higher bargaining power.

6.3 Decomposition of the Pareto Weight

Using the event study approach described in Section 3, we plot the dynamics of estimated spousal bargaining power around the first birth in Figure 4.[30] In the eight years after the birth of the first child, the wife's bargaining power on average decreases by 34.30%. The wife's bargaining power recovers only a little in the long run, indicating a persistent decline in her access to household resources. On average, the estimated Pareto weight decreases significantly from 0.45 before the first birth to 0.29 afterward.[31]

To understand how wage penalties and fertility itself affects the wife's bargaining power after the first birth, we compare the wife's current Pareto weight μ_t and her Pareto weight μ'_t where the time-varying factors include only relative spousal age and relative spousal wage.[32] Specifically, $\mu'_t = \frac{\exp(x'_{\mu t})}{1+\exp(x'_{\mu t})}$, where $x'_{\mu t} = \beta_{\mu 1}(\log(\frac{Age_{Wt}}{Age_{Ht}})) + \beta_{\mu 2}(\log(\frac{w_{Wt}}{w_{Ht}}))$.

[29] In the simulations, we take the saving decision as $(1+r)a_t - a_{t+1}$, where r is the interest rate, as given. We directly feed in the value by using the difference between total income and total expenditure.

[30] The dynamics of preferences for private goods, leisure, and public goods, as well as the relative home productivity around the time of the first birth are shown in Appendix D.7.

[31] In Appendix D.8, we present the sample mean of the GMM parameter estimates before and after the first birth, including the Pareto weights, preferences for different goods, and husband's home productivity. Additionally, we conduct t-tests to compare these means before and after childbirth, rejecting the null hypothesis of no change in all cases.

[32] Although relative age also changes over time, the magnitude is very small.

Figure 4 presents the dynamics of μ_t and μ_t'.[33] The proportion of the Pareto weight that can be explained by the relative wage ($\frac{\mu_t'}{\mu_t}$) is referred to as the relative wage effect. The remaining proportion that cannot be explained by the wage penalty ($\frac{\mu_t - \mu_t'}{\mu_t}$) is classified as the residual effect, which captures the effect of fertility itself on the wife's bargaining power. As shown in Figure 4, the relative wage effect increases gradually while the residual effect shrinks over time. On average, the relative wage effect accounts for only 28.5% of the decline in the wife's bargaining power while the residual accounts for 71.5%. These findings suggest that in addition to wage penalties, the presence of children has a direct impact on the wife's bargaining position. The two factors shift the Pareto weight in favor of the husband, thereby contributing to power inequality within the household.

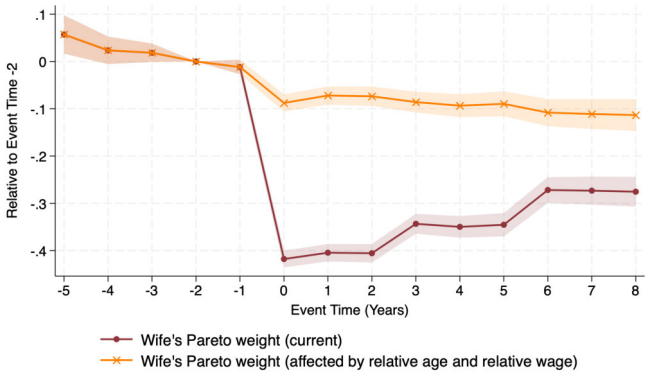


Figure 4: Decomposition of the Pareto Weight

7 Welfare Analyses

7.1 Effect of Childbirth on Welfare

In the previous section, we discussed the simultaneous shifts of various factors following the birth of the first child. These factors include the bargaining power of the wife versus the husband, their preferences for private and public goods, and the productivity of home production. As a result, even for the same individual, the shape of their indifference curves may vary across different periods (Cherchye et al., 2012). Therefore, it is not appropriate to compare utility levels directly between different periods because an individual's ranking of their consumption bundles may change over time. This issue becomes particularly important when considering non-excludable public goods, as we need to account for changes in individuals' willingness to pay for the public good and the actual cost borne in producing the public good.

To tackle this issue, we adopt the money metric welfare indices (MMWI) developed by Chiappori et al. (2024). The MMWI method contrasts two scenarios for the same individual within a specific period: one where they jointly produce public goods with their spouse and another where they independently produce these goods. In the latter scenario, we assume that individuals' preferences and productivity remain unchanged. The MMWI is the minimum expenditure

[33] Appendix D.9 provides the details of the decomposition for each period after childbirth.

required for individuals to achieve the same utility level when producing public goods independently as they would when producing them jointly with their spouses. We elaborate in detail on the optimization problem when individuals produce public goods on their own and explain how to compute the MMWI in Appendix E.1. The discussion on the advantages and limitations of using MMWI in our context is detailed in Section 7.3. After calculating the MMWI at the individual-year level, we apply the event study approach to examine the changes in welfare following childbirth.

Figure 5 illustrates the dynamics of the MMWI for the wife and husband over the years surrounding the birth of their first child. The results reveal a significant disparity in welfare changes between the husband and wife, as measured by the MMWI. On average, the wife experiences a decline of 12.16% in utility (in terms of expenditure equivalence), despite an increase in her preference for public goods. Her welfare decreases immediately after childbirth and continues to deteriorate over the first eight years. In contrast, the husband's utility shows a persistent increase of 6.97% after the birth of the first child. On average, the wife's welfare relative to the husband's declines from 91.92% to 75.28% after childbirth, indicating an increase in within-household welfare inequality.

In Appendix E.2, we examine the robustness of our welfare results with respect to the two assumptions regarding home production. We explore two alternative scenarios. First, we specify the individual home production technology to be equal to one ($\pi_W = \pi_H = 1$) when individuals produce the public good independently.[34] This alternative specification helps us rule out the concern that the increase in men's welfare in the baseline specification is driven by an increase in their home productivity.

Second, we analyze the equivalent specification in Cherchye et al. (2012), assuming that 30% of the spouse's home production time remains available in the new regime. Following their approach, we assume that the individual's home production time is unchanged and the spouse's home production time is at 30% of the original level. Then, we keep public goods at the same level as in the initial situation by increasing the expenditure on public goods to compensate for the decreased time input of the absent partner. The motivation for this specification is twofold: first, there is a minimum threshold of home production time required for childcare, and second, the presence of both parents is necessary and important for children's development. We then simulate the optimal private consumption and leisure arrangements that are necessary for individuals to achieve their original utility levels.

The two alternative assumptions of home production lead to a consistent conclusion that parenthood leads to an increase in the husband's welfare but a decline in the wife's welfare. Appendix D.3 also shows that the welfare implications drawn from alternative models, as discussed in Section 6.1, are consistent with those from our baseline model.

To further investigate the distributions of utility changes for both the husband and wife, we use the age and year dummies to predict the counterfactual levels of MMWI for individuals

[34] In this scenario, the home production function for individuals is $Q(h_{jt}, g_{jt}) = h_{jt}^{\rho} g_{jt}^{1-\rho}$.

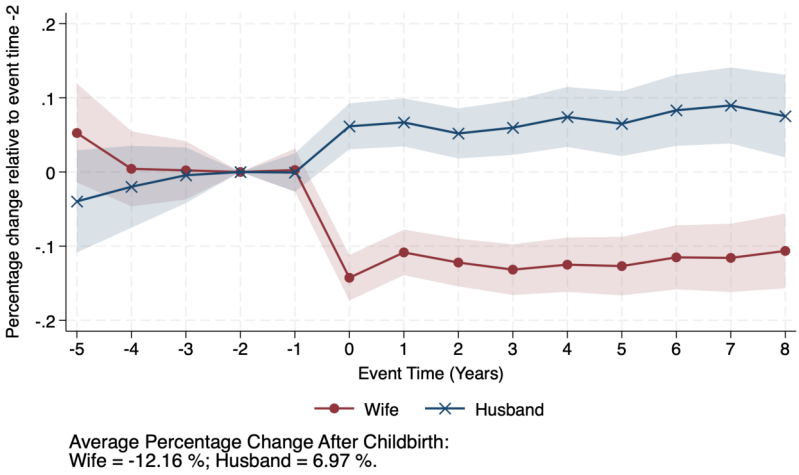


Figure 5: Money Metric Welfare Index

not having a baby, denoted as $\widetilde{MMWI}_{jt}$. This approach enables us to compute the percentage change in the actual MMWI at event time t relative to the counterfactual MMWI of not having a baby at the same event time t. For each household, we calculate the average welfare change in their post-birth periods, i.e., event time $\in (0, 8)$.

In Appendix E.3, we present the distribution of the welfare changes for our sampled households. The results in Figure E.1 show that 81.82% of wives experience a decline in welfare during the post-birth period. The median wife encounters a 16.38% decrease in welfare after having a baby. In contrast, 56.68% of husbands experience an increase in welfare after having a baby. The median husband experiences a 4.08% rise in welfare following childbirth.

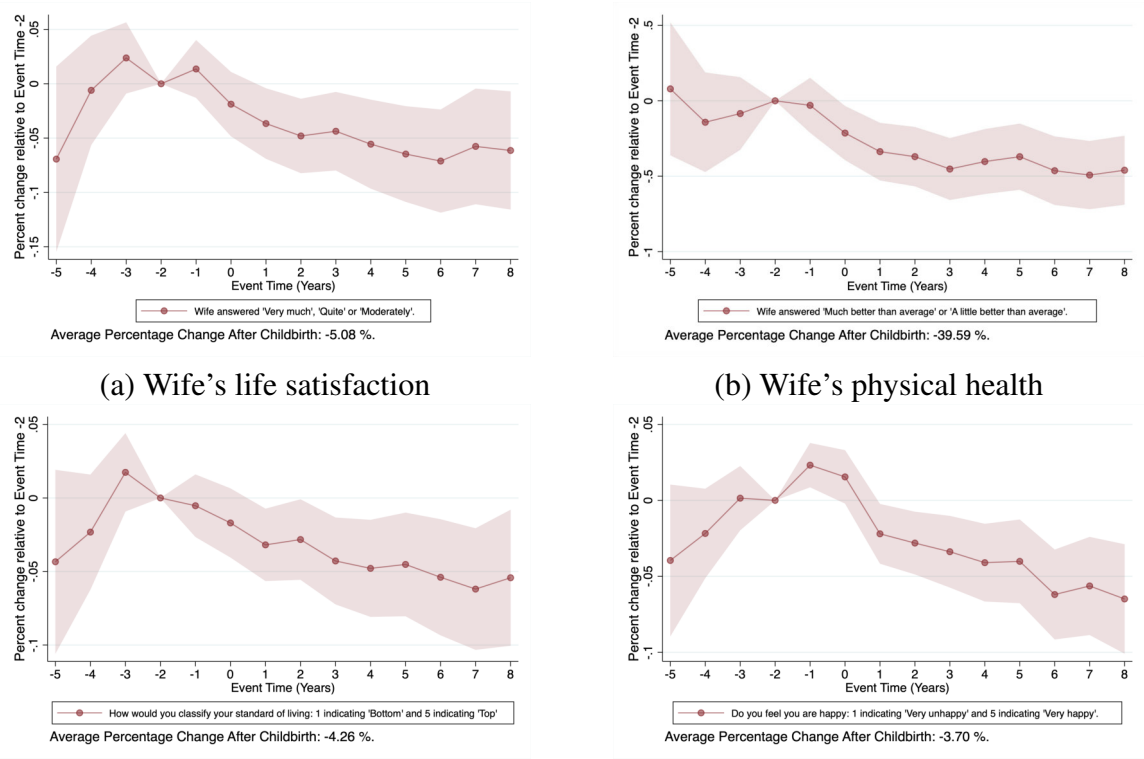
Additionally, we examine the heterogeneity in welfare changes among wives, focusing on four characteristics: educational attainment, labor force participation before giving birth, birth cohort, and age at first birth. The results in Figure E.2-Figure E.5 show that college-educated women and those who worked before their first child face larger welfare reductions. Furthermore, we find no significant differences in welfare changes between older and younger cohorts or between women who gave birth before age 31 and those who gave birth after.

7.2 Effect of Childbirth on Wives' Health Status and Life Satisfaction

To strengthen our evidence of the welfare effects, we examine wives' life satisfaction, self-reported health status, current standard of living, and happiness using the JPSC data. In Appendix E.4, we provide a detailed description of the subjective well-being measures. We apply the event study approach to analyze the dynamics surrounding the birth of the first child. As shown in Figure 6, women's life satisfaction drops by 5.1% and happiness declines by 3.7% after giving birth. Furthermore, women experience a 4.3% decrease in their self-reported standard of living and a 39.6% decrease in the likelihood of reporting good physical health status after childbirth. These findings indicate that parenthood imposes substantial welfare costs on

mothers.[35]

Furthermore, in Table E.2, we demonstrate a strong positive correlation between our estimated MMWI and these subjective well-being measures. Additionally, Table E.3 shows that a lower MMWI is associated with a lower probability of remaining married. Women who report lower life satisfaction, greater unhappiness, and a reduced standard of living are significantly more likely to divorce in the following period.



(a) Wife's life satisfaction

(b) Wife's physical health

(c) Wife's current standard of living

(d) Wife's happiness

Figure 6: Wives' Health Status and Life Satisfaction

7.3 Discussion of the Welfare Estimates

One key feature of the MMWI is that it converts individual welfare into monetary terms, enabling the measurement of how much individuals benefit from household public goods. Specifically, within a given period, we can determine the resources an individual would need to be equivalently well-off when single compared to when married, accounting for their preferences for public goods. The greater the resources required to maintain the same level of utility without a partner's input, the higher the welfare benefit derived from the household (Chiappori et al., 2024). Additionally, individuals with a stronger preference for public goods will require more expenditure to achieve the same utility level when producing public goods independently. By constructing the measure this way, we can incorporate both spouses' time and monetary contributions, as well as their preferences for public goods, into the assessment of individual

[35]Previous research has also documented the negative effects of parenthood on women's physical health, mental health, and happiness (Ahammer et al., 2024, Dehos et al., 2024, Sun et al., 2024).

welfare at time t.

Since monetary terms are comparable across periods, plotting the MMWI over time enables us to trace the dynamics of individual welfare and assess how it evolves for the same individual across different periods.[36] Therefore, by comparing the MMWI before and after childbirth, we can highlight the differing monetary value of childbirth for women compared to men, which, to our knowledge, is a novel contribution to the literature.

It is important to note that our measure does not fully capture the non-pecuniary utility and long-term payoffs associated with children, as discussed in Appendix E.5. Accurately identifying these components would require a comprehensive dynamic structural model that incorporates fertility decisions and children's human capital development. Nonetheless, our welfare results remain informative. By highlighting gender differences in the monetary valuation of welfare, we gain a better understanding of the monetary costs women incur when deciding to have a child. If women are rational decision-makers, the observed welfare metrics suggest that the unaccounted utility components must be sufficiently large for women to offset the documented monetary disadvantages they face.

8 Counterfactual Analyses

This section explores three counterfactual exercises to compare the effects of a wife's bargaining power penalty and wage penalty. In the first scenario, we eliminate the impact of childbirth on bargaining power. Specifically, bargaining power varies only with changes in the relative age between spouses, and is unaffected by fertility or wage effects.[37] In the second scenario, we eliminate the wage penalty for wives, which affects their labor market opportunities and bargaining power through spousal relative wages. In the third scenario, we combine the first two counterfactuals by eliminating the wage penalty for wives and the fertility effect on bargaining power. We then analyze how intrahousehold allocation of consumption and time, as well as the welfare of both the husband and wife, differ in these counterfactual scenarios compared to our baseline model.

The results of the counterfactual analysis on intrahousehold allocation are presented in Table 3. Column (1) displays the simulation outcomes before childbirth, while Column (2) shows the results after childbirth, serving as the baseline for our counterfactual comparisons. Columns (3) to (5) correspond to the three scenarios explained above.

Column (3) shows that in the first counterfactual scenario, as the wife's bargaining power increases after childbirth compared to the baseline, there is an increase in the wife's private consumption and leisure. Compared to the baseline, the wife's private consumption increases

[36] It is important to note that the magnitude of the MMWI in period t is solely influenced by parameters in that period. Consequently, it does not depend on parameters from other periods, making this measure robust to changes in parameters and environments (Cherchye et al., 2018).

[37] Although in reality, the age difference between husband and wife within a couple does not change, in our model, the relative age could vary over time due to the functional form we have chosen. Nevertheless, the effect of relative age on the wife's bargaining power is pretty small.

from 3,550 to 4,340 yen per week, and her leisure increases from 86.90 to 96.12 hours per week. On the other hand, the husband's private consumption decreases from 6,630 yen to 5,630 yen per week while his leisure decreases from 93.96 hours to 89.57 hours per week. These results suggest that empowering women can reduce the inequality in household resource allocation. Moreover, the wife's home production time decreases from 60.84 hours to 53.73 hours per week, while the husband's home production time increases from 10.12 hours to 13.59 hours per week, indicating that an increase in bargaining power can alleviate the heavy burden of housework and childcare among wives, and enhance the husband's role in home production.

In the second counterfactual scenario where the wife does not experience wage penalties after childbirth, there is an increase in the wife's work time, as depicted in Column (4). This increase in work time is primarily driven by an increase in her wage rate, which dominates the effect of an increase in her bargaining power. As observed in the first counterfactual, an increase in the wife's bargaining power would typically lead to a reduction in her work time. The higher wages and increased working hours for the wife result in higher household earnings. Consequently, both the wife and the husband experience an increase in private consumption compared to the baseline. Public consumption also increases in this scenario. Additionally, the relative increase in the wife's wages compared to the husband's implies an increase in the husband's comparative advantage in home production, leading to an increase in the husband's home production time.

As shown in Column (5), in the third counterfactual scenario where the wife experiences neither a wage penalty nor a decrease in bargaining power due to childbirth, the wife's private consumption further increases to 5,930 yen per week. This increase in consumption reflects the combined effect of her greater bargaining power and the larger household budget. Additionally, the wife spends less time on home production and more time on leisure. On the other hand, the husband spends more time on home production and less time on leisure. The responses in home production time and leisure are the largest in the three counterfactual scenarios for both spouses.

Next, we analyze the welfare change for both wives and husbands before and after childbirth in the baseline model and three counterfactual scenarios. The results are presented in Figure 7.

In the first scenario, where we eliminate the effect of childbirth on the wife's bargaining power, the wife still experiences a drop in welfare, but the magnitude shrinks from -12.16% in the baseline to -9.56%. This increase in welfare is primarily driven by an increase in private consumption and leisure for the wife. Conversely, the effect of childbirth on the husband's welfare declines from 6.97% in the baseline to 1.79% in the first counterfactual scenario.

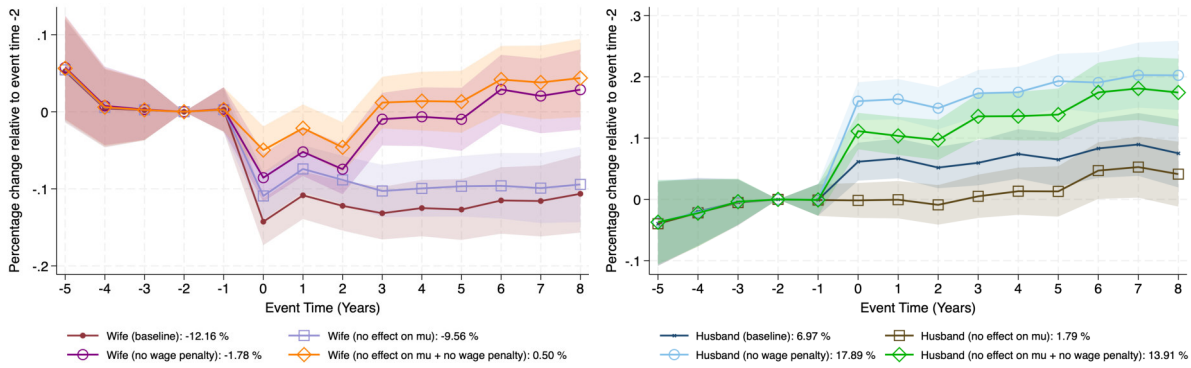
In the second scenario, where the wife does not experience a wage penalty, the drop in her welfare after childbirth shrinks from -12.16% to -1.78%. Since the wage penalty plays a more important role in the mid and late stages of the post-birth periods, the effect of removing the wage penalty on welfare gradually increases as the children grow older. Additionally, the effect of childbirth on the husband's welfare increases from 6.97% to 17.89%, which is the

Table 3: Counterfactual Analyses: Intrahousehold Allocation

	(1) Before	(2) After (Baseline)	(3) After (No effect on μ)	(4) After (No wage penalty)	(5) After (No effect on μ + No wage penalty)
Intra-household expenditure (1000 yen per week)					
Wife's private consumption	5.92	3.55	4.34	5.05	5.93
Husband's private consumption	6.33	6.63	5.63	8.08	7.10
Public consumption	35.85	43.26	42.29	46.01	44.65
Time use (hours per week): wife					
Wife's work time	30.50	20.26	18.15	27.77	24.75
Wife's home production time	30.36	60.84	53.73	57.49	49.92
Wife's leisure	107.14	86.90	96.12	82.74	93.33
Time use (hours per week): husband					
Husband's work time	66.80	63.92	64.84	61.09	62.18
Husband's home production time	6.96	10.12	13.59	15.40	19.21
Husband's leisure	94.23	93.96	89.57	91.50	86.61
Observations	1532	4858	4858	4858	4858

highest among all three scenarios. The increase in the wife's wages and labor supply rises the household budget, hence benefiting the husband as well. These findings suggest that policies aimed at mitigating the wage penalty associated with childbirth may have positive welfare implications for the entire household.

In the third scenario, where the wife experiences neither a wage penalty nor a reduction in her bargaining power, the effect of childbirth on the wife's welfare changes from negative to a positive 0.50%. Meanwhile, the effect of childbirth on the husband's welfare increases to 13.91%.



(a) Wife (b) Husband

Figure 7: Counterfactual Analyses Depicting Welfare Changes After Childbirth

Our findings indicate that both the wage penalty and a decrease in bargaining power are crucial factors in explaining the negative impact of childbirth on women's welfare. The removal of the wage penalty alone falls short in generating a positive welfare effect from fertility. It is only the simultaneous removal of both the wage penalty and the bargaining power penalty that yields a positive welfare effect. Ignoring the change in women's bargaining power leads to an underestimation of the welfare loss from childbirth by 21%.[38]

[38] 21%=1-9.56%/12.16%.

However, these two channels affect welfare through different mechanisms, leading to varying responses in resource allocations. Furthermore, their impacts on welfare improvement manifest at different stages, carrying distinct implications for welfare inequality. In the last three rows of Table 3, we present the MMWI levels for both wives and husbands, as well as the ratio of the wife's MMWI to the husband's MMWI. This ratio is a measure of welfare inequality within the household. Prior to the first birth, the wife's MMWI is 92% of her husband's, indicating a slight disadvantage for wives. However, following the first birth, the wife's MMWI drops to 75% of her husband's in the baseline scenario, which exacerbates gender inequality in welfare within the household.

Removing the negative effect of childbirth on bargaining power results in an increase in her welfare in all periods following childbirth. However, the husband's welfare declines compared to the baseline as he receives a smaller share of household resources. This shift increases the wife's welfare relative to her husband, from 75% in the baseline to 82% when the bargaining power penalty is removed. In contrast, eliminating the wage penalty has minimal impact on reducing within-household welfare inequality, as the wife's MMWI remains at 75% of the husband's.

In Appendix F.1, we conduct policy experiments examining childcare subsidies and maternity leave policies. However, because our model does not explicitly incorporate outside options, it cannot capture how these policies affect women's bargaining power. Instead, we assess their impact solely through changes in public goods prices or potential wages. We find that these policies have minimal influence on within-household welfare inequality, though these results should be interpreted with caution.

9 Conclusion

This paper examines the impact of childbirth on labor market outcomes, intrahousehold resource allocation, bargaining power, and welfare for both husbands and wives. The empirical analysis reveals a significant decrease in women's labor earnings but a much smaller decline in household earnings following childbirth. Additionally, wives' private consumption and leisure decrease relative to their husbands', while both spousal home production time and the share of household expenditure on public goods increase after the birth of the first child.

We develop a collective model and estimate it using GMM, and discover that the arrival of a child results in a 34% decline in the wife's bargaining power. Additionally, there is an increase in the preference for public goods among both wives and husbands; this increase is particularly potent among wives. Using money metric welfare indices, we find that the arrival of the first child leads to a 12% decrease in welfare for the wife and a 7% increase in welfare for the husband.

Our findings have several important implications. First, we highlight the role of the wife's bargaining power in influencing her consumption, time use, and overall welfare within the household. Our counterfactual experiments show that failing to account for the impact of

childbirth on the wife's bargaining power may result in an underestimation of the negative effects of childbirth on women's welfare by 21%. The decrease in women's bargaining power, private consumption, and leisure activities could be contributing factors to why women experience stress and unhappiness following childbirth, as well as why many women opt not to have children.

Second, novel policies that aim to empower women can mitigate the adverse effects of childbirth on women's welfare. While existing studies explore policy interventions such as parental leave policies that directly encourage women's re-entry into the labor market (Yamaguchi, 2019), we suggest that policies could focus on enhancing the wife's bargaining power after childbirth. For example, enacting laws to increase alimony payments provided by men to women in divorce would ensure the rights of divorced women with children and improve their outside options within marriage. By empowering women within the household, such policies can promote greater gender equality and improve the well-being of women during the post-childbirth period.

The remaining question is why women choose to have a child despite experiencing a decline in utility from parenthood. We provide several hypotheses to address this issue. First, fertility may be an exogenous shock, as opposed to an endogenous choice. Second, our model might not fully encapsulate the non-monetary benefits and long-term returns associated with having a child, as outlined in Section 7.3. Lastly, women may lack comprehensive knowledge regarding the impact of parenthood on labor market outcomes and bargaining power. As demonstrated by Kuziemko et al. (2018), women often underestimate the effects of motherhood on employment. Analogously, we hypothesize that before having a baby, women might not expect a decrease in their bargaining power. Incorporating long-term considerations, including the uncertainty and imperfect information surrounding motherhood expectations could be a valuable avenue for future research.

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APPENDIX

Appendix

A Data Appendix

A.1 Sample Selection Criteria

The Japanese Panel Survey of Consumers (JPSC) dataset is a longitudinal study that began in 1993 and continues to the present day. Our study uses data collected from 1993 to 2020 and includes 4,120 women with 52,144 individual-year observations.

Table A.1 provides an overview of the procedures used to obtain the final study sample. First, we restrict the data to married women, resulting in a sample of 35,657 observations. Next, we remove observations with missing values for variables such as wives' private expenditure and time allocation, husbands' private expenditure and time allocation, and public expenditure, leaving us with 32,200 observations.

Subsequently, we excluded cases where the age of the woman's first child was missing, including women without children, leaving us with 29,654 remaining observations. We then further eliminated women who entered the survey after the birth of their first child, resulting in the removal of 20,526 observations and leaving us with 9,128 observations. The substantial loss of observations is due to the fact that 79.3% of married women entered the survey after the birth of their first child.

Additionally, we drop women without any observations after the first birth, resulting in the removal of five observations and leaving us with 9,123 observations. Finally, we restrict our sample to couples observed at least once before and after childbirth. This final selection process yields a sample of 748 women.

In our event study sample, there are 8,751 observations within the event window $t \in [-5, 20]$. For the GMM estimation, we restrict the sample to five years prior and eight years after the birth of the first child, $t \in [-5, 8]$, to ensure a more balanced panel.[39] This results in a sample of 6,390 observations. Since we use the one-year lagged levels of consumption, hours, and wages as instruments for their respective logged variables, we lose 980 observations lacking the necessary lagged data. Consequently, our GMM estimation is based on 5,410 observations.

Table A.2 compares the distributions of women in the original sample and the study sample based on their marital status and parental status. In the original sample, which includes 4,120 women, 58 (1.4%) are never married with children, 2,194 (53.3%) are married with children, and 297 (7.2%) are divorced with children across the observed periods. In addition, the study sample, comprising 748 ever-married women, includes 693 (92.6%) who are married with children and 55 (7.4%) who are divorced with children.

[39] This restriction is less critical in the event study analysis, as we can control for age and year fixed effects.

Table A.1: Sample Selection Criteria in JPSC

	Number of women	Number of observations
Original sample	4120	52144
Married women	2910	35657
Non-missing expenditure and time use	2849	32200
First birth related:		
(1) Non-missing first-birth age	2464	29654
(2) Women with pre-birth information	753	9128
(3) Women with post-birth information	748	9123
(4) Women in the [-5,20] periods	748	8751
(5) Women in the [-5,8] periods (GMM)	748	5410

Table A.2: Distribution of Women by Marital and Parental Status

	Number of Women	Percentage (%)
Original sample	4120	100.0
Never Married	1210	29.4
Never married without children	1152	28.0
Never married with children	58	1.4
Ever Married	2910	70.6
Married with children	2194	53.3
Married without children	378	9.2
Divorced with children	297	7.2
Divorced without children	41	1.0
Studied sample	748	100.0
Married with children	693	92.6
Divorced with children	55	7.4

A.2 Potential Measurement Errors of Husbands' Private Consumption Reported by Wives

In Section 2, we mention potential measurement errors in the data, as the husband's consumption and time use are reported by the wife. In Appendix Section A.3, we show that the time use of husbands reported by their wives in the JPSC is comparable to that reported by household heads (i.e., husbands) in the STULA. In this section, we focus on discussing the measurement errors of husbands' private consumption.

Note that the measurement errors of the level of husband's consumption would not directly threaten our identification as the event study compares the changes in private consumption before and after childbirth. The concern is whether the change in the husband's consumption before and after the birth is systematically affected by this potential measurement error.

We consider two possible channels through which the wife's report may affect the change in the husband's consumption. First, after childbirth, a wife may be occupied with childcare and have less time to monitor her husband's spending, leading to less accurate measures of her husband's expenditure. Second, we observe that post-childbirth, the wife becomes more responsible for managing the household expenses, as shown in the first column of Table A.3. A wife managing the household expenses may have more accurate information regarding her husband's expenditure than if her husband were managing the household expenses.

In the second column of Table A.3, we investigate how the wife's time allocation affects her reported weekly consumption of her husband. We find that the wife's home production time and work time are uncorrelated with her reports of her husband's private consumption, indicating that the first channel is unlikely to cause a systematic measurement problem. In the third column of Table A.3, we further analyze whether the wife's management of household expenses affects her reports of her husband's consumption, and find no significant correlation, suggesting that the second channel is not a concern either. These two pieces of evidence jointly imply that any potential measurement errors are unlikely to significantly impact our main findings.

A.3 Data Comparability

To assess the representativeness of the JPSC data for the Japanese population, we conducted a comparative analysis with two prominent surveys published by the Statistics Bureau of Japan: the Survey on Time Use and Leisure Activities (STULA) and the Family Income and Expenditure Survey (FIES).

The STULA survey, a nationally representative survey focusing on time use, has been conducted every five years since 1976. Respondents include all persons aged 10 and older in the sampled households.[40] For direct comparison, we selected one specific year, 2011, within our sample period. Our analysis focused on the average weekly time allocation of married women and married men aged 25–49. The STULA survey provides more detailed activity breakdowns

[40]The STULA survey has been used to analyze individual time allocation in some studies, such as Kitao and Nakakuni (2024).

Table A.3: Management of Household Expenses

	Wife manages household expenses (dummy)	Husband's weekly private consumption (1000 yen)		
	(1)	(2)	(3)	(4)
After Childbirth (dummy)	0.093***			
	(0.014)			
Wife manages household expenses (dummy)			-0.019	0.083
			(0.253)	(0.256)
Wife's weekly home production time (hours)		-0.002		-0.002
		(0.003)		(0.003)
Wife's weekly work time (hours)		0.006		0.006
		(0.004)		(0.004)
Household weekly labor earnings (1000 yen)	-0.000**	0.008***	0.009***	0.008***
	(0.000)	(0.002)	(0.002)	(0.002)
Constant	0.849***	5.784***	5.746***	5.706***
	(0.025)	(0.348)	(0.390)	(0.436)
Individual FE	✓	✓	✓	✓
Year FE	✓	✓	✓	✓
R-Squared	0.491	0.481	0.481	0.481

Note: Standard errors are in parentheses. * $p < 0.10$ ** $p < 0.05$ *** $p < 0.01$

than the JPSC dataset. Consequently, we categorized all activities into three main categories: work time, home production time, and leisure. To categorize the activities, we first calculated the number of hours spent per week on each activity. Then, we categorized the following activities as leisure: sleeping, personal care, meals, watching TV, listening to the radio, reading newspapers or magazines, resting and relaxing, hobbies and amusements, sports, volunteer and social activities, and social life. Similarly, we categorized the following activities as work time: work, schoolwork, commuting to and from school or work, learning, self-education, and training. Finally, we categorized the following activities as home production time: housework, caring or nursing, childcare, shopping, medical examinations or treatments, and other miscellaneous tasks.

As shown in Table A.4, the distribution of weekly time spent on work, home production, and leisure exhibits remarkable similarities between the two surveys. For example, in the JPSC 2011 dataset, married women allocated 15% of their time to work-related activities, 28% to home production, and 56% to leisure. Similarly, in the STULA 2011 survey, married women devoted 16% of their time to work-related activities, 26% to home production, and 59% to leisure. Additionally, we observe that the work time, home production time, and leisure of husbands in the JPSC closely align with those in the STULA. While the JSPC data is reported by wives, the STULA data is reported by individuals themselves. The consistency between the

two surveys suggests that the wife's reported time use of the husband is reliable.

Table A.4: Time Allocation of Married Men and Women (aged 25-49)

	Married Women		Married Men	
	STULA	JPSC	STULA	JPSC
Work time	15.52%	13.24%	38.72%	37.70%
Home production time	25.62%	29.81%	4.07%	4.59%
Leisure	58.87%	56.95%	57.21%	57.71%

Note: The table reports the time use among married men and women aged 25–49 from the Survey on Time Use and Leisure Activities (STULA) and the Japanese Panel Survey of Consumers (JPSC) in 2011. We categorize time use into three main categories: work time, home production time, and leisure. The reported values represent the share of total time spent in each category. Since the three categories account for the entire 168 hours available in a week, there is no remaining time for other activities.

The Family Income and Expenditure Survey (FIES) is a comprehensive and nationally representative monthly survey that provides valuable information on income and expenditure. To compare the FIES with the JPSC, we again selected the year of 2011. As shown in Table A.5, the 2011 FIES data indicates that the average monthly earnings and consumption expenditure are 473,115 and 236,031 yen, respectively. In the 2011 JPSC data, the average monthly earnings and consumption expenditure are 507,392 and 209,932 yen, respectively. These statistics suggest that the JPSC sample provides a reasonable representation of income and expenditure in Japan during the selected period.

Table A.5: Income and Expenditure of Households with Workers

	FIES	JPSC
Monthly wages and salaries (yen)	473,115	498,357
Monthly total consumption expenditures (yen)	236,031	220,839

Note: The table reports the income and expenditure of households with workers from the Family Income and Expenditure Survey (FIES) and the Japanese Panel Survey of Consumers (JPSC) in 2011. The Japanese currency unit is the yen.

B Event Study Appendix

B.1 The Impact on Labor Market Performance

In this section, we discuss the labor market performance of husbands and wives before and after the birth of the first child. We analyze the labor force participation, working hours, hourly wages, and weekly labor earnings of both spouses. The event study analysis is conducted using the same sample as the main event study analysis.

In Figure B.1, women experience an average decline of 63.25% in weekly earnings within twenty years after childbirth. Notably, this earnings decline remains relatively stable and persistent throughout the 20-year period following the first birth. In contrast, husbands' earnings remain unaffected by childbirth. When we combine the earnings of both spouses, the child

penalty on total family earnings is considerably smaller. Over the twenty years following childbirth, family earnings decline by only 19.20%.

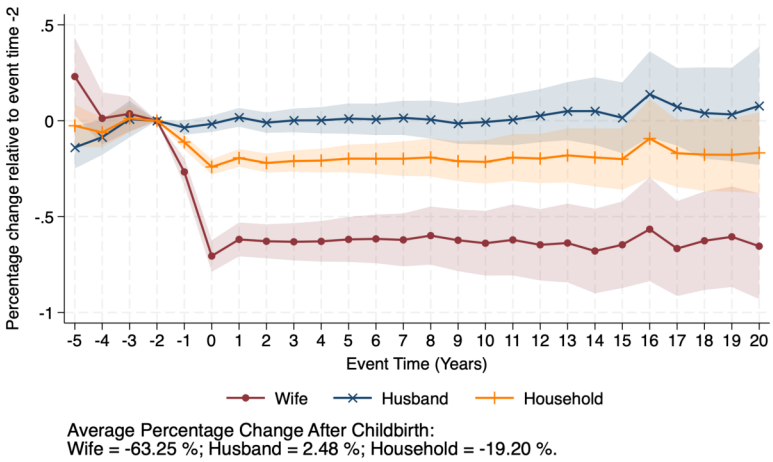
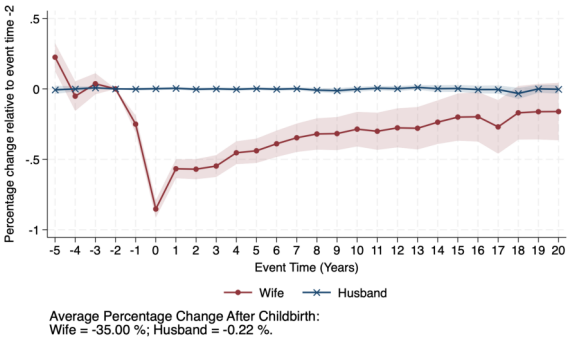


Figure B.1: Weekly Labor Earnings of Husbands and Wives

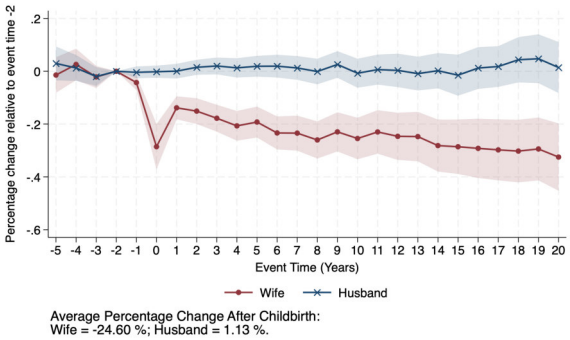
The women's earnings penalty can be attributed to three factors: labor force participation, hours of work, and the hourly wage (Kleven et al., 2019). The left panel of Figure B.2 shows that the wife's employment rate declines by more than 50% within the first three years after the birth of the first child. In Japan, women are predominantly employed in the non-regular sector, which is characterized by less job security and stability (Yamaguchi, 2019). As a result, the arrival of children often causes significant disruptions in employment. Over time, women tend to re-enter the labor force and regain employment, contributing to the observed recovery in the employment rate. However, even by the eighth year after the birth, labor force participation remains approximately 40% below the pre-childbirth trend. Over a 20-year period following childbirth, women experience an average employment decline of 35%.

Furthermore, within twenty years after the first birth, the wife's working hours (conditional on employment) decrease by an average of 24.60%, as illustrated in the right panel of Figure B.2. This decline is quite persistent, with the magnitude gradually increasing over time. The reduction likely reflects women's tendency to switch occupations and shift to sectors that offer greater flexibility to accommodate their caregiving responsibilities (Cortés and Pan, 2023).

Figure B.3 shows that the wife's hourly wages (conditional on employment) decrease by an average of 31.17% over the twenty years following the first birth. However, no significant wage decline is observed in the first two years after childbirth. This lack of significance may be due to selection bias, as women with higher wages are more likely to continue working following childbirth. Additionally, as more women gradually re-enter the labor market as their first child ages, the negative impact on wages becomes more evident. This trend potentially reflects a compositional change due to selection into labor market, human capital depreciation, and a shift to occupations to avoid longer hours.



(a) Labor force participation



(b) Working hours
(conditional on employment)

Figure B.2: Labor Force Participation and Working Hours of Husbands and Wives

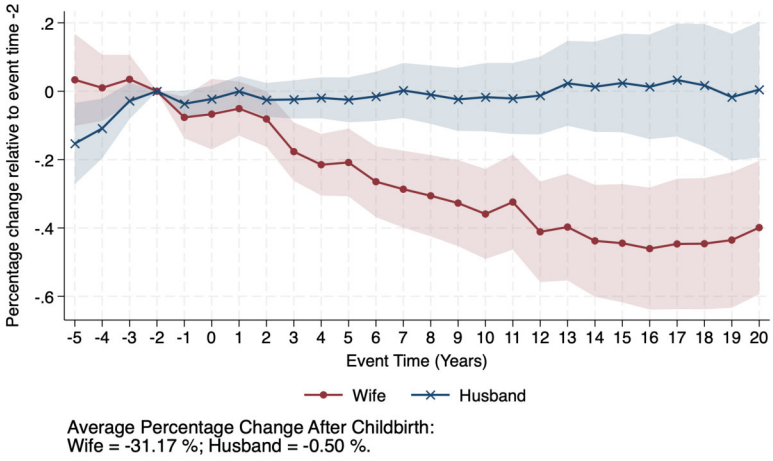
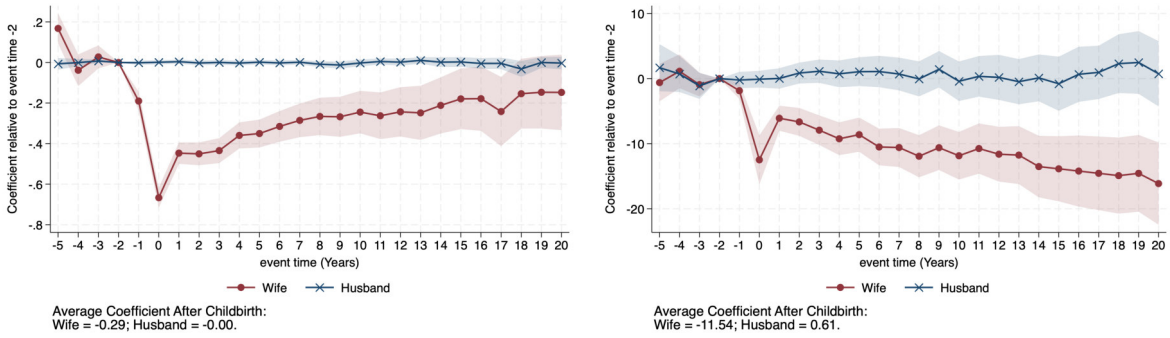


Figure B.3: Hourly Wage Rates of Husbands and Wives (conditional on employment)

B.2 Event Time Coefficients in the Event Study Analysis

The main analysis in Section 3 reports $P_t^g \equiv \frac{\alpha_j^g}{\widetilde{Y_{ist}^g}}$, the percentage change in the outcome of having a child at event time t relative to the outcome of not having a child $\widetilde{Y_{ist}^g}$. In this section, we report the level change, i.e., the event time coefficients α_j^g from the event study analysis to demonstrate the robustness of our results. These coefficients are interpreted as the impact of having children relative to event time $t = -2$.

The left panel of Figure B.4 shows that the wife's employment rate drops by an average of 29 percentage points relative to the rate two years prior to childbirth, while the husband's employment rate is largely unchanged. The right panel of the same figure indicates that the wife's working hours (conditional on employment) decrease by an average of 11.54 hours per week after childbirth, whereas the husband's working hours do not experience a significant change.



(a) Labor force participation

(b) Weekly working hours (conditional on employment)

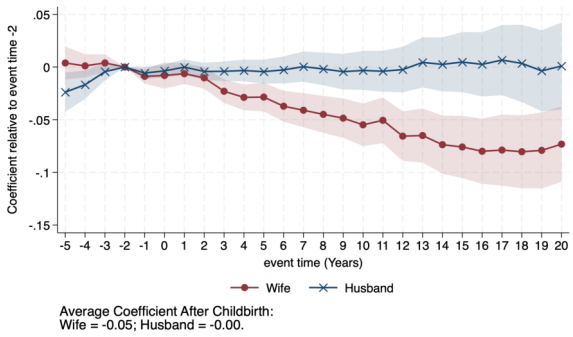
Figure B.4: Labor Force Participation and Working Hours of Husbands and Wives

The left panel of Figure B.5 shows that the wife's hourly wage decreases by an average of 50 yen after childbirth, while the husband's wage remains constant. The right panel reveals that the wife's weekly labor earnings decrease by 35,880 yen after childbirth, which drives a fall of 29,540 yen in weekly household earnings.

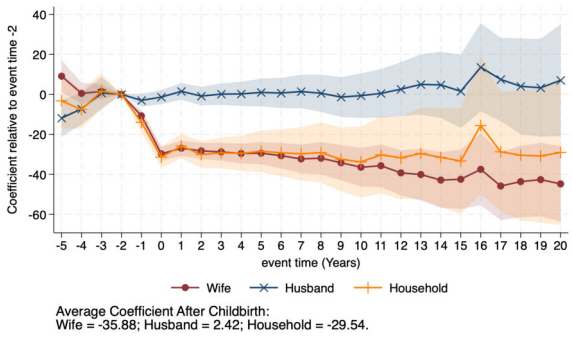
The left panel of Figure B.6 shows that following childbirth, weekly private consumption falls by 2,270 yen for the wife. Relative to the husband, the wife's weekly private consumption decreases by 41 percentage points, as depicted in the right panel.

The left panel of Figure B.7 shows that the wife's weekly leisure decreases by 9.94 hours after having a child, while the husband's leisure decreases by 4.76 hours per week. Furthermore, there is a significant increase in the wife's leisure at event time = -1, reflecting her need for rest and preparation for pregnancy before childbirth. The wife's leisure relative to the husband's drops by eight percentage points after childbirth, as shown in the right panel.

The left panel of Figure B.8 shows that over the twenty years following childbirth, the wife's weekly home production time on average increases by 32.49 hours while the husband's

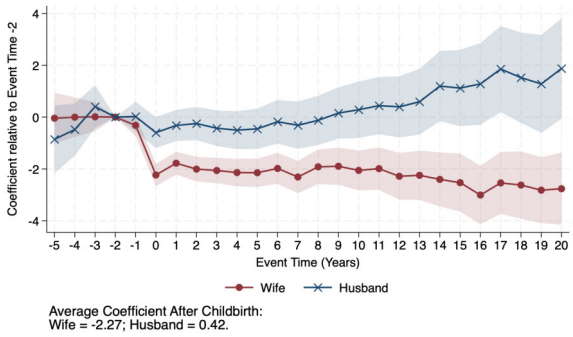


(a) Hourly wage
(conditional on employment)

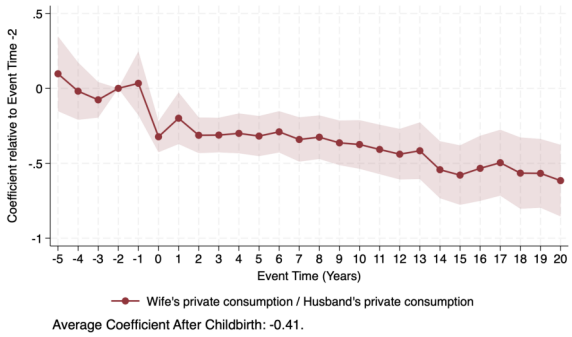


(b) Weekly labor earnings

Figure B.5: Wage Rates and Labor Earnings of Husbands and Wives

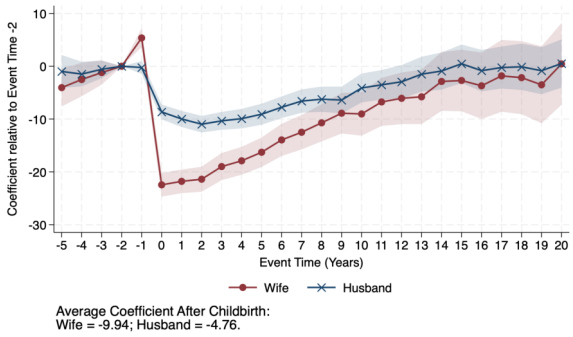


(a) Weekly private consumption



(b) Wife's weekly private consumption
(relative to husband)

Figure B.6: Private Consumption of Husbands and Wives



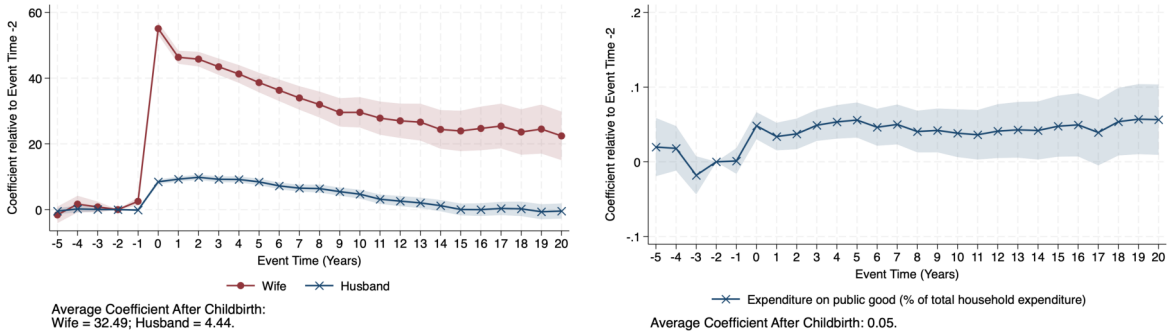
(a) Weekly leisure

(b) Wife's weekly leisure
(relative to husband)

Figure B.7: Leisure of Husbands and Wives

weekly home time increases by only 4.44 hours. Before the first birth, husbands' average home time is only 3.53 hours per week, much lower than the 24.55 hours for wives. Wives experience a larger increase in the number of hours spent in home production compared to husbands. However, since husbands' home production time is much lower than wives before the first birth, the percentage increase is larger for husbands.

The right panel of Figure B.8 shows that the household's public expenditure as a share of total expenditure increases by 5 percentage points after childbirth.



(a) Weekly home production time (b) Expenditure on public good

Figure B.8: Home Production Time and Public Expenditure

B.3 Heterogeneous Effects in Relative Private Consumption and Leisure

We examine the heterogeneity in the response of a wife's private consumption relative to her husband's, as well as her leisure relative to her husband's, by analyzing the gender of the first child and the maximum number of children women have in the observed periods. Figure B.9 indicates that the effects on both relative private consumption and leisure are more pronounced when the first child is a girl compared to when the first child is a boy, which aligns with the son-preference culture prevalent in Asia. Additionally, Figure B.10 shows that the effect of the first child on relative private consumption and relative leisure is slightly larger for women with two or more children compared to those with one child. This may be because their outcomes reflect the accumulated effects of having additional children.

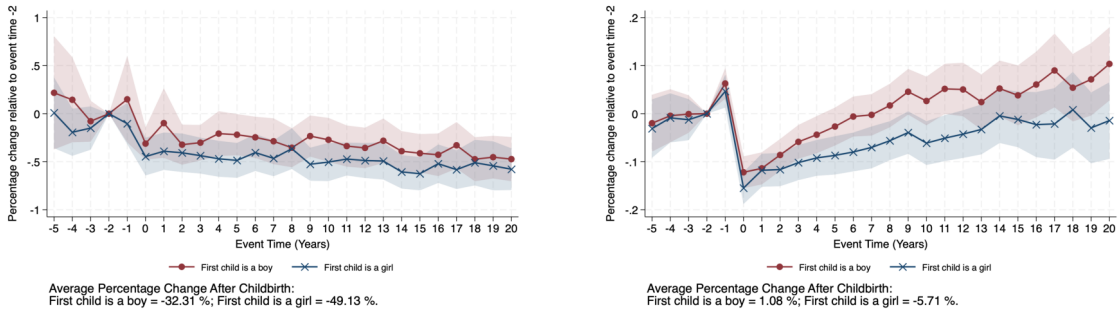


Figure B.9: Relative Private Consumption and Leisure by the Gender of First Child

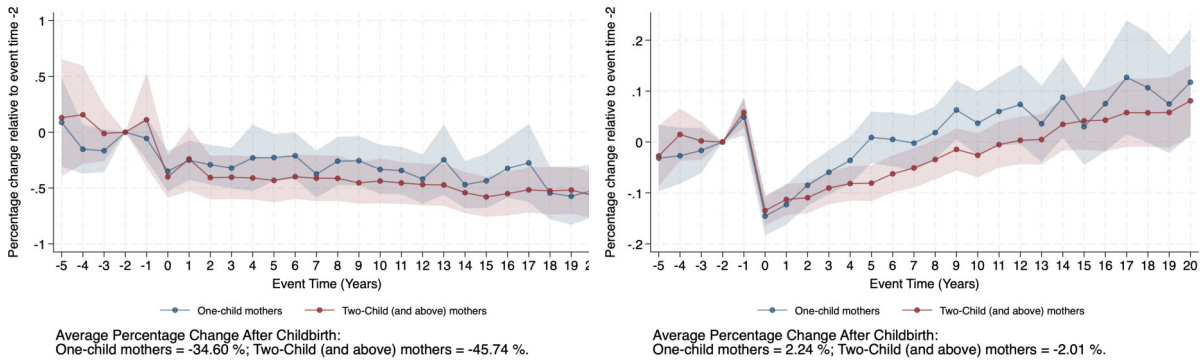


Figure B.10: Relative Private Consumption and Leisure by the Number of Children

C Model Appendix

C.1 Alternative Functional Forms

In this section, we consider an alternative functional form for individual utilities, a CRRA specification with separable preferences, which is used in Gayle and Shephard (2019). We show that in this case, the relative consumption between wives and husbands only depends on their Pareto weights.

The individual utilities are given by:

$$u(c,\ell,Q)=\frac{c^{1-\sigma_c}-1}{1-\sigma_c}+\beta_\ell\frac{\ell^{1-\sigma_\ell}-1}{1-\sigma_\ell}+\beta_Q\frac{Q^{1-\sigma_Q}-1}{1-\sigma_Q}.$$

Here the time subscript t is omitted for simplicity.

The household jointly determines the private consumption c_j, market purchased goods g, and leisure l_j, home production time h_j, and working time m_j, where $j\in\{W,H\}$ and y is non-labor income.

$$\begin{aligned}\underset{g,\{c_j,l_j,h_j,m_j\}_{j=W,H}}{max}\quad & (1-\mu)\left[\frac{c_H^{1-\sigma_c^H}-1}{1-\sigma_c^H}+\beta_\ell^H\frac{\ell_H^{1-\sigma_\ell^H}-1}{1-\sigma_\ell^H}+\beta_Q^H\frac{Q^{1-\sigma_Q^H}-1}{1-\sigma_Q^H}\right]\\ & +\mu\left[\frac{c_W^{1-\sigma_c^W}-1}{1-\sigma_c^W}+\beta_\ell^W\frac{\ell^{1-\sigma_\ell^W}-1}{1-\sigma_\ell^W}+\beta_Q^W\frac{Q^{1-\sigma_Q^W}-1}{1-\sigma_Q^W}\right]\end{aligned}$$

subject to

$$Q=Q(h_H,h_W,g)$$

$$\ell_j+h_j+m_j=T$$

$$c_H+c_W+g=w_Hm_H+w_Wm_W+y$$

Based on Equation (2) and Equation (3) derived in Section 4, we derive the MRS between the wife's and the husband's private consumption (c_{Wt} and c_{Ht}) in Equation (C.1) and the MRS between the wife's and the husband's leisure (ℓ_{Wt} and ℓ_{Ht}) in Equation (C.2):

$$\frac{(c_W)^{\sigma_c^W}}{(c_H)^{\sigma_c^H}} = \frac{\mu}{1-\mu} \tag{C.1}$$

$$\frac{(\ell_W)^{\sigma_\ell^W}}{(\ell_H)^{\sigma_\ell^H}} = \frac{\mu}{1-\mu}\frac{w_H}{w_W}\frac{\beta_l^W}{\beta_l^H} \tag{C.2}$$

There are two important implications: first, when the Pareto weight μ increases, the wife's private consumption relative to the husband's increases, given fixed σ_c^W and σ_c^H. Second, the wife's leisure l_W increases with the Pareto weight μ, as well as with the relative preference for leisure $\frac{\beta_l^W}{\beta_l^H}$ and the relative wage $\frac{w_W}{w_H}$.

C.2 Empirical Specification

In this section, we specify the empirical structure of our parameters. In particular, we allow these parameters to vary across periods to capture the effects of fertility. Specifically, preferences (α_{kt}^j), Pareto weights (μ_t), and relative productivity (π_t) are modeled as functions of period dummy variables: 0–2 years after the first birth ($PostFirstBirth_{012}$, corresponding to $t = 1$), 3–5 years after the first birth ($PostFirstBirth_{345}$, corresponding to $t = 2$), and 6–8 years after the first birth ($PostFirstBirth_{678}$, corresponding to $t = 3$).

For the Pareto weight at period t, we use the following specification:

$$\mu_t = \frac{\exp(x_{\mu t})}{1+\exp(x_{\mu t})}$$

where

$$\begin{aligned} x_{\mu t} =& \beta_{\mu 1}(log(\frac{Age_W}{Age_H})) + \beta_{\mu 2}(log(\frac{w_{Wt}}{w_{Ht}})) \\ &+ \beta_{\mu 3} PostFirstBirth_{012} + \beta_{\mu 4} PostFirstBirth_{345} + \beta_{\mu 5} PostFirstBirth_{678} \end{aligned}$$

We consider the relative spousal ages and relative spousal current wages as distribution factors that can shift bargaining power. Additionally, we examine the direct effect of fertility on bargaining power. By including the $PostFirstBirth$ dummies, we can capture the impact of different stages of the post-birth period on the Pareto weights, while the pre-birth period serves as the reference period. It could also capture the potential effect of second or higher-order birth. In this specification, the Pareto weight is normalized to be one-half when spouses have the same age and wage prior to the first birth.[41]

Next, we model preference for consumption α_{1t}^j and leisure α_{2t}^j by gender using the follow-

[41] We have also considered adding spousal relative education as a distribution factor affecting the Pareto weight. However, the estimation results show that spousal relative education does not significantly affect the Pareto weight after controlling for spousal relative wages. Therefore, we do not include spousal relative education in the specification of μ_t.

ing specification:

$$\alpha_{kt}^{j} = \frac{\exp(x_{kt}^{j})}{1 + \exp(x_{1t}^{j}) + \exp(x_{2t}^{j})} \quad \text{for } k = 1, 2$$

where

$$\begin{aligned} x_{kt}^{j} =& \delta_{k0}^{j} + \delta_{k1}^{j} Age_{jt} + \delta_{k2}^{j} Edu_{jt} \\ &+ \delta_{k3}^{j} PostFirstBirth_{012} + \delta_{k4}^{j} PostFirstBirth_{345} + \delta_{k5}^{j} PostFirstBirth_{678}. \end{aligned}$$

In this specification, x_{kt}^{j} includes a constant term, age, education, and three time dummies. Since the sum of individual preferences must equal 1, the husband's and wife's preferences for public goods, α_{3t}^{j}, are also functions of age, education, and the three event time dummies related to the post-birth periods.

Furthermore, the relative productivity for public goods between husbands and wives is modeled as a function of the three event time dummies related to the post-birth periods:

$$\pi_t = \frac{\exp(x_{\pi t})}{1 + \exp(x_{\pi t})}$$

where

$$x_{\pi t} = \beta_{\pi 0} + \beta_{\pi 1} PostFirstBirth_{012} + \beta_{\pi 2} PostFirstBirth_{345} + \beta_{\pi 3} PostFirstBirth_{678}.$$

The coefficients of $PostFirstBirth$ dummies capture whether the home productivity of husbands relative to wives changes after childbirth.

Lastly, the wages of the husband and the wife are also allowed to change after childbirth, which is captured by the $PostFirstBirth$ dummies. Additionally, wages are functions of individual fixed effects ϑ^{i} and potential experience exp_{jt}:[42]

$$\begin{aligned} \log w_{it} = \vartheta^{i} &+ \theta_{1}^{j} exp_{it} + \theta_{2}^{j} exp_{it}^{2} + \theta_{3}^{j} PostFirstBirth_{012} + \theta_{4}^{j} PostFirstBirth_{345} \\ &+ \theta_{5}^{j} PostFirstBirth_{678} + \theta_{6}^{j} PostFirstBirth_{8+} + \varepsilon_{it} \end{aligned} \tag{C.3}$$

where the coefficients are allowed to be different across gender $j \in \{W, H\}$. ϑ^{i} captures the time-invariant individual skills, such as education and ability, and ε_{it} are i.i.d. shocks.[43]

C.3 Mincer Equation

We use the Heckman two-stage method (Heckman, 1979) to correct for sample selection. The method involves a two-stage model, the working decision equation, and the wage equation.

[42] The differences in education result in differences in wages have already been fully reflected in the individual fixed effects ϑ^{i}. The potential experience a_{jt} is measured by age minus years of schooling minus 6 (i.e., the age at which formal schooling begins).

[43] To obtain a more accurate estimate of individual fixed effects, we use the entire sample observed in JPSC, rather than the (-5, 8) sample. To account for the effects of periods occurring eight or more years after the first birth, we incorporate a dummy variable, $PostFirstBirth_{8+}$.

In the first-stage model, we include two sets of variables. The first set includes variables X_{it} that simultaneously affect an individual's working decision and wages; these variables include age, education, and the $PostFirstBirth$ dummies. The second set Z_{it} comprises variables that exogenously shift the working decision rule but do not affect wages, such as spousal age, education, the number of children aged 0-6, and household size. The variables Z_{it} serve as instruments to identify the parameters in the two-stage model. The working decision equation is:

$$D_{it} = a_0' X_{it} + a_1' Z_{it} + v_{it}, \tag{C.4}$$

where (ϵ_{it}, v_{it}) are assumed to follow a joint normal distribution and ρ denotes the correlation of the two disturbances.

$$\begin{bmatrix} \epsilon_{it} \\ v_{it} \end{bmatrix} \sim N\left(\begin{bmatrix} 0 \\ 0 \end{bmatrix}, \begin{bmatrix} \sigma_\epsilon^2 & \rho\sigma_\epsilon\sigma_v \\ \rho\sigma_\epsilon\sigma_v & \sigma_v^2 \end{bmatrix} \right)$$

In the second stage, we use the control function approach to estimate the wage equation, incorporating the inverse Mills ratio (IMR) as a control variable in the second stage. Our results, shown in Column (2) of Table C.1, indicate that childbirth leads to a significant decline in wages for wives. The effect becomes more pronounced as children grow older, possibly due to the depreciation of the wife's human capital, the birth(s) of subsequent children, or the wife switching to more flexible occupations. Specifically, women with children experience a 6.5% wage cut compared to women without children when their children are between the ages of 0 and 2. This wage penalty increases to 19.5% when their children are between the ages of 6 and 8. In contrast, we find no significant impact of childbirth on the husband's wage rate, as shown in Column (4) of Table C.1.

A comparison of Columns (1) and (2) indicates that the coefficient for the wife's potential experience becomes larger after controlling for $PostFirstBirth$ dummies. This result suggests that the estimated return to experience for women could be biased if we ignore the negative effect of the first birth on women's wages. A regression that does not control for fertility underestimates the return to experience, as shown in Column (1).

C.4 Estimating Equations in GMM

The estimating equations are constructed based on the marginal rate of substitution (MRS) equations, following Lise and Yamada (2019). Here we list all the MRSs used in our estimation.

C.4.1 Home Production Technology

Moment condition (C.5) is the MRS between the wife's and the husband's home production time (h_{Wt} and h_{Ht}). The relative home production time is governed solely by the home production technology (π and γ) and the relative wage.

$$\left(\frac{\pi_t}{1-\pi_t}\right)\left(\frac{h_{Wt}}{h_{Ht}}\right)^{\gamma-1} = \frac{w_{Wt}}{w_{Ht}} \tag{C.5}$$

Table C.1: Mincer Equation Estimates

	Wife's wage rate		Husband's wage rate	
	(1)	(2)	(3)	(4)
Potential experience	0.011***	0.025***	0.046***	0.045***
	(0.002)	(0.003)	(0.001)	(0.001)
Potential experience (squared)	-0.00001	-0.00026***	-0.00084***	-0.00082***
	(0.000)	(0.000)	(0.000)	(0.000)
Post first birth (0–2 years)		-0.065*		0.011
		(0.038)		(0.009)
Post first birth (3–5 years)		-0.165***		0.015
		(0.031)		(0.010)
Post first birth (6–8 years)		-0.195***		0.011
		(0.029)		(0.011)
Post first birth (8+ years)		-0.173***		0.021
		(0.029)		(0.013)
Constant	-2.515***	-2.584***	-2.319***	-2.312***
	(0.034)	(0.042)	(0.017)	(0.021)
Individual FE	✓	✓	✓	✓
Inverse Mills Ratio	✓	✓	✓	✓
R-Squared	0.655	0.657	0.731	0.731

Note: The table presents the Mincer wage equation estimates for wives and husbands. Potential experience is measured as age minus years of schooling minus 6 (i.e., the age at which formal schooling begins). We include four 'PostFirstBirth' dummies in the equation. Standard errors are shown in parentheses. * $p < 0.10$ ** $p < 0.05$ *** $p < 0.01$

Moment conditions (C.6) and (C.7) are the MRS between individual home production time (h_{jt}) and market-purchased inputs (g).

$$\pi_t(\frac{\rho}{1-\rho})(\frac{h_{Wt}^{\gamma-1}}{G_t})g_t = w_{Wt} \tag{C.6}$$

$$(1-\pi_t)(\frac{\rho}{1-\rho})(\frac{h_{Ht}^{\gamma-1}}{G_t})g_t = w_{Ht} \tag{C.7}$$

where $G_t = \pi_t h_{Wt}^{\gamma} + (1-\pi_t)h_{Ht}^{\gamma}$.

C.4.2 Private Consumption and Leisure

Moment conditions (C.8) and (C.9) are the MRSs between individual private consumption (c_{jt}) and leisure (ℓ_{jt}).

$$\frac{\alpha_{1t}^W}{\alpha_{2t}^W}(\frac{c_{Wt}}{\ell_{Wt}})^{\phi^W-1} = \frac{1}{w_{Wt}} \tag{C.8}$$

$$\frac{\alpha_{1t}^H}{\alpha_{2t}^H}(\frac{c_{Ht}}{\ell_{Ht}})^{\phi^H-1} = \frac{1}{w_{Ht}} \tag{C.9}$$

Moment condition (C.10) is the MRS between the wife's and the husband's leisure (ℓ_{Wt}

and ℓ_{Ht}).

$$(\frac{\mu_t}{1-\mu_t})(\frac{A_{Wt}\alpha_{2t}^W \ell_{Wt}^{\phi^W-1}}{A_{Ht}\alpha_{2t}^H \ell_{Ht}^{\phi^H-1}}) = \frac{w_{Wt}}{w_{Ht}} \tag{C.10}$$

where $A_{jt} = [\alpha_{1t}^j c_{jt}^{\phi^j} + \alpha_{2t}^j \ell_{jt}^{\phi^j} + (1-\alpha_{1t}^j - \alpha_{2t}^j) q_t^{\phi^j}]^{\frac{1-\sigma^j-\phi^j}{\phi^j}}$.

Moment condition (C.11) is the MRS between the wife's and the husband's private consumption (c_{Wt} and c_{Ht}).

$$(\frac{\mu_t}{1-\mu_t})(\frac{A_{Wt}\alpha_{1t}^W c_{Wt}^{\phi^W-1}}{A_{Ht}\alpha_{1t}^H c_{Ht}^{\phi^H-1}}) = 1 \tag{C.11}$$

In general, the relative marginal utility of consumption between the wife and the husband depends on the entire allocation of hours and expenditure (A_{jt}), and is thus not independent of leisure and expenditure on public goods.

C.4.3 Public Consumption

Moment conditions (C.12) and (C.13) are the MRS between individual leisure (ℓ_{jt}) and home production time (h_{jt}).

$$\mu_t A_{Wt}\alpha_{2t}^W \ell_{Wt}^{\phi^W-1} = \pi_t \rho h_{Wt}^{\gamma-1} G_t^{\frac{\rho-\gamma}{\gamma}} g_t^{1-\rho} D_t \tag{C.12}$$

$$(1-\mu_t) A_{Ht}\alpha_{2t}^H \ell_{Ht}^{\phi^H-1} = (1-\pi_t) \rho h_{Ht}^{\gamma-1} G_t^{\frac{\rho-\gamma}{\gamma}} g_t^{1-\rho} D_t \tag{C.13}$$

where the household's marginal value of public consumption is $D_t = \mu_t A_{Wt}\alpha_{3t}^W Q_t^{\phi^W-1} + (1-\mu_t) A_{Ht}\alpha_{3t}^H Q_t^{\phi^H-1}$ and $\alpha_{3t}^j = 1 - \alpha_{1t}^j - \alpha_{2t}^j$.

Moment conditions (C.14) and (C.15) are the MRS between individual private consumption (c_{jt}) and market purchased inputs (g).

$$\mu_t A_{Wt}\alpha_{1t}^W c_{Wt}^{\phi^W-1} = (1-\rho) G_t^{\frac{\rho}{\gamma}} g_t^{-\rho} D_t \tag{C.14}$$

$$(1-\mu_t) A_{Ht}\alpha_{1t}^H c_{Ht}^{\phi^H-1} = (1-\rho) G_t^{\frac{\rho}{\gamma}} g_t^{-\rho} D_t \tag{C.15}$$

In Equations (C.5), (C.6), (C.7), (C.8), (C.9), and (C.10), if an individual's wage is not observed, we predict their potential wages using Equation (C.3), as discussed in Section 5.1. Consequently, the predicted wage serves as a measurement of the shadow price of time for non-working wives. Thus, we include both working and non-working individuals when estimating all the equations.[44]

[44] However, due to the fact that individuals may report their private consumption as zero, we drop the relevant MRSs for individuals with zero private consumption.

D Estimation Results Appendix

D.1 Summary Statistics of the Restricted Sample

Table D.1 presents summary statistics for the sample restricted to a time frame of five years before and eight years after the birth of the first child.

Within this restricted sample, the wife's average weekly private consumption is lower than the husband's (3290 yen vs. 6520 yen). Furthermore, wives spend an average of 90.95 hours per week on leisure, 55.17 hours on home production, and 20.72 hours on work and commuting. Meanwhile, husbands spend on average 93.47 hours per week on leisure, 10.20 hours on home production, and 63.75 hours on work and commuting.

Table D.1: Summary Statistics (JPSC 1993-2020)

	Mean	SD		Mean	SD
Household characteristics			*Household expenditure (per week)*		
Wife's age	33.23	4.30	Wife's private expenditure	3.29	3.36
Husband's age	34.70	5.03	Husband's private expenditure	6.52	4.95
Wife's education level (years of schooling)	14.09	1.65	Public expenditure	38.55	16.12
Husband's education level (years of schooling)	14.37	2.10			
Marriage-related characteristics			*Fertility-related characteristics*		
Wife's age at marriage	28.21	3.38	Wife's age at first birth	31.02	3.35
Husband's age at marriage	29.71	4.27	Husband's age at first birth	32.58	4.37
Household size (coresident)	3.42	1.19	Number of children	1.14	0.82
Time use (hours per week): wife			*Time use (hours per week): husband*		
Wife's work time	20.72	23.19	Husband's work time	63.75	12.10
Wife's home production time	55.17	28.34	Husband's home production time	10.20	8.45
Wife's leisure	90.95	20.86	Husband's leisure	93.47	13.77
Labor market performance: wife			*Labor market performance: husband*		
Wife's employment status	0.45	0.50	Husband's employment status	0.99	0.08
Wife's hourly wages	1.10	0.66	Husband's hourly wages	1.62	0.80
Wife's weekly earnings	21.91	33.62	Husband's weekly earnings	90.23	48.51

Note: The table presents descriptive statistics for the household sample constructed from the JPSC dataset (1993-2020). The sample comprises married couples within the (-5, 8) periods relative to the year of the birth of the first child. The sample consists of 748 unique household observations, with a total of 6390 household-year observations. All monetary values are reported in 2013 Japanese 1000 Yen. Standard deviations are shown in parentheses.

D.2 Heterogeneous Effects in Bargaining Power

In this section, we analyze whether the effect of childbirth on women's bargaining power varies by women's education and the gender of the first child. First, we interact the $PostFirstBirth$ dummies with a dummy variable indicating whether women have a college degree. This interaction term captures whether childbirth has a differential impact among high- and low-skilled women. The results in Table D.2 indicate that there is no significant difference in the drop of bargaining power between women with and without a college degree.

Second, we interact the $PostFirstBirth$ dummies with a dummy variable indicating whether the first child is a boy. The results in Table D.3 indicate that women with a boy and those with a girl experience a similar decline in their bargaining power.

Table D.2: GMM Parameter Estimates (By Wife's Education)

	Estimate	
Wife's Pareto weights		
$\beta_{\mu 1} : log(\frac{Age_W}{Age_H})$	-0.709***	(0.143)
$\beta_{\mu 2} : log(\frac{w_{Wt}}{w_{Ht}})$	0.559***	(0.015)
$\beta_{\mu 4}$: post first birth (0–2 years)	-0.732***	(0.135)
$\beta_{\mu 5}$: post first birth (3–5 years)	-0.587***	(0.181)
$\beta_{\mu 6}$: post first birth (6–8 years)	-0.373***	(0.135)
$\beta_{\mu 7}$: post first birth (0–2 years)*Wife with a college degree	0.136	(0.388)
$\beta_{\mu 8}$: post first birth (3–5 years)*Wife with a college degree	0.215	(0.589)
$\beta_{\mu 9}$: post first birth (6–8 years)*Wife with a college degree	0.165	(0.544)
Wife's preference for private goods		
δ_{10}^W: constant	-0.165	(0.164)
δ_{11}^W: wife's age	0.006	(0.005)
δ_{12}^W: wife's education	-0.000	(0.004)
δ_{13}^W: post first birth (0–2 years)	-0.228***	(0.045)
δ_{14}^W: post first birth (3–5 years)	-0.353***	(0.048)
δ_{15}^W: post first birth (6–8 years)	-0.474***	(0.058)
Wife's preference for leisure		
δ_{20}^W: constant	-0.668***	(0.108)
δ_{21}^W: wife's age	0.017***	(0.002)
δ_{22}^W: wife's education	-0.031***	(0.005)
δ_{23}^W: post first birth (0–2 years)	-0.420***	(0.021)
δ_{24}^W: post first birth (3–5 years)	-0.443***	(0.023)
δ_{25}^W: post first birth (6–8 years)	-0.451***	(0.029)
Husband's preference for private goods		
δ_{10}^H: constant	-0.310***	(0.114)
δ_{11}^H: husband's age	-0.007**	(0.003)
δ_{12}^H: husband's education	-0.012**	(0.006)
δ_{13}^H: post first birth (0–2 years)	-0.235***	(0.027)
δ_{14}^H: post first birth (3–5 years)	-0.226***	(0.033)
δ_{15}^H: post first birth (6–8 years)	-0.199***	(0.043)
Husband's preference for leisure		
δ_{20}^H: constant	-1.598***	(0.080)
δ_{21}^H: husband's age	0.010***	(0.002)
δ_{22}^H: husband's education	0.004	(0.004)
δ_{23}^H: post first birth (0–2 years)	-0.154***	(0.016)
δ_{24}^H: post first birth (3–5 years)	-0.131***	(0.020)
δ_{25}^H: post first birth (6–8 years)	-0.075***	(0.024)
Wife's home productivity		
$\beta_{\pi 0}$: constant	0.347***	(0.040)
$\beta_{\pi 1}$: post first birth (0–2 years)	-0.641***	(0.026)
$\beta_{\pi 2}$: post first birth (3–5 years)	-0.638***	(0.029)
$\beta_{\pi 3}$: post first birth (6–8 years)	-0.630***	(0.034)
Consumptions complementaity		
ϕ^W	0.144***	(0.008)
ϕ^H	0.113***	(0.009)
Home production		
γ: home production complementaity	0.808***	(0.019)
ρ: time's output elasticity in home production	0.091***	(0.005)

Table D.3: GMM Parameter Estimates (By the Gender of First Child)

	Estimate	
Wife's Pareto weights		
$\beta_{\mu 1}$: $log(\frac{Age_W}{Age_H})$	-0.705***	(0.146)
$\beta_{\mu 2}$: $log(\frac{w_{Wt}}{w_{Ht}})$	0.558***	(0.015)
$\beta_{\mu 4}$: post first birth (0–2 years)	-0.701***	(0.203)
$\beta_{\mu 5}$: post first birth (3–5 years)	-0.482**	(0.237)
$\beta_{\mu 6}$: post first birth (6–8 years)	-0.317*	(0.181)
$\beta_{\mu 7}$: post first birth (0–2 years)*First child is a boy	0.031	(0.361)
$\beta_{\mu 8}$: post first birth (3–5 years)*First child is a boy	-0.081	(0.445)
$\beta_{\mu 9}$: post first birth (6–8 years)*First child is a boy	-0.022	(0.312)
Wife's preference for private goods		
δ^W_{10}: constant	-0.569***	(0.192)
δ^W_{11}: wife's age	0.006	(0.005)
δ^W_{12}: wife's education	0.029***	(0.009)
δ^W_{13}: post first birth (0–2 years)	-0.226***	(0.044)
δ^W_{14}: post first birth (3–5 years)	-0.346***	(0.047)
δ^W_{15}: post first birth (6–8 years)	-0.462***	(0.057)
Wife's preference for leisure		
δ^W_{20}: constant	-0.840***	(0.099)
δ^W_{21}: wife's age	0.016***	(0.002)
δ^W_{22}: wife's education	-0.019***	(0.005)
δ^W_{23}: post first birth (0–2 years)	-0.418***	(0.021)
δ^W_{24}: post first birth (3–5 years)	-0.438***	(0.023)
δ^W_{25}: post first birth (6–8 years)	-0.442***	(0.029)
Husband's preference for private goods		
δ^H_{10}: constant	-0.278**	(0.117)
δ^H_{11}: husband's age	-0.007**	(0.003)
δ^H_{12}: husband's education	-0.014**	(0.006)
δ^H_{13}: post first birth (0–2 years)	-0.234***	(0.027)
δ^H_{14}: post first birth (3–5 years)	-0.228***	(0.032)
δ^H_{15}: post first birth (6–8 years)	-0.199***	(0.041)
Husband's preference for leisure		
δ^H_{20}: constant	-1.573***	(0.080)
δ^H_{21}: husband's age	0.010***	(0.002)
δ^H_{22}: husband's education	0.003	(0.004)
δ^H_{23}: post first birth (0–2 years)	-0.154***	(0.017)
δ^H_{24}: post first birth (3–5 years)	-0.131***	(0.020)
δ^H_{25}: post first birth (6–8 years)	-0.076***	(0.024)
Wife's home productivity		
$\beta_{\pi 0}$: constant	0.340***	(0.040)
$\beta_{\pi 1}$: post first birth (0–2 years)	-0.642***	(0.026)
$\beta_{\pi 2}$: post first birth (3–5 years)	-0.639***	(0.029)
$\beta_{\pi 3}$: post first birth (6–8 years)	-0.629***	(0.033)
Consumptions complementaity		
ϕ^W	0.144***	(0.008)
ϕ^H	0.113***	(0.009)
Home production		
γ: home production complementaity	0.813***	(0.019)
ρ: time's output elasticity in home production	0.091***	(0.005)

D.3 Robustness Checks of GMM Estimates

To address concerns regarding the robustness of our estimations against varying functional form assumptions, we propose two alternative specifications. In the first specification, we define the Pareto weight μ_t, spousal preferences α_{kt}^j, and the home productivity π_t as functions of the number of children rather than the age of the first child. In the second specification, we adopt Lise and Yamada (2019) approach in defining μ_t. Under both specifications, the negative effects of fertility on the wife's bargaining power persist. Additionally, we observe consistent effects of childbirth on both husbands' and wives' preferences for private consumption and leisure, as well as on their respective home productivities. The welfare implications drawn from the two alternatives are consistent as well, bolstering confidence in our main findings.

D.3.1 Specification 1: Number of Children

In this specification, we replace the post-birth event time dummies with indicators representing the number of children in the household during a specific period; $Children_{1t}$, $Children_{2t}$ and $Children_{3t}$ indicate that the household has one child, two children, and three or more children, respectively, in a certain period t. Households without children at t are used as the reference group.

The number of children is treated as a discrete variable to capture the potential changes in the parameters associated with different family sizes. Specifically, we can capture the effect of children along two margins, i.e., the extensive margin (the presence of children) as well as the intensive margin (the number of children). Treating the number of children as a continuous variable would require assumptions about the linearity of effects, which may not hold in practice.

First, we model the Pareto weight at period t as $\mu_t = \frac{\exp(x_{\mu t})}{1+\exp(x_{\mu t})}$ where

$$\begin{aligned} x_{\mu t} =& \beta_{\mu 1}(log(\frac{Age_W}{Age_H})) + \beta_{\mu 2}(log(\frac{w_{Wt}}{w_{Ht}})) \\ &+ \beta_{\mu 3} Children_{1t} + \beta_{\mu 4} Children_{2t} + \beta_{\mu 5} Children_{3t} \end{aligned}$$

Second, we model preference for consumption and leisure by gender as

$$\alpha_{kt}^j = \frac{\exp(x_{kt}^j)}{1 + \exp(x_{1t}^j) + \exp(x_{2t}^j)} \quad \text{for } k = 1, 2$$

where x_{kt}^j includes a constant term, age, education, and three indicators of the number of children in the household (one child, two children, and three or more children).

Third, we model productivity in the production of public goods as

$$\pi_t = \frac{\exp(x_{\pi t})}{1 + \exp(x_{\pi t})}$$

where $x_{\pi t}$ includes three indicators of the number of children in the household (one child, two children, and three or more children).

The GMM results are shown in Table D.4 and the childbirth dynamics of bargaining power are shown in Figure D.1. The estimates of the wife's Pareto weights, the preferences for private goods and leisure for husbands and wives, and the wife's home productivity remain robust in this alternative specification. Compared to wives without children, wives with children have less bargaining power. The wife's bargaining power decreases by 38.29% after the first birth. The marginal effect of having an additional child exhibits an increasing trend; with each additional child, the wife's bargaining power further diminishes.

The welfare results, as estimated using the money metric welfare index, are presented in Figure D.2. Following the birth of the first child, the wife's welfare decreases by 13.38% while the husband's welfare increases by 7.43%. These estimates are similar to those generated by our baseline estimation of welfare changes (-12.16% versus 6.97%).

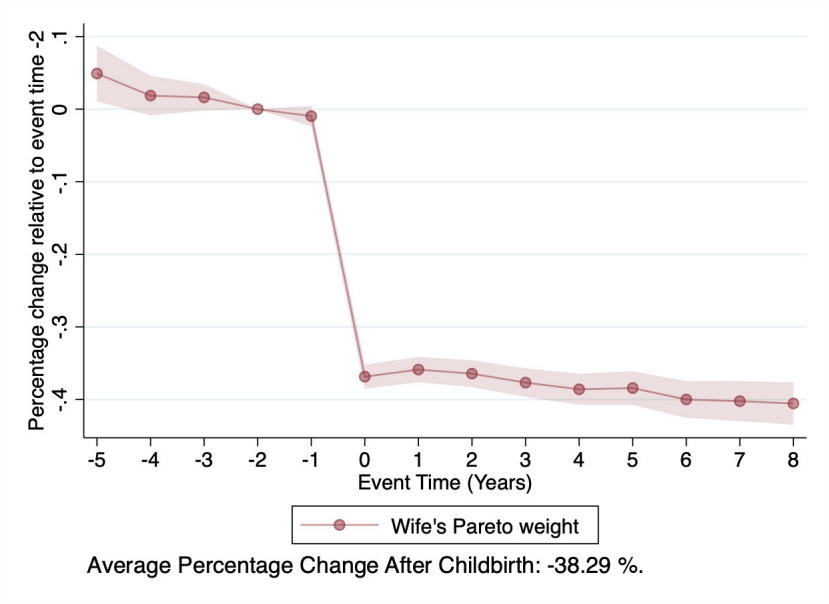


Figure D.1: The Dynamics of Bargaining Power (Alternative Specification: Number of Children)

D.3.2 Specification 2: Lise and Yamada (2019)

In this specification, to facilitate comparisons of the results of our Pareto weight with those obtained by Lise and Yamada (2019), we define the Pareto weight in period t as follows:

$$\mu_t = \frac{\exp(x_{\mu t})}{1 + \exp(x_{\mu t})}$$

Table D.4: GMM Parameter Estimates (Alternative Specification: Number of Children)

	Estimate	
Wife's Pareto weights		
$\beta_{\mu 1}$: $\log(\frac{age_W}{age_H})$	-0.611***	(0.129)
$\beta_{\mu 2}$: $\log(W_w)$	0.526***	(0.016)
$\beta_{\mu 3}$: $\log(W_h)$	-0.598***	(0.020)
$\beta_{\mu 4}$: Number of children = 1	-0.621***	(0.055)
$\beta_{\mu 5}$: Number of children = 2	-0.655***	(0.057)
$\beta_{\mu 6}$: Number of children ≥ 3	-0.730***	(0.125)
Wife's preference for private goods		
δ^W_{10}: constant	-0.567***	(0.171)
δ^W_{11}: wife's age	0.004	(0.004)
δ^W_{12}: wife's education	0.030***	(0.009)
δ^W_{13}: Number of children = 1	-0.228***	(0.043)
δ^W_{14}: Number of children = 2	-0.331***	(0.047)
δ^W_{15}: Number of children ≥ 3	-0.332***	(0.104)
Wife's preference for leisure		
δ^W_{20}: constant	-1.020***	(0.095)
δ^W_{21}: wife's age	0.022***	(0.002)
δ^W_{22}: wife's education	-0.020***	(0.005)
δ^W_{23}: Number of children = 1	-0.407***	(0.021)
δ^W_{24}: Number of children = 2	-0.445***	(0.025)
δ^W_{25}: Number of children ≥ 3	-0.591***	(0.053)
Husband's preference for private goods		
δ^H_{10}: constant	-0.109	(0.107)
δ^H_{11}: husband's age	-0.011***	(0.003)
δ^H_{12}: husband's education	-0.014***	(0.006)
δ^H_{13}: Number of children = 1	-0.224***	(0.029)
δ^H_{14}: Number of children = 2	-0.290***	(0.035)
δ^H_{15}: Number of children ≥ 3	-0.323***	(0.056)
Husband's preference for leisure		
δ^H_{20}: constant	-1.533***	(0.072)
δ^H_{21}: husband's age	0.010***	(0.002)
δ^H_{22}: husband's education	0.002	(0.004)
δ^H_{23}: Number of children = 1	-0.156***	(0.017)
δ^H_{24}: Number of children = 2	-0.168***	(0.020)
δ^H_{25}: Number of children ≥ 3	-0.215***	(0.037)
Wife's home productivity		
$\beta_{\pi 0}$: constant	0.329***	(0.039)
$\beta_{\pi 1}$: Number of children = 1	-0.596***	(0.029)
$\beta_{\pi 2}$: Number of children = 2	-0.668***	(0.032)
$\beta_{\pi 3}$: Number of children ≥ 3	-0.738***	(0.048)
Consumptions complementaity		
ϕ^W	0.144***	(0.010)
ϕ^H	0.119***	(0.011)
Home production		
γ: home production complementaity	0.816***	(0.018)
ρ: time's output elasticity in home production	0.092***	(0.004)

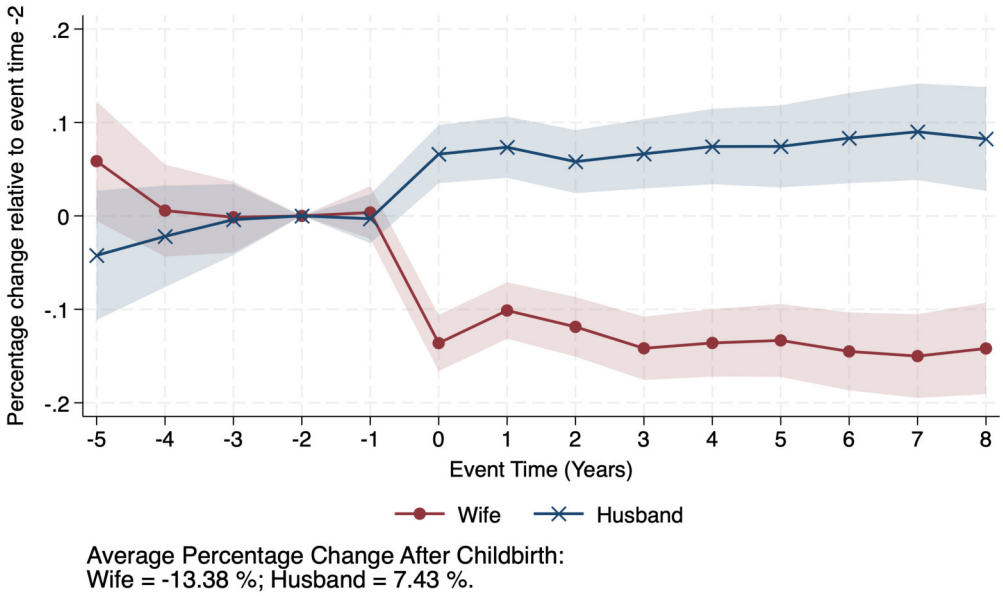


Figure D.2: Money Metric Welfare Indices (Alternative Specification: Number of Children)

where

$$x_{\mu t} = \beta_{\mu 1} log(\frac{w_{\hat{W}0}}{w_{\hat{H}0}}) + \beta_{\mu 2}(log(\frac{w_{\hat{W}10}}{w_{\hat{H}10}}) - log(\frac{w_{\hat{W}0}}{w_{\hat{H}0}})) + \beta_{\mu 3} log(Y_0) + \beta_{\mu 4}(log(\frac{w_{Wt}}{w_{Ht}}) - log(\frac{w_{\hat{W}t}}{w_{\hat{H}t}}))$$
$$+ \beta_{\mu 5} PostFirstBirth_{012} + \beta_{\mu 6} PostFirstBirth_{345} + \beta_{\mu 7} PostFirstBirth_{678}$$

We incorporate the following distribution factors: (1) the predicted relative wage between the wife and the husband at the time of marriage, denoted by $log(\frac{w_{\hat{W}0}}{w_{\hat{H}0}})$; (2) the predicted relative wage growth within 10 years between the wife and the husband, $log(\frac{w_{\hat{W}10}}{w_{\hat{H}10}}) - log(\frac{w_{\hat{W}0}}{w_{\hat{H}0}})$; (3) the logarithm of household income at the time of marriage, $log(Y_0)$; (4) the relative wage shock $\varepsilon_{Wt} - \varepsilon_{Ht} = log(\frac{w_{Wt}}{w_{Ht}}) - log(\frac{w_{\hat{W}t}}{w_{\hat{H}t}})$, where the individual wage shock $\varepsilon_{jt} = logw_{jt} - log\hat{w}_{jt}$ is calculated by the deviations between real wages and predicted wages in period t; and (5) the post-birth period dummies $PostFirstBirth_{012}$, $PostFirstBirth_{345}$ and $PostFirstBirth_{678}$. The first four factors align precisely with Lise and Yamada (2019), and the fifth factor is introduced to account for the impact of fertility on bargaining power.

We assume that the wage penalty cannot be anticipated at the time of marriage. Wage growth, $log(\frac{w_{\hat{W}10}}{w_{\hat{H}10}}) - log(\frac{w_{\hat{W}0}}{w_{\hat{H}0}})$, is computed based only on the return to potential experience. In the Mincer equation, the $PostFirstBirth$ dummies in the wage equation are considered as wage shocks observable in period t. Women face two types of wage shocks at period t. One is the normal wage shock, and the other is the wage penalty from having a child, which is reflected in the three $PostFirstBirth$ dummies.

For non-working wives, as their realized wages ($\log w_t$) and the associated wage shocks ($\varepsilon_{Wt} = logw_{Wt} - log\hat{w}_{Wt}$) are not directly observable, we employ the Heckman two-stage method to estimate their expected wage shock, ε_{Wt}. Conditional on the wife's working status,

their wage shock can be computed as follows:

$$IMR = E(\epsilon_{jt} \mid D_t) = \begin{cases} \rho\sigma_\epsilon \frac{\varphi((\hat{a}_0' X_{it} + \hat{a}_1' Z_{it})/\sigma_v)}{\Phi((\hat{a}_0' X_{it} + \hat{a}_1' Z_{it})/\sigma_v)} & \text{if } D_t = 1 \\ -\rho\sigma_\epsilon \frac{\varphi((\hat{a}_0' X_{it} + \hat{a}_1' Z_{it})/\sigma_v)}{1-\Phi((\hat{a}_0' X_{it} + \hat{a}_1' Z_{it})/\sigma_v)} & \text{if } D_t = 0 \end{cases}$$

where $D_t = 1$ means that wives are working and $D_t = 0$ means that wives are not working. The definitions of $\rho, \sigma_\epsilon, \sigma_v, X_{it}, Z_{it}$ follow the descriptions in Section 5.1. Therefore, non-working wives will experience a wage shock of $E(\varepsilon_{Wt} \mid D_t = 0)$. This approach enables us to account for the wage shock effect experienced by nonworking wives.

The GMM results are shown in Table D.5. Both the wage, $log(\frac{w_{\hat{W}0}}{w_{\hat{H}0}})$, and the wage growth within 10 years, $log(\frac{w_{\hat{W}10}}{w_{\hat{H}10}}) - log(\frac{w_{\hat{W}0}}{w_{\hat{H}0}})$, predicted at the time of marriage play a significant role in determining the initial Pareto weight. A higher wage and a higher wage growth for the wife relative to the husband correspond to increased bargaining power for the wife. The relative spousal wage shock, $log(\frac{w_{Wt}}{w_{Ht}}) - log(\frac{w_{\hat{W}t}}{w_{\hat{H}t}})$, also affect the wife's bargaining power. If the wife experiences a relatively positive wage shock compared to her husband, her bargaining power will increase. These findings replicate the main conclusions of Lise and Yamada (2019). Moreover, the post-birth relative event dummies are negatively correlated with the wife's bargaining power. The dynamics of bargaining power following childbirth are illustrated in Figure D.3. After the first birth, the wife's bargaining power decreases by 36.84%, which aligns with our baseline estimate of -34.30%.

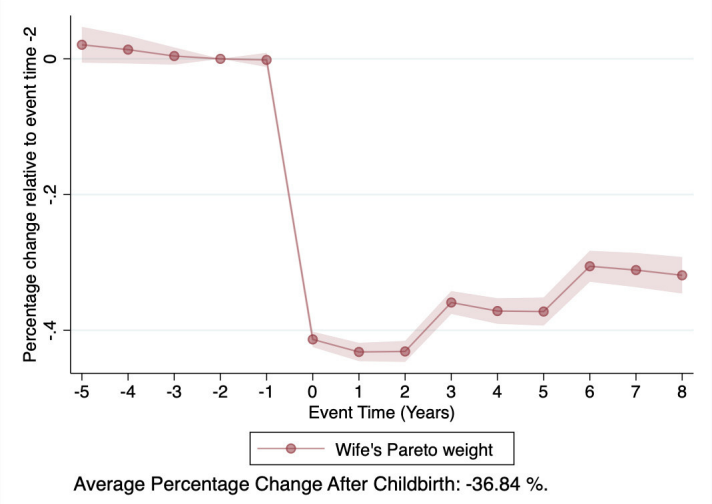


Figure D.3: The Dynamics of Bargaining Power (Alternative Specification: Lise and Yamada (2019))

The welfare results, estimated using the money metric welfare index, are depicted in Figure D.4. Following the birth of the first child, the wife's welfare decreases by 11.35% while the husband's welfare increases by 8.27%. These estimates closely resemble those obtained from our baseline estimation of welfare changes (-12.16% versus 6.97%).

Table D.5: GMM Parameter Estimates (Alternative Specification: Lise and Yamada (2019))

	Estimate	
Wife's Pareto weights		
$\beta_{\mu 1}: \omega_0^W - \omega_0^H$	0.372***	(0.021)
$\beta_{\mu 2}: \Delta\omega_{10}^W - \Delta\omega_{10}^H$	0.621**	(0.295)
$\beta_{\mu 3}: v_0$	0.058***	(0.016)
$\beta_{\mu 4}: \epsilon^W - \epsilon^H$	0.332***	(0.023)
$\beta_{\mu 5}$: post first birth (0–2 years)	-0.889***	(0.075)
$\beta_{\mu 6}$: post first birth (3–5 years)	-0.686***	(0.068)
$\beta_{\mu 7}$: post first birth (6–8 years)	-0.506***	(0.068)
Wife's preference for private goods		
δ_{10}^W: constant	-0.004	(0.059)
δ_{11}^W: wife's age	-0.005	(0.004)
δ_{12}^W: wife's education	0.008	(0.008)
δ_{13}^W: post first birth (0–2 years)	-0.161***	(0.048)
δ_{14}^W: post first birth (3–5 years)	-0.266***	(0.049)
δ_{15}^W: post first birth (6–8 years)	-0.358***	(0.057)
Wife's preference for leisure		
δ_{20}^W: constant	-0.748***	(0.109)
δ_{21}^W: wife's age	0.016***	(0.003)
δ_{22}^W: wife's education	-0.027***	(0.006)
δ_{23}^W: post first birth (0–2 years)	-0.370***	(0.022)
δ_{24}^W: post first birth (3–5 years)	-0.401***	(0.026)
δ_{25}^W: post first birth (6–8 years)	-0.403***	(0.032)
Husband's preference for private goods		
δ_{10}^H: constant	-0.077	(0.104)
δ_{11}^H: husband's age	-0.011***	(0.003)
δ_{12}^H: husband's education	-0.015**	(0.006)
δ_{13}^H: post first birth (0–2 years)	-0.280***	(0.030)
δ_{14}^H: post first birth (3–5 years)	-0.259***	(0.035)
δ_{15}^H: post first birth (6–8 years)	-0.232***	(0.043)
Husband's preference for leisure		
δ_{20}^H: constant	-1.460***	(0.093)
δ_{21}^H: husband's age	0.007***	(0.002)
δ_{22}^H: husband's education	0.004	(0.004)
δ_{23}^H: post first birth (0–2 years)	-0.165***	(0.018)
δ_{24}^H: post first birth (3–5 years)	-0.134***	(0.021)
δ_{25}^H: post first birth (6–8 years)	-0.077***	(0.026)
Wife's home productivity		
$\beta_{\pi 0}$: constant	0.538***	(0.042)
$\beta_{\pi 1}$: post first birth (0–2 years)	-0.667***	(0.028)
$\beta_{\pi 2}$: post first birth (3–5 years)	-0.674***	(0.031)
$\beta_{\pi 3}$: post first birth (6–8 years)	-0.659***	(0.036)
Consumptions complementaity		
ϕ^W	0.137***	(0.011)
ϕ^H	0.119***	(0.015)
Home production		
γ: home production complementaity	0.706***	(0.020)
ρ: time's output elasticity in home production	0.093***	(0.006)

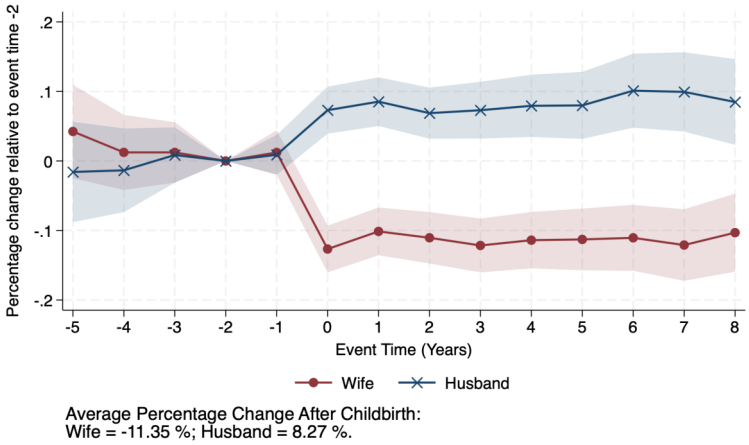


Figure D.4: Money Metric Welfare Indices (Alternative Specification: Lise and Yamada (2019))

D.4 Model Fit

Table D.6 presents the goodness of fit for the estimation. The results indicate that our model fits the data well in terms of consumption allocation and time use both before and after the first birth. To be concrete, the model predicts that after childbirth, the wife's private consumption, work time, and leisure decrease, while her home production time increases. The model also predicts that the husband's home production time increases and leisure decreases, while there is almost no change in his private consumption or work time. In addition, the model predicts an increase in public consumption. These findings are consistent with the patterns observed in the data.

Table D.6: Model Fit

	Before the first birth		After the first birth		Whole sample	
	(1)	(2)	(3)	(4)	(5)	(6)
	Data	Simulated	Data	Simulated	Data	Simulated
Intra-household expenditure (1000 yen per week)						
Wife's private consumption	4.41	5.92	2.94	3.55	3.29	4.12
Husband's private consumption	6.64	6.33	6.48	6.63	6.52	6.56
Public consumption	35.26	35.85	39.59	43.26	38.55	41.48
Time use (hours per week): wife						
Wife's work time	34.07	30.50	16.51	20.26	20.72	22.71
Wife's home production time	24.55	30.36	64.83	60.84	55.17	53.53
Wife's leisure	107.40	107.14	85.76	86.90	90.95	91.75
Time use (hours per week): husband						
Husband's work time	63.57	66.80	63.81	63.92	63.75	64.61
Husband's home production time	3.53	6.96	12.31	10.12	10.20	9.37
Husband's leisure	100.38	94.23	91.29	93.96	93.47	94.02
Observations	1532	1532	4858	4858	6390	6390

D.5 Estimate a Restricted Model Without the Change in the Bargaining Power

To enhance our identification argument, we re-estimate the model under the assumption that women's bargaining power remains constant after childbirth. The estimation outcomes are displayed in Table D.7, while the model fit is detailed in Table D.8.

The baseline model reveals a reduction in the preference for private consumption for both wives and husbands following childbirth, as indicated by the coefficients for the three post-first-birth dummies. Conversely, the restricted model indicates a substantial decrease in the preference for private consumption for wives post-childbirth, with only a minimal decline for husbands. This is because, in the absence of changes in bargaining power, the preferences for private consumption are the sole parameters influencing the changes in private consumption for wives and husbands. Similarly, in contrast to the baseline model, the restricted model demonstrates a more significant decline in the preference for leisure for wives and a smaller decrease for husbands.

The estimated parameters from the restricted model fail to predict the wife's home production time and leisure time post-childbirth to match the data. It predicts an increase in home production time that is lower than observed while underestimating the decline in leisure time. In Equation (C.12) in Appendix C.4, which outlines the MRS between the wife's leisure time and home production time, both bargaining power and the preference for leisure play a role in determining the relationship between leisure and home time. By neglecting the loss of bargaining power, we disregard that the husband uses his power to assign more home production tasks to the wife, thereby crowding out her leisure time. Consequently, the shift in preferences alone is insufficient to fully explain the observed trade-off between home production time and leisure for the wife. This suggests that a change in women's bargaining power is essential in predicting changes in consumption and time allocations for wives and husbands.

D.6 Women's Retrospective Efforts by Bargaining Power

We present evidence supporting our bargaining power estimates using women's retrospective responses to their efforts in the JPSC dataset. In the most recent survey wave (wave 2021), participants were asked:

> "*Looking back on your life, how much effort and awareness have you devoted to several topics?*"

The topics cover efforts devoted to housework and family, husband, and children's education. Women rated these topics on a five-point scale: Very excessive, somewhat excessive, just right, somewhat insufficient, and very insufficient. We compute women's average bargaining power across the study period and categorize them into low and high bargaining power groups based on the median. Figure D.5 displays the proportion of women reporting "very excessive" or "somewhat excessive" responses for each category.

Table D.7: GMM Parameter Estimates (No direct fertility effect on μ)

	Baseline		Restricted	
	Estimate	Standard Error	Baseline	Standard Error
Wife's Pareto weights				
$\beta_{\mu 1}$: $\log(\frac{\text{Age}_W}{\text{Age}_H})$	-0.702***	(0.141)	-0.618***	(0.128)
$\beta_{\mu 2}$: $\log(\frac{w_{Wt}}{w_{Ht}})$	0.557***	(0.015)	0.581***	(0.014)
$\beta_{\mu 4}$: post first birth (0–2 years)	-0.685***	(0.061)		
$\beta_{\mu 5}$: post first birth (3–5 years)	-0.522***	(0.057)		
$\beta_{\mu 6}$: post first birth (6–8 years)	-0.328***	(0.055)		
Wife's preference for private goods				
δ_{10}^W: constant	-0.556***	(0.186)	-0.372**	(0.169)
δ_{11}^W: wife's age	0.005	(0.005)	0.001	(0.004)
δ_{12}^W: wife's education	0.029***	(0.009)	0.032***	(0.009)
δ_{13}^W: post first birth (0–2 years)	-0.227***	(0.042)	-0.543***	(0.034)
δ_{14}^W: post first birth (3–5 years)	-0.345***	(0.046)	-0.550***	(0.041)
δ_{15}^W: post first birth (6–8 years)	-0.462***	(0.056)	-0.547***	(0.051)
Wife's preference for leisure				
δ_{20}^W: constant	-0.838***	(0.099)	-0.757***	(0.095)
δ_{21}^W: wife's age	0.016***	(0.002)	0.015***	(0.002)
δ_{22}^W: wife's education	-0.019***	(0.005)	-0.017***	(0.005)
δ_{23}^W: post first birth (0–2 years)	-0.417***	(0.021)	-0.569***	(0.016)
δ_{24}^W: post first birth (3–5 years)	-0.438***	(0.023)	-0.536***	(0.020)
δ_{25}^W: post first birth (6–8 years)	-0.444***	(0.029)	-0.479***	(0.025)
Husband's preference for private goods				
δ_{10}^H: constant	-0.277**	(0.114)	-0.264**	(0.104)
δ_{11}^H: husband's age	-0.007**	(0.003)	-0.008***	(0.003)
δ_{12}^H: husband's education	-0.014**	(0.006)	-0.016***	(0.005)
δ_{13}^H: post first birth (0–2 years)	-0.235***	(0.028)	-0.051**	(0.024)
δ_{14}^H: post first birth (3–5 years)	-0.227***	(0.032)	-0.078***	(0.028)
δ_{15}^H: post first birth (6–8 years)	-0.199***	(0.041)	-0.095***	(0.035)
Husband's preference for leisure				
δ_{20}^H: constant	-1.573***	(0.078)	-1.705***	(0.080)
δ_{21}^H: husband's age	0.010***	(0.002)	0.011***	(0.002)
δ_{22}^H: husband's education	0.003	(0.004)	0.003	(0.004)
δ_{23}^H: post first birth (0–2 years)	-0.154***	(0.017)	-0.051***	(0.016)
δ_{24}^H: post first birth (3–5 years)	-0.130***	(0.020)	-0.052***	(0.019)
δ_{25}^H: post first birth (6–8 years)	-0.075***	(0.024)	-0.032	(0.024)
Wife's home productivity				
$\beta_{\pi 0}$: constant	0.340***	(0.040)	0.332***	(0.041)
$\beta_{\pi 1}$: post first birth (0–2 years)	-0.641***	(0.026)	-0.596***	(0.026)
$\beta_{\pi 2}$: post first birth (3–5 years)	-0.638***	(0.029)	-0.599***	(0.028)
$\beta_{\pi 3}$: post first birth (6–8 years)	-0.628***	(0.033)	-0.601***	(0.033)
Consumption complementarity				
ϕ^W	0.144***	(0.008)	0.136***	(0.006)
ϕ^H	0.113***	(0.009)	0.169***	(0.008)
Home production				
γ: home production complementarity	0.812***	(0.018)	0.805***	(0.019)
ρ: time's output elasticity in home production	0.091***	(0.005)	-2.298***	(0.005)

Note: In the restricted model, wife's bargaining power does not change after childbirth, i.e., $\mu = \mu(\frac{Age_W}{Age_H}, \frac{w_{Wt}}{w_{Ht}})$.

Table D.8: Model Fit (No direct fertility effect on μ)

	Before the first birth			After the first birth			Whole sample		
	(1) Data	(2) Baseline	(3) Restricted	(4) Data	(5) Baseline	(6) Restricted	(7) Data	(8) Baseline	(9) Restricted
Intra-household expenditure (1000 yen per week)									
Wife's private expenditure	4.41	5.92	6.14	2.94	3.55	4.13	3.29	4.12	4.61
Husband's private expenditure	6.64	6.33	5.95	6.48	6.63	6.00	6.52	6.56	5.99
Public expenditure	35.26	35.85	35.58	39.59	43.26	43.06	38.55	41.48	41.27
Time use (hours per week): wife									
Wife's work time	34.07	30.50	30.56	16.51	20.26	19.14	20.72	22.71	21.88
Wife's home production time	24.55	30.36	29.11	64.83	60.84	55.49	55.17	53.53	49.16
Wife's leisure	107.40	107.14	108.33	85.76	86.90	93.37	90.95	91.75	96.96
Time use (hours per week): husband									
Husband's work time	63.57	66.80	66.39	63.81	63.92	64.74	63.75	64.61	65.14
Husband's home production time	3.53	6.96	7.61	12.31	10.12	12.50	10.20	9.37	11.32
Husband's leisure	100.38	94.23	94.00	91.29	93.96	90.76	93.47	94.02	91.54
Observations	1532	1532	1532	4858	4858	4858	6390	6390	6390

Note: In the restricted model, wife's bargaining power does not change after childbirth, i.e., $\mu = \mu(\frac{Age_W}{Age_H}, \frac{w_{Wt}}{w_{Ht}})$.

Our results reveal that women with lower bargaining power are more likely to perceive their effort and awareness to housework, their spouse, and their children's education as excessive, compared to those with higher bargaining power. If women's decisions are guided by their preferences, we would anticipate responses indicating "just right" or even "insufficient" effort. Thus, if our bargaining power estimates inaccurately reflect women's preferences, we would expect an equal distribution of "very excessive" or "somewhat excessive" responses across low and high bargaining power groups. However, this is not the case. This discrepancy suggests that women with lower bargaining power are much more likely to struggle to justify their efforts in home production than those with higher bargaining power.

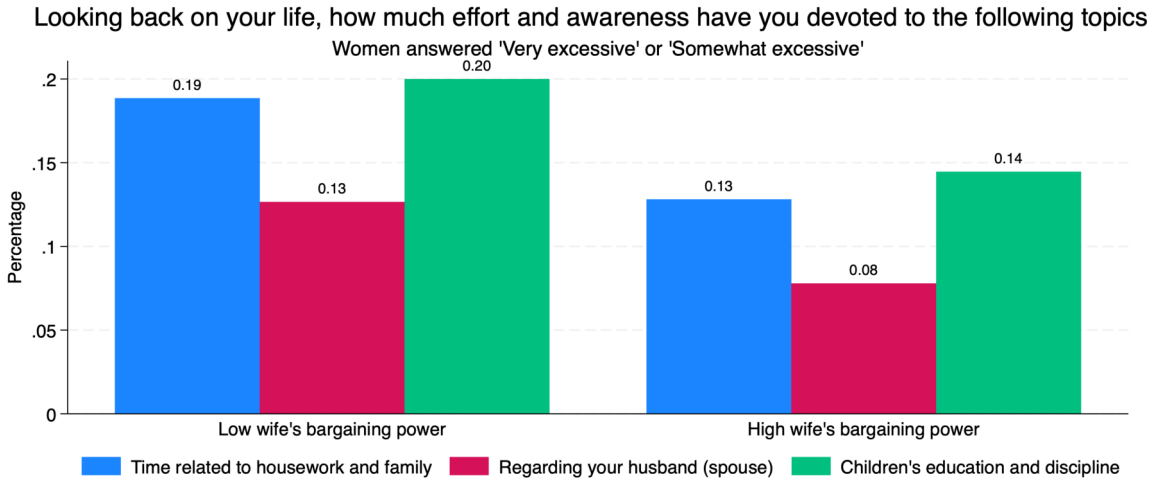


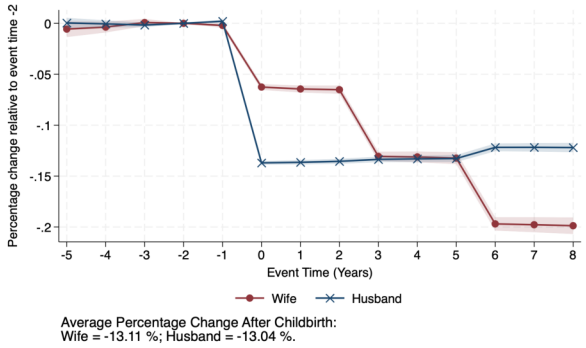
Figure D.5: Women's Retrospective Efforts by Bargaining Power

D.7 The Dynamics of Spousal Preferences and Home productivity

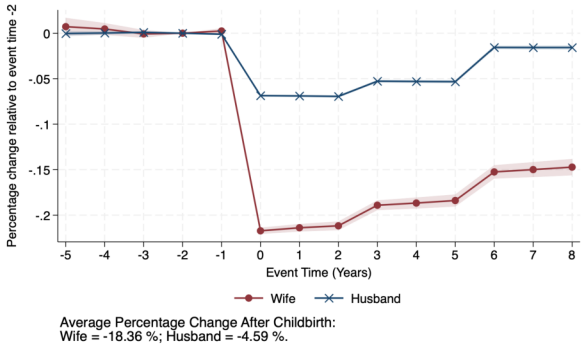
Using the event study approach described in Section 3, we plot the dynamics of estimated preferences for private goods, leisure, and public goods, as well as their relative home productivity around the time of the first birth.

The first three panels of Figure D.6 depict the dynamics of spousal preferences. In terms of the preference for private goods, both the wife and husband experience a similar decline over the eight-year period after childbirth (13.11% for wives vs. 13.04% for husbands). However, wives experience a larger decline in the preference for leisure compared to husbands (18.36% vs. 4.59%). Hence, the increase in the preference for public goods is greater for wives than for husbands (24.55% vs. 7.54%). Consequently, the decrease in the wife's relative private consumption is primarily driven by the reduction in her bargaining power. The decrease in the wife's relative leisure can be attributed to both the reduction in her bargaining power and a larger decline in the preference for leisure compared to the husband. The increase in spousal home production time and public expenditure can be explained by the rise in spousal preferences for public goods.

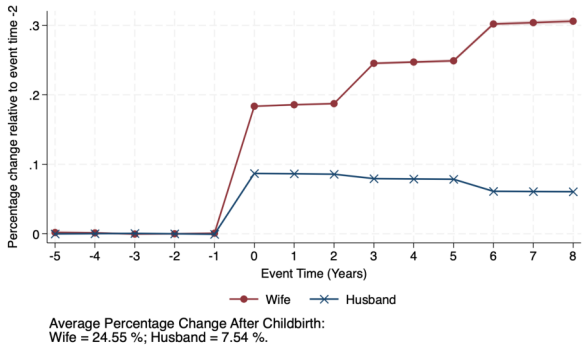
Furthermore, the lower right panel of Figure D.6 illustrates that the husband's relative productivity in home production increases by 37.90% after the arrival of the first child. This finding helps to explain the fact that husbands experience a larger percentage increase in home time compared to wives after childbirth.



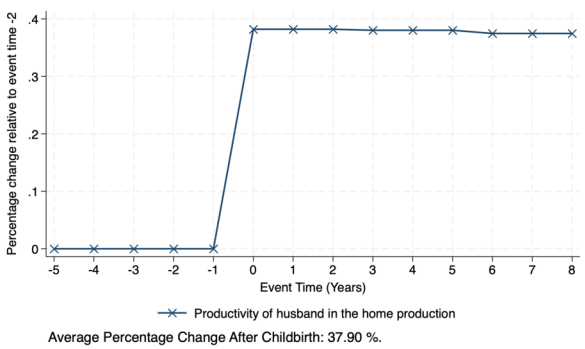
(a) Preference for private goods



(b) Preference for leisure



(c) Preference for public goods



(c) Home productivity of husband

Figure D.6: Childbirth Dynamics: Preferences and Home Productivity

D.8 The Sample Mean of GMM Estimates

Table D.9 presents the sample mean of the GMM parameter estimates before and after the first birth, including the wife's Pareto weight, preferences for various goods, and the husband's relative home productivity. Additionally, we perform t-tests to compare these means before and after childbirth. Note that the parameter estimates reported in the first column may differ slightly from those in Table 2 of Lise and Yamada (2019) because our analysis focuses specifically on the periods surrounding the first birth, and the sample restrictions differ accordingly.

Table D.9: GMM Parameter Estimates (Sample Mean)

	Event study sample	Before the first birth	After the first birth	Diff. (t-test)
Wife's Pareto weight				
μ	0.33	0.45	0.29	-0.16***
	(0.10)	(0.07)	(0.07)	(0.00)
Relative home productivity				
husband: π^H	0.54	0.42	0.57	0.16***
	(0.07)	(0.00)	(0.00)	(0.00)
Wife' preferences				
α_1^W: private goods	0.36	0.40	0.35	-0.05***
	(0.03)	(0.01)	(0.02)	(0.00)
α_2^W: leisure	0.19	0.21	0.18	-0.03***
	(0.02)	(0.01)	(0.01)	(0.00)
α_3^W: public goods	0.45	0.39	0.47	0.08***
	(0.04)	(0.01)	(0.02)	(0.00)
Husband' preferences				
α_1^H: private goods	0.24	0.27	0.23	-0.04***
	(0.02)	(0.01)	(0.01)	(0.00)
α_2^H: leisure	0.1669	0.1674	0.1667	-0.0007**
	(0.01)	(0.01)	(0.01)	(0.00)
α_3^H: public goods	0.59	0.56	0.60	0.04***
	(0.02)	(0.00)	(0.01)	(0.00)
Observations	6390	1532	4858	6390

Note: The estimates are evaluated at the sample mean. Standard deviation are reported in the parenthesis.

D.9 The Decomposition of the Pareto Weight

In Section 6.3, we evaluate the relative importance of the wage effect and the fertility effect in shaping the intertemporal dynamics of the wife's Pareto weight by comparing two versions of the wife's Pareto weight: (1) the wife's current Pareto weight μ_t; (2) the wife's Pareto weight $\mu_t' = \frac{\exp(x_{\mu t}')}{1+\exp(x_{\mu t}')}$ where the time-varying factors $x_{\mu t}'$ include relative spousal age and wage, defined as $x_{\mu t}' = \beta_{\mu 1}(log(\frac{Age_W}{Age_H})) + \beta_{\mu 2}(log(\frac{w_{Wt}}{w_{Ht}}))$.

In Table D.10, we present the relative wage effect and fertility effect across various post-

birth periods. In the early stages of the post-birth period, the fertility effect plays a significant role in reducing the wife's bargaining power, accounting for 79.02% – 81.86% of the decrease. However, as the first child grows older, the fertility effect becomes less significant, and the wage penalty becomes more prominent. When the first child reaches eight years old, the wage effect accounts for 41.15% of the decrease in bargaining power.

Table D.10: Relative Wage Effect and Fertility Effect

	Relative wage effect (%)	Fertility effect (%)
Event time = 0	20.98	79.02
Event time = 1	17.78	82.22
Event time = 2	18.14	81.86
Event time = 3	25.02	74.98
Event time = 4	26.71	73.29
Event time = 5	25.94	74.06
Event time = 6	39.76	60.24
Event time = 7	40.64	59.36
Event time = 8	41.15	58.85
Mean	28.46	71.54

Note: The estimates are evaluated at the sample mean.

E Welfare Analysis Appendix

E.1 The Calculation Procedure for MMWI

To compute the MMWI, we undertake the following procedure. First, based on the individual's current optimal solutions $(\tilde{c}_{Wt}, \tilde{c}_{Ht}, \tilde{g}_t, \tilde{\ell}_{Wt}, \tilde{\ell}_{Ht}, \tilde{h}_{Wt}, \tilde{h}_{Ht}, \tilde{m}_{Wt}, \tilde{m}_{Ht})$ within the household, we calculate the wife's indirect utility, $u^W_{Married}(\tilde{c}_{Wt}, \tilde{\ell}_{Wt}, Q_t(\tilde{h}_{Wt}, \tilde{h}_{Ht}, \tilde{g}_t))$, and the husband's indirect utility, $u^H_{Married}(\tilde{c}_{Ht}, \tilde{\ell}_{Ht}, Q_t(\tilde{h}_{Wt}, \tilde{h}_{Ht}, \tilde{g}_t))$.

Next, we consider a scenario where individuals live alone and produce the public good by themselves. In this scenario, we assume that the individual home production productivity, denoted as π_j, remains unchanged regardless of whether individuals produce Q_t on their own or with their partners. Hence, $\pi_W = \pi_t$ for the wife and $\pi_H = 1 - \pi_t$ for the husband. This assumption emphasizes the roles performed by both parents during childcare, which implies that their efficiency in raising children stays constant even if they are the sole childcare provider. Additionally, we assume that the home production time from their spouses is zero. Specifically, for individual $j \in \{W, H\}$, given their current wages w_{jt} and non-labor income levels y_{jt}, we

consider the following individual optimization problem:

$$
\begin{aligned}
\underset{c_{jt},g_{jt},\ell_{jt},h_{jt},m_{jt}}{\text{Max}} \quad & u^j_{Singled}(c_{jt},\ell_{jt},Q_t) = \frac{1}{1-\sigma^j}(\alpha^j_{1t}c^{\phi^j}_{jt} + \alpha^j_{2t}\ell^{\phi^j}_{jt} + (1-\alpha^j_{1t}-\alpha^j_{2t})Q^{\phi^j}_t)^{\frac{1-\sigma^j}{\phi^j}} \\
\text{subject to} \quad & Q(h_{jt},g_{jt}) = (\pi_j h^{\gamma}_{jt})^{\frac{\rho}{\gamma}} g^{1-\rho}_{jt} \\
& \ell_{jt} + h_{jt} + m_{jt} = T \\
& c_{jt} + g_{jt} = w_{jt}m_{jt} + y_{jt}
\end{aligned}
$$

where u^j_{Single} denotes the individual's utility function when living alone and producing the public good by themselves. The optimal solutions to this problem are denoted as $(c^*_{Wt}, g^*_{Wt}, \ell^*_{Wt}, h^*_{Wt}, m^*_{Wt})$ for the wife and $(c^*_{Ht}, g^*_{Ht}, \ell^*_{Ht}, h^*_{Ht}, m^*_{Ht})$ for the husband.

Finally, we calculate the MMWI for each individual as the minimum expenditure required to achieve the same level of utility in the single scenario as they would have in the married scenario. Specifically, for individual $j \in \{W, H\}$, the MMWI is given by:

$$
\begin{aligned}
MMWI_{jt} &= \underset{c^*_{jt},g^*_{jt},\ell^*_{jt},h^*_{jt},m^*_{jt}}{\text{Min}} \left(\begin{array}{c} c^*_{jt} + g^*_{jt} + w_{jt}(\ell^*_{jt} + h^*_{jt}) \\ \text{s.t. } u^j_{Singled}(c^*_{jt},\ell^*_{jt},Q_t(h^*_{jt},g^*_{jt})) \geq u^j_{Married}(\tilde{c}_{jt},\tilde{\ell}_{jt},Q_t(\tilde{h}_{Wt},\tilde{h}_{Ht},\tilde{g}_t)) \end{array} \right) \\
&= \underset{c^*_{jt},g^*_{jt},\ell^*_{jt},h^*_{jt},m^*_{jt}}{\text{Min}} \left(\begin{array}{c} w_{jt}T + y_{jt} \\ \text{s.t. } u^j_{Singled}(c^*_{jt},\ell^*_{jt},Q_t(h^*_{jt},g^*_{jt})) \geq u^j_{Married}(\tilde{c}_{jt},\tilde{\ell}_{jt},Q_t(\tilde{h}_{Wt},\tilde{h}_{Ht},\tilde{g}_t)) \end{array} \right)
\end{aligned}
$$

We find y_{jt} such that individuals can achieve exactly the same utility when living alone as they would when married, and $w_{jt}T + y_{jt}$ equals the MMWI.

E.2 Robustness Checks of MMWI

In Section 7, when computing the money metric welfare indices (MMWI), we make two assumptions regarding home production. Firstly, we assume that individual home production productivity, denoted as π_j, remains unchanged regardless of whether individuals produce Q_t on their own or with their partners. Hence, $\pi_W = \pi_t$ for the wife and $\pi_H = 1 - \pi_t$ for the husband. Second, we assume that the home production time input of the spouse is zero.

To examine whether our welfare results are sensitive to the two assumptions, we consider two alternative assumptions regarding home production. First, we specify the individual home production technology to be one ($\pi_W = \pi_H = 1$). Second, we analyze the analogous specification in Cherchye et al. (2012). All the welfare results in the baseline and the counterfactuals are shown in Table E.1. Panel A shows the results for the wife and Panel B shows the results for the husband. The first column shows the main measure used in Section 7, the second column shows the alternative measure using specification 1, and the third column shows the alternative measure using specification 2.

E.2.1 Specification 1: Individual Home Productivity $\pi_j = 1$

In this specification, we assume that the individual home production technology $\pi_W = \pi_H = 1$ when the individual is the sole producer of the public good. Thus, the home production function for individuals can be represented as $Q(h_{jt}, g_{jt}) = h_{jt}^{\rho} g_{jt}^{1-\rho}$. This alternative specification helps us rule out the concern that the increase in men's welfare in the baseline specification is driven by an increase in their home productivity.

Using this alternative specification, we found that the wife's welfare declines by 12.89%, while the husband's welfare increases by 7.98% during the post-birth period. These estimates align with those obtained from our baseline estimation (-12.16% vs. 6.97%).

In the first counterfactual analysis, which assumes no fertility or wage effects on the wife's bargaining power, the effect of childbirth on women's welfare increases from -12.89% in the baseline to -10.30%, while the welfare effect for husbands declines from 7.98% in the baseline to 3.01%. In the second counterfactual, when the wife does not encounter a wage penalty, the welfare effect for wives increases from -12.89% in the baseline to -4.80%. Meanwhile, the welfare effect for husbands also increases, from 7.98% in the baseline to 13.61%. Lastly, in the absence of both wage penalties for wives and any adverse fertility impact on bargaining power, the welfare effect increases to -1.83% for wives and 8.35% for husbands. These results are consistent with the findings using the baseline specification.

E.2.2 Specification 2: Cherchye et al. (2012)

We analyze an equivalent specification examined in Cherchye et al. (2012), where each individual maintains an identical home production time allocation as observed within the household, with 30% of the partner's allotted home production time remaining available for the production of public goods. This specification also requires the public goods to maintain the same level, so individuals need to increase public expenditure when they produce the public goods alone. Thereafter, we simulate the optimal private consumption and leisure required to match the individual utility level.

The main motivation behind considering this specification is to highlight the role of home production time for both wives and husbands in child-rearing. The reallocation of time is not entirely flexible due to two reasons: First, home production time, especially the time spent on childcare, cannot be perfectly substituted by public expenditure to achieve the same level of public goods — there is a minimum threshold of home production time required for childcare. Second, the presence of both parents is necessary and important for children's development. This specification captures these two key aspects and investigates how welfare implications change when the home production time of both spouses is taken into consideration.

To substantiate the individual optimization problem, let us consider the wife ($j = W$) as an example. At period t, the current optimal solutions within the household are denoted as $(\tilde{c}_{Wt}, \tilde{c}_{Ht}, \tilde{g}_t, \tilde{\ell}_{Wt}, \tilde{\ell}_{Ht}, \tilde{h}_{Wt}, \tilde{h}_{Ht}, \tilde{m}_{Wt}, \tilde{m}_{Ht})$. The original level of public goods are represented as $\tilde{Q}_t(\tilde{h}_{Wt}, \tilde{h}_{Ht}, \tilde{g}_t)$. When the wife is living alone and responsible for producing the public

goods, her home production time is fixed at $\tilde{h}_{Wt}$. Furthermore, she could gain home production time support from her husband due to co-parenting, while only 30% of her husband's home time can be used for home production. To maintain the same level of public goods as before, she needs to increase the public expenditure g^*_{Wt} such that $Q_t(\tilde{h}_{Wt}, 0.3\tilde{h}_{Ht}, g^*_{Wt}) = \tilde{Q}_t(\tilde{h}_{Wt}, \tilde{h}_{Ht}, \tilde{g}_t)$. Then, given the fixed levels of g^*_{Wt}, $\tilde{h}_{Wt}$, $\tilde{h}_{Ht}$, and $\tilde{Q}_t$, the wife's optimization problem can be expressed as follows:

$$
\begin{aligned}
\underset{c_{Wt},\ell_{Wt},m_{Wt}}{\text{Max}} \quad & u^W_{Singled}(c_{Wt}, \ell_{Wt}, \tilde{Q}_t) = \frac{1}{1-\sigma^W}(\alpha^W_{1t} c^{\phi^W}_{Wt} + \alpha^W_{2t} \ell^{\phi^W}_{Wt} + (1-\alpha^W_{1t}-\alpha^W_{2t})\tilde{Q}^{\phi^W}_t)^{\frac{1-\sigma^W}{\phi^W}} \\
\text{subject to} \quad & \tilde{Q}_t = (\pi_W \tilde{h}^{\gamma}_{Wt} + \pi_H (0.3\tilde{h}_{Ht})^{\gamma})^{\frac{\rho}{\gamma}} (g^*_{Wt})^{1-\rho} \\
& \ell_{Wt} + \tilde{h}_{Wt} + m_{Wt} = T \\
& c_{Wt} + g^*_{Wt} = w_{Wt} m_{Wt} + y_{Wt}
\end{aligned}
$$

where the wife chooses the optimal $c^*_{Wt}, \ell^*_{Wt}, m^*_{Wt}$ to maximize her utility. The MMWI will be calculated as the minimum expenditure required to achieve the same level of utility in the single scenario as she would have achieved in the married scenario. Specifically, for the wife ($j = W$), the MMWI is given by:

$$
MMWI_{Wt} = \underset{c^*_{Wt},\ell^*_{Wt},m^*_{Wt}}{\text{Min}} \left(\begin{array}{c} c^*_{Wt} + g^*_{Wt} + w_{Wt}(\ell^*_{Wt} + \tilde{h}_{Wt}) + 0.3 w_{Ht} \tilde{h}_{Ht} \\ \text{s.t. } u^W_{Singled}(c^*_{Wt}, \ell^*_{Wt}, \tilde{Q}_t) \geq u^W_{Married}(\tilde{c}_{Wt}, \tilde{\ell}_{Wt}, \tilde{Q}_t) \end{array} \right)
$$

The optimization problem for the husband is identical.

Note that the MMWI includes the value of spousal home production time, $0.3 w_{Ht} \tilde{h}_{Ht}$. Therefore, the welfare of wives estimated using this approach will be higher than that in the baseline model. We focus more on the changes in welfare when we shut down the effect of having a child on bargaining power or the wage penalty.

The last column of Table E.1 illustrates the welfare results following the specification in Cherchye et al. (2012). We find that the wife encounters a reduction in welfare of -6.15% after childbirth, in contrast to a 14.02% improvement in welfare experienced by the husband. Notably, these values of welfare effects are higher than our previous welfare assessments. A possible explanation is that we now include spousal time when calculating the MMWI in all periods. For wives, the home production time of the husband is increasing after childbirth while his wages are largely unchanged. Therefore, when we add the amount of $0.3 w_{Ht} h_{Ht}$ to calculate the minimum expenditure for wives to maintain the same individual utility level, we get a larger welfare effect for wives.

We apply this alternative specification to evaluate changes in welfare across three hypothetical scenarios. In the first scenario, where there is no effect on bargaining power, the effect of childbirth on wives' welfare increases from -6.15% in the baseline to -1.02%, while the effect of childbirth on husbands' welfare declines from 14.02% in the baseline to 10.39%. In the second scenario, where there are no wage penalties for women, the arrival of the first child leads to an

increase in welfare by 3.02% for wives and 21.48% for husbands. Lastly, in the third scenario, where there is neither a wage penalty nor a drop in the wife's bargaining power, the welfare effect is 8.92% for wives and 16.37% for husbands. In sum, the changes in welfare effect in the three counterfactuals are consistent with what we found in the baseline specification.

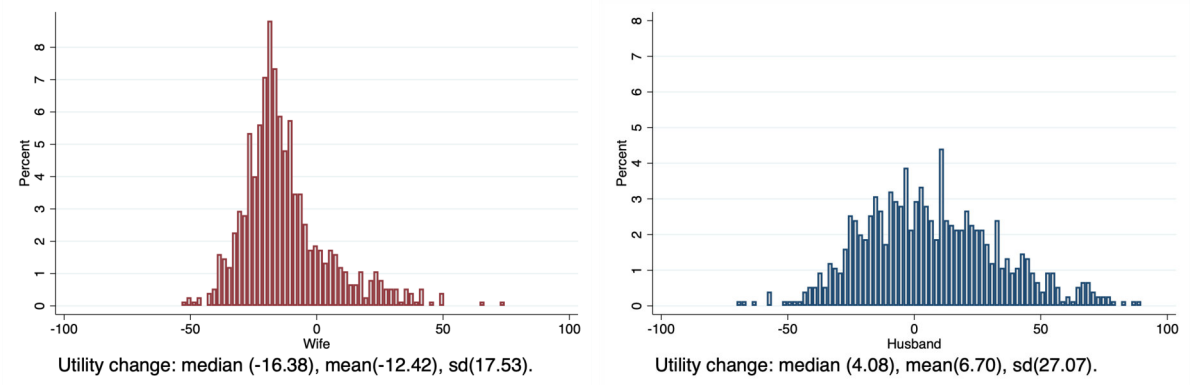
Table E.1: Welfare Changes After Childbirth: Alternative Specifications of MMWI

	Main Measure	$\pi_j = 1$	Cherchye et al. (2012)
Panel A: Wife			
Baseline	-12.16%	-12.89%	-6.15%
No effect on μ	-9.56%	-10.30%	-1.02%
No wage penalty	-1.78%	-4.80%	3.02%
No wage penalty + No effect on μ	0.50%	-1.83%	8.92%
Panel B: Husband			
Baseline	6.97%	7.98%	14.02%
No effect on μ	1.79%	3.01%	10.39%
No wage penalty	17.89%	13.61%	21.48%
No wage penalty + No effect on μ	13.91%	8.35%	16.37%

Note: The Table presents the welfare results using the alternative specifications of MMWI. In Specification 1, we assume that the individual home production technology $\pi_W = \pi_H = 1$ when the individual is the sole producer of the public good. In Specification 2, we assume that each individual maintains identical home time as observed within the household, with 30% of the partner's home time remaining available for home production.

E.3 Heterogeneity in the Welfare Effect of Childbirth

First, we present the distribution of the welfare changes for our sampled households. Figure E.1 shows that 81.82% of wives experience a decline in welfare during the post-birth period. The median wife encounters a 16.38% decrease in welfare after having a baby. In contrast, 56.68% of husbands experience an increase in welfare after having a baby. The median husband experiences a 4.08% rise in welfare following childbirth.

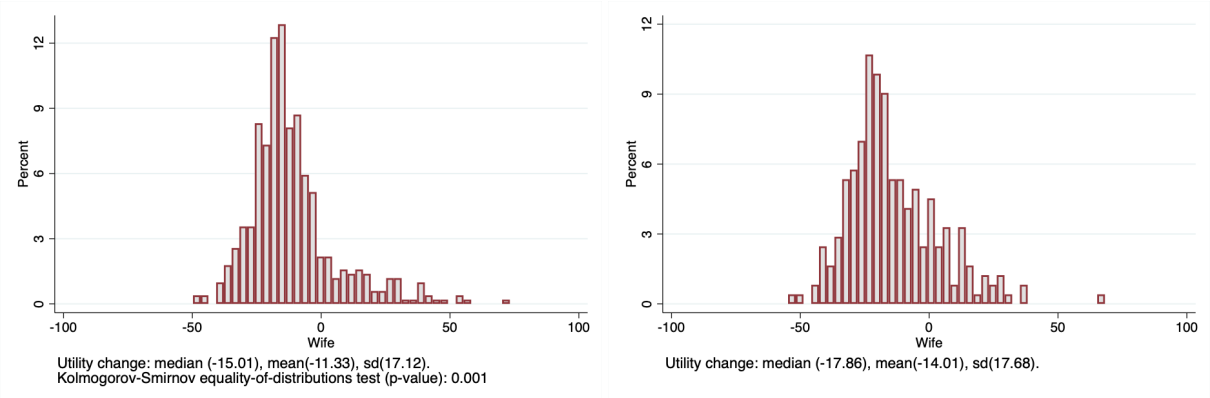


(a) Wife (b) Husband

Figure E.1: Distribution in Welfare Changes After Childbirth

Second, we examine the heterogeneity in welfare changes among wives, focusing on four characteristics: educational attainment, labor force participation before giving birth, birth cohort, and age at first birth.

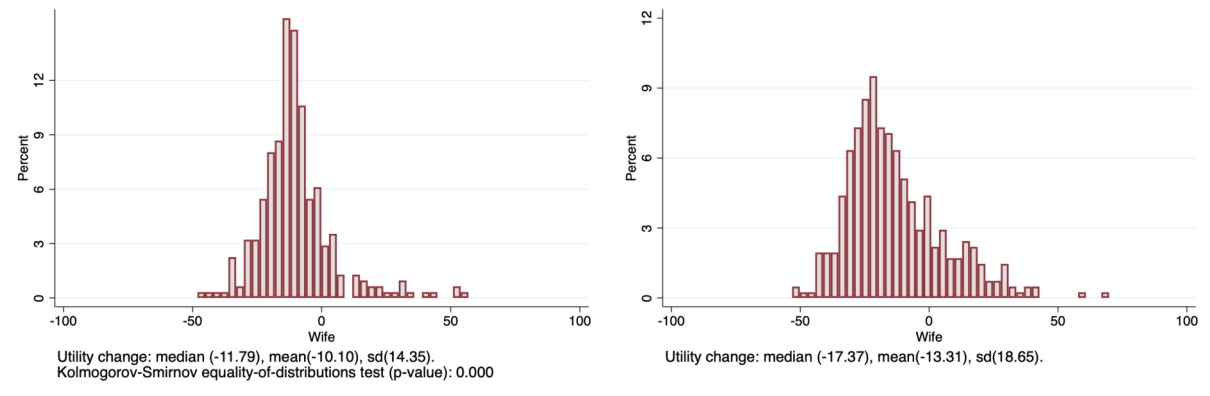
Figure E.2 compares college graduates with non-college graduates. College graduates experience a larger reduction in welfare than non-college graduates, both in terms of the median (-17.86% versus -15.01%) and the mean (-14.01% versus -11.33%). The two distributions exhibit significant differences based on the Kolmogorov-Smirnov test (p-value = 0.001).



(a) Wife without a college degree (b) Wife with a college degree

Figure E.2: Heterogeneity in Welfare Change Among Women (by Educational Attainment)

Figure E.3 classified women based on their employment status in the year preceding the first birth.[45] Women who worked before having their first child experienced a more pronounced decline in welfare following childbirth compared to those who had not worked (mean -13.31% vs. -10.10%). The two distributions are significantly different according to the Kolmogorov-Smirnov test (p-value = 0.000).

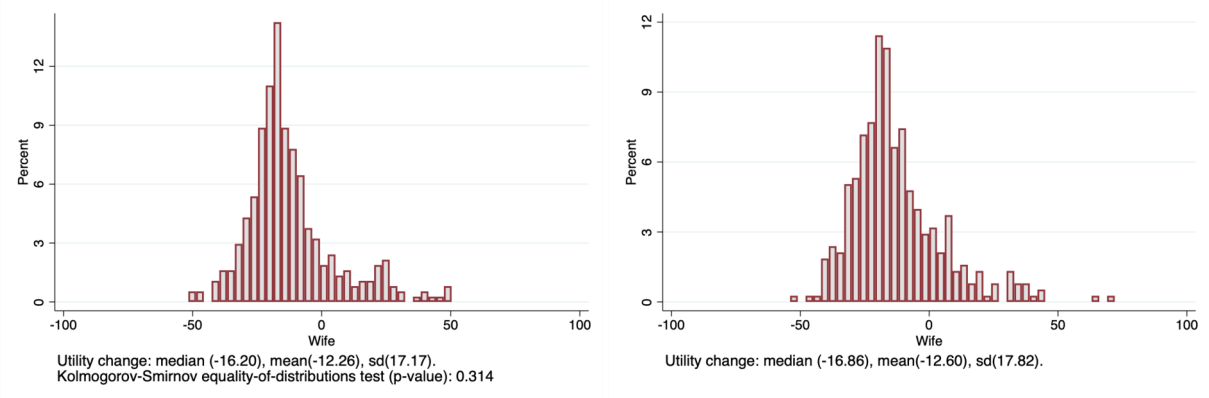


(a) Unemployed wife at $t = -1$ (b) Employed wife at $t = -1$

Figure E.3: Heterogeneity in Welfare Change Among Women (by Labor Force Participation Before Giving Birth)

[45] We chose this particular event time because 96.84% of women were observed at event time = -1, whereas only 58.14% could be traced back to event time = -2.

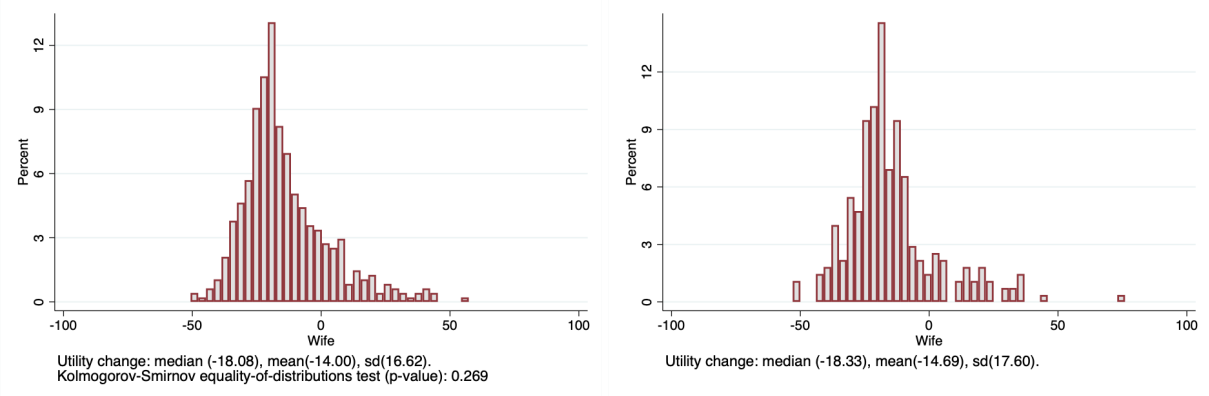
Figure E.4 categorizes women into two groups based on their birth cohorts, using the median year of 1976 as the reference point. On average, women born before 1976 experience a 12.26% reduction in their welfare following childbirth while women born in or after 1976 experience a decrease of 12.60%. There is no statistically significant difference between the two distributions of welfare changes (Kolmogorov-Smirnov test: p-value = 0.314).



(a) Wife born $<$ 1976 (b) Wife born $\geq$ 1976

Figure E.4: Heterogeneity in Welfare Change Among Women (by Birth Cohort)

Figure E.5 categorizes women based on their age at first birth, using the median age of 31 as the reference point. We find that women who give birth before or at the age of 31 experience an average decline in welfare of 14.00% while women who give birth after the age of 31 experience a decline of 14.69%. The differences between the two distributions of welfare changes are not statistically significant (Kolmogorov-Smirnov test: p-value = 0.269).



(a) Wife's age at the first birth $\leq$ 31 (b) Wife's age at the first birth $>$ 31

Figure E.5: Heterogeneity in Welfare Change Among Women (by Age at First Birth)

E.4 The Relationship between MMWI, Subjective Well-being, and the Divorce Rate

To provide further evidence in support of our welfare implications, we examine wives' life satisfaction, self-reported health status, current standard of living, and happiness using the JPSC data.

Regarding life satisfaction, women are asked, "Are you generally satisfied with your life?" They can choose from the options of 'Very much', 'Quite', 'Moderately', 'A little', and 'Not at all'. We classify the first three categories as indicating satisfaction. As illustrated in the upper left panel of Figure 6, the likelihood of women reporting satisfaction decreases by 5.08% after childbirth.

Concerning health status, women are asked, "Do you think you are in better physical condition than most people your age?" They can choose from the options of 'Much better than average', 'A little better than average', 'Average', 'A little below average', and 'Way below average'. The first two categories are classified as indicating good health. As shown in the upper right panel of Figure 6, the likelihood of women reporting good health decreases by 39.59% after childbirth.

We also investigate the impact of childbirth on the current standard of living. In the JPSC survey, women are asked, "How would you classify your standard of living?" We use a continuous measure that ranges from 1 to 5, where 1 indicates that the wife answered 'Bottom' and 5 indicates that the wife answered 'Top'. As depicted in the bottom left panel of Figure 6, the wife's reported standard of living experiences a decrease of 4.26% after the birth of the first child.

Lastly, we examine the effect of childbirth on happiness. In the JPSC survey, women are asked, "Do you feel that you are happy?" We employ a continuous measure that ranges from 1 to 5, where 1 indicates that the wife answered 'Very unhappy' and 5 indicates that the wife answered 'Very happy'. As illustrated in the bottom right panel of Figure 6, the birth of the first child reduces the wife's happiness by 3.70%. In sum, our study consistently demonstrates a negative impact of childbirth on women's subjective well-being, which is consistent with the existing literature.

Table E.2 displays the correlation between the estimated levels of the wife's MMWI and her subjective well-being indicators. Our findings reveal a positive correlation between the wife's MMWI levels and her reported physical health, life satisfaction, happiness, and current standard of living. These results suggest that our welfare measure effectively captures important dimensions of women's well-being.

Table E.2: Wives' MMWI, Health Status, and Life Satisfaction

	Wife			
	(1) Life satisfaction	(2) Feeling of happiness	(3) Current standard of living	(4) Physical health
Wife's MMWI/1000	0.310***	1.035***	2.567***	0.670***
	(0.107)	(0.323)	(0.334)	(0.215)
R-Squared	0.00638	0.0448	0.0306	0.0105
Observations	6390	6196	6303	4833

Note: We include the wife's age as a control variable. Standard errors are in parentheses. * $p < 0.10$ ** $p < 0.05$ *** $p < 0.01$

Table E.3 analyzes how women's MMWI and subjective well-being impact the probability of divorce in the following period. The results reveal that women reporting lower life satisfaction, unhappiness, and a reduced standard of living are significantly more likely to divorce in the subsequent period. In Column (6), after accounting for all subjective well-being measures, a lower MMWI is negatively associated with the likelihood of remaining married. These results suggest that MMWI and subjective well-being are crucial factors in predicting divorce.

Table E.3: Wives' MMWI, Subjective Well-being, and Divorce

	(1) Divorced	(2) Divorced	(3) Divorced	(4) Divorced	(5) Divorced	(6) Divorced
Wife's MMWI/1000 (lag)	-0.040					-0.067*
	(0.030)					(0.035)
Wife's Physical health (lag)		-0.003				0.002
		(0.006)				(0.005)
Wife's Life satisfaction (lag)			-0.017*			-0.008
			(0.009)			(0.008)
Wife's Feeling of happiness (lag)				-0.012**		-0.012***
				(0.005)		(0.004)
Wife's Current standard of living (lag)					-0.022***	-0.004
					(0.007)	(0.003)
Constant	0.012***	0.039***	0.049***	0.084***	0.099***	0.083***
	(0.005)	(0.002)	(0.008)	(0.021)	(0.020)	(0.021)
Individual FE	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓
R-Squared	0.184	0.635	0.491	0.514	0.504	0.198
Observations	6055	8911	11269	10844	11052	4489

Note: Standard errors are in parentheses. * $p < 0.10$ ** $p < 0.05$ *** $p < 0.01$

E.5 Interpreting Welfare Estimates: A Comparison with a Fully Dynamic Model

For the reader's interest, and to illustrate how the omission of certain components can lead to a more ambiguous welfare analysis, we present a fully-fledged dynamic model and compare it with our simplified dynamic framework. The simplified dynamic model only considers wealth accumulation, while the full model further captures children's human capital accumulation and parents' fertility decisions. In the full model, the household's utility in period t is expressed as a function of the asset A_{t-1}, the stock of public goods Q_{t-1}, and whether the household has a child D_{t-1} at the start of the period t:

$$V_t(A_{t-1}, Q_{t-1}, D_{t-1}) = \max_{c_{jt}, \ell_{jt}, h_{jt}, g_t, D_t} \mu_t V_t^W(A_{t-1}, Q_{t-1}, D_{t-1}) + (1-\mu_t) V_t^M(A_{t-1}, Q_{t-1}, D_{t-1})$$

$$V_t^j(A_{t-1}, Q_{t-1}, D_{t-1}) = u_t^j(c_{Wt}, \ell_{Wt}, Q_t | D_t) + b_t^j D_t + \beta V_{t+1}^j(A_t, Q_t, D_t)$$

Our simplified model includes $u_t^j(c_{jt}, \ell_{jt}, Q_t|D_t)$ in the individual value function, where individual j's current-period utility depends private consumption c_{jt}, leisure ℓ_{jt}, and public goods Q_t, conditional on whether has a child D_t.

There are two additional components absent from our model: $b_t^j D_t$ and $V_{t+1}^j(A_t, Q_t, D_t)$. First, b_t^j represents the non-pecuniary utility derived solely from the presence of children for individual j, including factors such as fertility preferences, emotional satisfaction, or fulfillment.[46] As b_t^W and b_t^H are additive to u_t^W and u_t^H, they do not directly impact intra-household resource allocations, making them difficult to identify solely from allocation choices.

Secondly, V_{t+1}^j represents individual utility in future periods, contingent upon the accumulated public goods by the end of period t (Q_t). Investments in public goods could yield benefits over time, particularly through the accumulation of children's human capital, which necessitates a dynamic specification. However, in the current framework, both short-term and long-term benefits are embedded within the per-period utility function $u_t^j(c_{jt}, \ell_{jt}, Q_t|D_t)$. This simplification may result in underestimating the returns associated with children in the long term.

F Conterfactural Analysis Appendix

F.1 Policy experiments

In this section, we explore how an explicit policy intervention would impact intrahousehold allocation and its welfare implications. We consider two policy experiments, childcare subsidies and paid maternity leave.

First, we examine the impact of childcare subsidies, which reduce the price of market inputs for the public good from 1 to 0.5 after childbirth.[47] The results of the intrahousehold resource allocation are presented in Table F.1. Column (2) reports the baseline model outcomes, where the price of the public good is set to 1, while Column (3) presents the new allocation when the price is reduced to 0.5.

The results in Column (3) indicate that lowering the price of the public good leads to a substantial increase in total public expenditure (public consumption multiplied by the price of public goods), rising from 43.26 thousand yen per week in the baseline to 68.69 thousand yen per week in the counterfactual scenario. Additionally, both spouses increase their labor supply while reducing the time allocated to home production. This adjustment suggests that when spouses have cheaper access to market substitutes for home production, such as hiring childcare services, they can be relieved of domestic responsibilities, enabling them to devote more time to the labor market. Specifically, the wife's work time exhibits a more considerable

[46] For instance, societal norms may indicate that women find fulfillment through having children, leading to a positive non-pecuniary utility for women (b_t^W). Similarly, if the husband strongly desires children, this could result in a positive b_t^H for men.

[47] However, the model does not distinguish between expenditures directly related to children and other public expenditures. As a result, the observed decline in the price of the composite public good could stem from reductions in the costs of various public expenditures, such as housing and utilities.

increase, rising from 20.26 to 34.71 hours per week, accompanied by a greater reduction in her home production time than her husband's. These findings imply that a childcare subsidy from the government could enhance women's labor force participation by alleviating the time burden of childcare.

We further evaluate the policy's impact on the welfare of the wife and husband following childbirth, as illustrated in Figure F.1. Relative to the baseline, the wife's welfare improves under the counterfactual, with the welfare loss decreasing from -12.16% to -5.48% when the costs of public goods are halved. The husband's welfare also increases, from a gain of 6.97% in the baseline to 13.44% in the counterfactual. While both spouses benefit from the policy, the welfare gap between them remains essentially unchanged, at approximately 75%. This persistence of welfare inequality suggests that, although a reduction in childcare costs enhances overall household welfare and the wife's labor market outcomes, it does not substantially change the underlying welfare disparities between the wife and the husband.

Table F.1: Counterfactual Analysis: Intrahousehold Allocation (Price of g_t = 0.5)

			After the first birth
	(1)	(2)	(3)
	Data	Baseline	Price of Public Goods Cut by Half
Intra-household expenditure (1000 yen per week)			
Wife's private expenditure	2.94	3.55	6.01
Husband's private expenditure	6.48	6.63	10.18
Public expenditure	39.59	43.26	68.69
Time use (hours per week): wife			
Wife's work time	16.51	20.26	34.71
Wife's home production time	64.83	60.84	51.86
Wife's leisure	85.76	86.90	81.43
Time use (hours per week): husband			
Husband's work time	63.81	63.92	73.88
Husband's home production time	12.31	10.12	8.18
Husband's leisure	91.29	93.96	85.95
Observations	4858	4858	4858

Note: In the baseline scenario, the price of public goods is set at $p_g = 1$. In the counterfactual scenario, the price of public goods is reduced to $p_g = 0.5$. Public expenditure is calculated as the product of public consumption and the price of public goods.

In addition to reducing childcare costs, we consider paid maternity leave, which is designed to support women's return to the workforce during early parenthood. In Japan, this policy typically comprises two key components (Yamaguchi, 2019). The first is cash benefits, whereby women receive a percentage of their pre-leave earnings while on parental leave. The second is job protection, which ensures that mothers of newborns can return to their pre-leave employ-

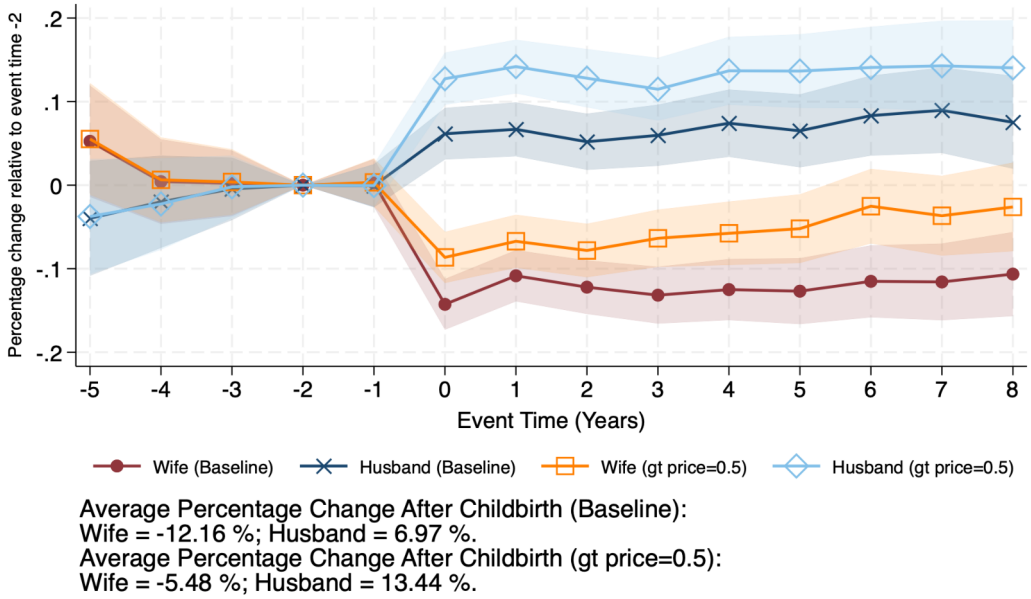


Figure F.1: Counterfactual Analyses: Welfare Changes After Childbirth (Price of $g_t = 0.5$)

ment sectors. Since case benefits only apply to the first year after a child's birth, their effects are only temporary and do not yield significant long-term improvements in women's welfare.

For the job protection component, our counterfactual experiment that eliminates the negative effect of childbirth on women's wages can serve as a proxy. In this scenario, we assume that women's potential wages remain unaffected by the arrival of children, implying that they can return to their original jobs without experiencing wage losses. In this counterfactual, women's working hours increase, and their welfare improves compared to the baseline. However, welfare inequality between spouses persists because women continue to face a decline in bargaining power after childbirth.

One limitation of these policy counterfactuals is that they assume the policies have no effect on bargaining power, which could lead to biased estimates on resource allocation and welfare inequality. For instance, childcare subsidies and maternity leave may alter men's and women's outside options, thereby influencing their bargaining power within the household. Since the current model does not account for this channel, the results should be interpreted with caution.

Appendix References

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