The Macroeconomic Effects of the American Families Plan: Does the Impact on Fertility Matter?

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Abstract

This paper quantifies the macroeconomic effects of the American Families Plan. In this analysis, the impact on fertility is particularly considered. I then develop a computable overlapping generations model with heterogeneous households in a general equilibrium framework. A key feature of this model is that the fertility choices of married couples are incorporated. The model also integrates tax credits and childcare subsidy programs. The simulation results indicate that the American Families Plan markedly boosts the fertility rate, coinciding with a rise in the labor force participation of married mothers. Such demographic shifts lead to positive long-run effects on most macroeconomic variables. The significant economic outcomes are primarily attributed to the effects on fertility. Without these effects, the improvements in macroeconomic variables are less significant. Moreover, these demographic changes have a significant impact on the transition dynamics. However, when the effects on fertility are taken into account, the welfare effect diminishes for both current and future generations.

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1 Introduction

In 2021, President Biden announced the American Families Plan. The goal of this plan is to ease the lives of American families by enhancing the U.S. social safety net.[1] The American Families Plan is a once-in-a-generation investment. More concretely, this plan primarily includes direct support for childcare and an expansion of tax credits.[2] This policy is expected to yield significant economic outcomes. For example, Collyer et al. (2021) report that the American Families Plan will lead to a substantial reduction in the national and child poverty rates. However, its macroeconomic effects have not been well studied yet.

The objective of this paper is to quantify the macroeconomic effects of the American Families Plan. Particularly, the effects on fertility are considered in this analysis. In the existing literature, most studies focus exclusively on women's labor supply, often neglecting fertility effects. Although a few studies analyze the effect on fertility, their results are mixed depending on the specific child-related transfer policies they focus on. For instance, Bick (2016) suggests that the effect is modest, whereas Fehr and Ujhelyiova (2013) indicate a significant increase in fertility. In light of these backgrounds, this paper addresses two key questions: i) Does fertility change if the American Families Plan is implemented? and ii) Does the change in fertility significantly affect macroeconomic and welfare outcomes?

To tackle this question, I develop a computable overlapping generations model in a general equilibrium framework, incorporating heterogeneous agents to capture the behaviors of both married couples and singles. The model is calibrated to accurately represent the current U.S. economy, effectively reproducing the labor force participation rate patterns of married couples, particularly married mothers, over the life cycle and mirrors the distribution of children. Subsequently, the model is used to simulate an economy with the implementation of the American Families Plan. The simulation results suggest that the American Families Plan significantly boosts both the fertility rate and the labor force participation rate of married mothers. This leads to positive long-run effects on most macroeconomic variables. More importantly, these economic outcomes can be attributed to the increase in the fertility rate. If this effect is excluded, the improvements in macroeconomic variables are less pronounced. Furthermore, these demographic shifts noticeably affect the transition dynamics of macroeconomic variables. However, the welfare impact is diminished for both current and future generations when the effect on fertility is considered.

[1] Details of the American Families Plan can be found on the White House website. For example, https://www.whitehouse.gov/briefing-room/statements-releases/2021/04/28/fact-sheet-the-american-families-plan/.

[2] Another policy which is beyond the scope of this paper is an additional four years of free, public education. More specifically, it includes free universal pre-school for all three- and four-year-olds and two years of free community college.

The model economy consists of three agents: households, firms, and the government. Men and women inherently differ in their education levels. Some are married, while others remain single throughout their lives. A key feature of this model is the inclusion of children within households. In this framework, only married couples can decide the number of children in the initial period. None of the single men and women is assumed to have children. When married couples have children, childcare costs are incurred only if the mothers are employed. On the other hand, they derive utility from having children. I assume that this benefit varies based on the number of children and the education levels of the wives. While working, households face idiosyncratic labor efficiency shock at the beginning of each period. Additionally, they might receive childcare subsidies and tax credits based on either their labor earnings or total incomes, another vital feature of my model. Regarding tax credits, there are three available programs: the Earned Income Tax Credit (EITC), the Child Tax Credit (CTC), and the Child and Dependent Care Tax Credit (CDCTC). In retirement, they receive Social Security benefits. To align with the current US Social Security program, my model incorporates spousal and survivor benefits. Last but not least, regardless of their work status, households receive lump-sum transfers from bequests. Based on these assumptions, households decide on consumption, labor supply, and assets. Firms produce two types of goods: homogeneous goods and childcare services. Homogeneous goods are produced using capital and labor inputs with constant returns to scale production technology, while childcare services rely solely on labor inputs. The government imposes taxes primarily to finance these expenditures, including Social Security, tax credits and childcare subsidies.

The model is initially solved for a stationary equilibrium to calibrate it to reflect the current US economy. The calibration results indicate that my model reasonably replicates patterns observed in the labor force participation rates of married couples over the life cycle, with specific emphasis on capturing the rates of married mothers, the proportion of elderly women receiving spouse and survivor benefits, and the distribution of number of children. Subsequently, using the calibrated model, I simulate an economy where the American Families Plan is implemented under two scenarios. The first scenario follows the baseline model, while the second scenario excludes the effect on fertility.

My simulation results indicate that the American Families Plan significantly increases the fertility rate. In the baseline model, the fertility rate stands at 1.511, while in the simulation it rises to 1.868. This increase is accompanied by a 9.222% rise in the labor force participation rate of married mothers. The mechanism behind these results is straightforward. As a result of the expansion of child-related transfers, a larger fraction of married mothers are able to work longer, enabling households to have more children. These demographic shifts increase all aggregate variables such as labor and consumption. However, an exception is aggregate capital, which decreases as a result of these demographic changes. Furthermore, expenditure on Social Security decreases, suggesting that the government does not need to impose an additional tax to balance the budget, even with the expansion of child credits and childcare subsidies. In contrast, transfers from bequests are reduced.

The significant economic outcomes can largely be attributed to the positive effects on fertility. To validate this, I conduct a simulation in which the fertility rate is held constant at the baseline level. Even in this scenario, the labor force participation rate of married mothers increases nearly at the same rate due to the expansion of tax credits and childcare subsidies. However, all macroeconomic variables except for aggregate capital per capita show a less significant rise in the absence of demographic changes. Conversely, government expenditures increase due to the expansion of child credits and childcare subsidies, necessitating the imposition of an additional tax.

The rise in the fertility rate instigates distinct transition dynamics of macroeconomic variables. In this analysis, the economy begins in a stationary equilibrium according to the baseline model. The government then announces the American Families Plan before a new cohort enters the economy. Under the scenario, the fertility rate and the labor force participation rate of married mothers jump and quickly reach the new stationary equilibrium level. However, since there is a delay before the children enter the economy, demographic changes are not immediate.

During this phase, households accumulate more assets. This is because households expect that transfers from bequests are reduced due to the demographic changes. Accordingly, they cannot sufficiently increase consumption despite the increase in the labor supply of married mothers, which leads to a higher additional tax on income. After the demographic shifts, total Social Security spending declines. Subsequently, the government no longer needs to impose an additional tax on income. Yet, the reduction in bequest transfers prompts households to draw down their asset holdings. In contrast, when the fertility rate effect is excluded, the economy is solely influenced by the rise in the labor force participation rate of married mothers. Thus, macroeconomic variable change modestly across the time.

Considering these simulation results, how does the welfare effect of the American Families Plan vary between the two scenarios? My calculations indicate that when the influence of fertility is incorporated, the long-run welfare effect for all household types diminishes. This reduction is predominantly due to the increase in population size. This demographic shift results in smaller lump-sum transfers for households, significantly lowering the welfare. The diminished bequest transfers also have a pronounced negative impact on the current generation's welfare. When the effect on the fertility rate is taken into account, most cohorts experience negative welfare effects, and the severity of these effects is more salient than when the effect on the fertility rate is excluded. Hence, it is crucial to consider the effects on fertility rate when assessing the economic and welfare outcomes of expanding child-related transfers.

This paper contributes to the existing literature on the effects of childcare costs and child-related transfers from a macroeconomic perspective.[3] In this literature, several papers focus on women's labor supply, neglecting the impact on fertility. Attanasio et al. (2008) argue that childcare costs significantly influence on mother's labor force participation rate. Hannusch (2019) suggests that child-related transfer programs contribute to the employment gap between married women with and without children across different countries. Domeij and Klein (2013) demonstrate that subsidizing daycare costs in Germany significantly increases mothers' labor supply and leads to the welfare gain. Lastly, Guner et al. (2020), which is the most closely related to my paper, show that the expansion of childcare subsidies and credits substantially increases women's labor supply, whereas expanding child credits reduces it in the US. However, all of these papers neglect the effect on fertility. There are a few exceptions. Fehr and Ujhelyiova (2013) contend that expanding public childcare can enhance both the woman labor force participation rate and fertility. In contrast, Bick (2016) asserts that extending subsidized childcare only modestly affects fertility.[4] However, none of these papers explore the subsequent ripple effects following changes in mother's labor supply and fertility. Therefore, the contribution of this paper is to examine the short- and long-run effects of childcare costs and child-related transfers on key macroeconomic variables, including fertility and mothers' labor supply.

This paper is also related to the research on the impact of family policies on fertility rates. Besides the studies by Fehr and Ujhelyiova (2013) and Bick (2016), a few empirical studies investigate the effect of child-care reform on fertility. Bauernschuster et al. (2016) examine the effects of expanding public childcare for children under the age of three in Germany. They find significant impacts on both fertility and woman employment. Rindfuss et al.(2010) show with data from Norway that increased availability of childcare significantly boosts fertility. This paper explores the same issue, using the American Families Plan as a case study.

[3]Some papers empirically examine the impact of childcare costs on woman labor supply. Examples of such studies include Heckman (1974), Hotz and Miller (1988), and Backer et al. (2008).

[4]More specifically, Bick (2016) examines two policy reforms introduced in Germany. The first reform provides access to subsidized childcare for all working mothers with children under the age of two. The second reform guarantees that all children aged zero to two can access subsidized childcare irrespective of their mother's employment status.

The rest of the paper is structured as follows. Section 2 presents the model, while Section 3 outlines the calibration strategy. In Section 4, the model is simulated for an economy where the American Families Plan is implemented, and the key findings of this paper are presented. Finally, Section 5 concludes.

2 Model

The model is based on a quantitative overlapping generations model. It features three types of agents: households, firms, and the government. A distinctive aspect of this model is that it includes both married couples and single individuals within the economy. Among these, some married couples have children and make decisions regarding their number. In contrast, none of the single individuals have children. Furthermore, child-related transfers are available, influencing consumption, savings, labor supply for women, and fertility decisions among married couples. In the following, the model environment is described, followed by a description of household problems, and the definition of a stationary equilibrium.

2.1 Demographics

Individuals are endowed with a gender, represented by g where $g \in \{m, f\}$, and an education level, denoted by edu. Before entering the economy, a woman meets a man. Some of these pairs are exogenously matched and subsequently decide on the number of children they desire. I assume that such marriages remain intact without any risk of divorce. Those who are not matched stay single throughout their lives. For the sake of simplicity, single men and women do not have children in this model. Let ω_{couple} and k represent the fractions of married couples and the number of children, respectively. It is assumed that all children are born in the same period and live with their parents for I periods. After these I periods, they become independent and enter the economy as new cohorts. Consequently, the size of these new cohorts is endogenously determined by the fertility decisions of married couples.

All individuals can live up to age J but face a mortality risk Φ_j^g in each age period j. I assume that this mortality risk is exogenously given and gender-specific. Let μ_{couple} and μ_{single}^g represent the distribution of married couples and singles. Note that μ_{couple} represents the distribution of married men and women, whereas widows and widowers are categorized under singles.

2.2 Labor Earnings

When each individual is employed, their labor earnings, denoted as e_j, are determined as follows:

$$e_j = w\eta_j^{g,edu}(\bar{e}_{j-1})\,\varepsilon^g l, \tag{1}$$

where w represents the market wage, $\eta_j^{g,edu}(\bar{e}_{j-1})$ is labor efficiency which depends on age, gender, and the education level, ε^g is the gender-specific idiosyncratic labor efficiency shock that follows a Markov process, and l denotes work hours. An important assumption is that $\eta_j^{g,edu}$ evolves endogenously, depending on the average past labor earnings up to $j-1$, denoted by $\bar{e}_{j-1}$; following Borella et al. (2022), $\bar{e}_{j-1}$ serves as a proxy for human capital. The specification of $\eta_j^{g,edu}$ will be described in the following section. ε^g is assumed to be exogenous, and labor supply, l, responds at both the extensive and intensive margins.

2.3 Childcare Costs

During the periods when children live with their parents, childcare costs are incurred only if the mothers are employed; otherwise, these costs are 0. Childcare costs are independent of the number of hours mothers work but vary based on i) the mothers' education level and ii) the age of the children. The price of childcare services is represented by p, and the total childcare cost in each period is pdk. Additionally, the government conditionally subsidizes these costs. In such cases, households are only responsible for a fraction, denoted by θ, with the government covering the remaining cost. In the current US system, childcare subsidies are means-tested. Let $\hat{y}$ denote the threshold level of income required for eligibility for these subsidies.[5]

2.4 Preferences

Households can accumulate one-period riskless assets to self-insure against risks. When a new cohort enters the economy, their initial asset level is assumed to be 0. The market interest rate for these assets is denoted by r. Households are not allowed to borrow. Married couples jointly value each member's consumption and leisure time. Let $u\left(c^m, c^f, l^m, l^f\right)$ denote a utility function where c^m and c^f consumption levels of the husband and the wife, respectively. Single individuals derive utility from their consumption, denoted as c^g and incur a utility loss from working, represented as l^g. Households' future utility is discounted at a constant

[5] Another condition for childcare subsidies is that the mothers must be employed. This condition is implicitly satisfied in my model, as the childcare costs are zero if the mothers are not working.

rate, denoted by β. While households incur expenses for children's consumption, it does not contribute to utility in my model. Instead, households derive utility, represented as $B\left(k, edu^f\right)$, from having k children. I assume that this utility depends on the education levels of women. The purpose of this assumption is to capture the evidence suggesting that highly educated women tend to have fewer children compared to men.[6]

Due to mortality risks, households may unintentionally leave assets behind. The government collects these bequests and redistributes them as lump-sum transfers, denoted by tr^*. Consequently, the amount of these transfers for married couples is $2 \times tr^*$.

2.5 Social Security

All individuals become eligible for Social Security when they reach age J_R. I assume that none of the individuals can claim Social Security earlier or later. The Social Security system operates as a pay-as-you-go pension scheme. In principle, Social Security benefits are calculated based on the average past earnings of individual members up to $J_R - 1$, denoted as $\bar{e}^g_{J_R-1}$. Additionally, married couples and widows/widowers may be conditionally entitled to spousal or survivor benefits. I will detail the specifics of the Social Security system and its calculations in the following section. For simplicity, all individuals exit the labor market after they begin collecting Social Security benefits and do not reenter.

2.6 Production Technology

Firms produce homogenous goods. The aggregate production function exhibits a constant return to scale:

$$Y = F(K, L) = AK^{\alpha} L_{goods}^{1-\alpha},$$

where A is the aggregate productivity, which is constant, K denotes aggregate capital, and L_{goods} is the aggregate labor for goods. Aggregate capital is depreciated by δ.

Taking the first-order conditions yields

$$A\alpha K^{\alpha-1} L_{goods}^{1-\alpha} - (r + \delta) = 0, \tag{2}$$

[6]This trend is evident in the June 2008 supplement of the Current Population Survey (CPS). For instance, among women with college education or higher, the average number of children is 1.788 if their male partners have less than a high school education, and 1.681 if the men have a college education or higher. Conversely, among men with a college education or higher, the average number of children is 2.027 when their female partners have less than a high school education.

and

$$A(1-\alpha)K^{\alpha}L_{goods}^{-\alpha}-w=0. \tag{3}$$

Aggregate labor is also used for childcare services, denoted by $L_{childcare}$. I assume that only a unit of labor is required for childcare services. Therefore, the price of childcare services, p, is equal to w to maximize their profits. I denote L as the total aggregate labor.

2.7 Fiscal Policy

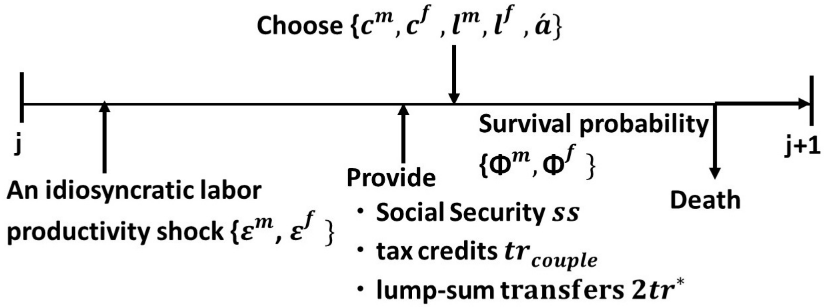
On the one hand, the government imposes various taxes. These taxes consist of the Social Security tax τ^{ss}, the consumption tax τ^{c}, and a progressive tax on total income τ^{I}. The Social Security tax is levied on labor earnings, and no additional tax is imposed if an individual's labor earnings exceed a maximum amount, represented by e^{ss}. Regarding the income tax, the incomes of married couples are filed jointly, in accordance with the US tax system. On the other hand, the government expenditures cover Social Security benefits, childcare subsidies for low-income families, tax credits, and consumption denoted as G. As for the tax credits, I take into account the EITC, the CTC, and the CDCTC. The total credits for married couples and singles are represented as tr_{couple} and tr^{g}_{single}, respectively. I will provide the details of the current tax credit programs in the following section.

2.8 Households' Problem

Households vary across several dimensions: the age j, the education levels$\left\{edu^m, edu^f\right\}$, assets a, the average past earnings $\left\{\bar{e}^m_{j-1}, \bar{e}^f_{j-1}\right\}$, idiosyncratic labor efficiency shocks $\left\{\varepsilon^m, \varepsilon^f\right\}$, and the number of children k. Let $\mathbf{x} = \left(j, edu^m, edu^f, a, \bar{e}^m_{j-1}, \bar{e}^f_{j-1}, \varepsilon^m, \varepsilon^f, k\right)$. In each period, they make optimal decisions regarding $\left\{c^m, c^f, l^m, l^f, a'\right\}$, where a' represents assets in the next period. Additionally, before entering the economy, married couples decide on the number of children they wish to have.

Figure 1 illustrates the timing of events for married couples. Initially, idiosyncratic labor efficiency shocks occur. Subsequently, households collect Social Security if they are older than j_R, and they receive tax credits denoted by tr_{couple}, along with lump-sum transfers from bequests, which are double the amount of tr^{*}. Subsequently, they jointly decide on consumption, labor supply, and assets. Before proceeding to the next period, members of the household may pass away, depending on their survival probabilities. Consequently, some married couples become widowed in the subsequent period. Singles experience similar

Figure 1: Model Timing for Married Couples



sequences of events.

I express households' problems recursively and separate them into two problems: married couples $V_{couple}(\mathbf{x})$ and singles $V^g_{single}(\mathbf{x})$. First, the value function for married couples $V_{couple}(\mathbf{x})$, is formulated as follows:

$$V_{couple}(\mathbf{x}) = \max_{\{c^m, c^f, l^m, l^f, a'\}} u\left(c^m, c^f, l^m, l^f\right) + \beta \left[\Phi^m_j \Phi^f_j \mathbb{E}\left[V_{couple}(\mathbf{x}')\right] + \right.$$
$$\left. \left(1-\Phi^m_j\right)\Phi^f_j \mathbb{E}\left[V^f_{single}(\mathbf{x}')\right] + \Phi^m_j\left(1-\Phi^f_j\right)\mathbb{E}\left[V^m_{single}(\mathbf{x}')\right]\right],$$

subject to

I) with children:

$$\begin{cases} (1+\tau^c)\left(c^m+c^f\right) + a' + \mathbf{1}_{j\leqq 3}\mathbf{1}_{l^f>0}\theta w d(\mathbf{x}) k(\mathbf{x}) = a(\mathbf{x}) + \tilde{y}(\mathbf{x}) + ss(\mathbf{x}) + tr_{couple}(\mathbf{x}) + 2tr^* & if\, e(\mathbf{x}) + ra(\mathbf{x}) < \hat{y}, \\ (1+\tau^c)\left(c^m+c^f\right) + a' + \mathbf{1}_{j\leqq 3}\mathbf{1}_{l^f>0} w d(\mathbf{x}) k(\mathbf{x}) = a(\mathbf{x}) + \tilde{y}(\mathbf{x}) + ss(\mathbf{x}) + tr_{couple}(\mathbf{x}) + 2tr^* & otherwise, \end{cases}$$

II) without children:

$$(1+\tau^c)\left(c^m+c^f\right) + a' = a(\mathbf{x}) + \tilde{y}(\mathbf{x}) + ss(\mathbf{x}) + tr_{couple}(\mathbf{x}) + 2tr^*,$$

$$\tilde{y}(\mathbf{x}) = \left(1-\tau^I\left[e(\mathbf{x})+ra(\mathbf{x})\right]\right)\left(e(\mathbf{x})+ra(\mathbf{x})\right) - \tau^{ss}\min\left\{e^m(\mathbf{x}), e^{ss}\right\} - \tau^{ss}\min\left\{e^f(\mathbf{x}), e^{ss}\right\},$$

$$a'(\mathbf{x}) \geq 0,$$

where $e(\mathbf{x}) \equiv e^m(\mathbf{x}) + e^f(\mathbf{x})$, $ss(\mathbf{x}) \equiv ss^m(\mathbf{x}) + ss^f(\mathbf{x})$, $\mathbf{1}_{j \leqq 3}$ and $\mathbf{1}_{l^f>0}$ are indicator functions that takes the value 1 if the age is less or equal to three and a wife is working, respectively. When married couples have children, they encounter one of two budget constraints, depending on whether their total income falls below $\hat{y}$. If this condition is satisfied, and the wives are working, they cover only θ of the childcare costs, being eligible for childcare subsidies. Otherwise, they are responsible for the entire amount. Moreover, as highlighted by the last constraint, households cannot borrow against future income.

Similarly, the value function for singles $V_s^g(\mathbf{x})$ is expressed as follows:

$$V_{single}^g(\mathbf{x}) = \max_{\{c^g, l^g, a'\}} u(c^g, l^g) + \beta\Phi_j^g \mathbb{E}\left[V_{single}^g(\mathbf{x}')\right],$$

subject to

I) with children:[7]

$$\begin{cases} (1+\tau^c)\,c^g + a' + \mathbf{1}_{j\leqq 3}\mathbf{1}_{l^g>0}\theta wd(\mathbf{x})\,k(\mathbf{x}) = a(\mathbf{x}) + \tilde{y}^g(\mathbf{x}) + ss^g(\mathbf{x}) + tr_{single}^g(\mathbf{x}) + tr^* & \textit{if } e^g(\mathbf{x}) + ra(\mathbf{x}) < \hat{y}, \\ (1+\tau^c)\,c^g + a' + \mathbf{1}_{j\leqq 3}\mathbf{1}_{l^g>0} wd(\mathbf{x})\,k(\mathbf{x}) = a(\mathbf{x}) + \tilde{y}^g(\mathbf{x}) + ss^g(\mathbf{x}) + tr_{single}^g(\mathbf{x}) + tr^* & \textit{otherwise,} \end{cases}$$

II) without children:

$$(1+\tau^c)\,c^g + a' = a(\mathbf{x}) + \tilde{y}^g(\mathbf{x}) + ss^g(\mathbf{x}) + tr_{single}^g(\mathbf{x}) + tr^*,$$

$$\tilde{y}^g(\mathbf{x}) = \left(1 - \tau^I\left[e^g(\mathbf{x}) + ra(\mathbf{x})\right]\right)\left(e^g(\mathbf{x}) + ra(\mathbf{x})\right) - \tau^{ss}\min\left\{e^g(\mathbf{x}), e^{ss}\right\},$$

$$a'(\mathbf{x}) \geq 0.$$

[7]Recall that this case is only for single women due to the assumption that single men do not have children.

Lastly, married couples base their fertility decision on

$$\max_{k}\left\{\mathbb{E}_0\left[V_{couple}(\mathbf{x})\right]+B\left(k,edu^f\right)\right\}. \tag{4}$$

2.9 Stationary Equilibrium

I define a stationary equilibrium as well as a set of conditions that the model must satisfy. Recall that $\mu_{couple}(\mathbf{x})$ represents the distribution of married men and women.

Definition: For a given set of the government policy variables $\{G, ss, \tau^{ss}, e^{ss}, \tau^c, \tau^I, tr^g_{single}, tr_{couple}\}$, a stationary equilibrium consists of households' decision rules $\{c^m, c^f, l^m, l^f, a'\}$ for each state, the fertility choice of married couples, k, factor prices, a lump-sum transfer of accidental bequests tr^*, and the distribution of married couples and signles $\mu_{couple}(\mathbf{x})$ and $\mu^g_{single}(\mathbf{x})$ that satisfy the following conditions:

- Households' allocation rule solves the recursive optimization problem defined in Section 2.8.
- Married couples determine the number of children based on (4) .
- Factor prices are determined by (2) and (3).
- The labor and capital market clearing conditions are the following.

$$L=\sum_{\mathbf{x}}\left[\left(\eta_j^{m,edu}\varepsilon^m l^m(\mathbf{x})+\eta_j^{f,edu}\varepsilon^f l^f(\mathbf{x})\right)\left(\frac{\mu_{couple}(\mathbf{x})}{2}\right)+\eta_j^{m,edu}\varepsilon^m l^m(\mathbf{x})\,\mu^m_{single}(\mathbf{x})+\eta_j^{f,edu}\varepsilon^f l^f(\mathbf{x})\,\mu^f_{single}(\mathbf{x})\right], \tag{5}$$

$$L_{childcare}=\sum_{\mathbf{x}}d(\mathbf{x})\,k(\mathbf{x})\left(\frac{\mu_{couple}(\mathbf{x})}{2}+\mu^f_{single}(\mathbf{x})\right), \tag{6}$$

$$L_{goods}=L-L_{childcare}, \tag{7}$$

$$K=\sum_{\mathbf{x}}\left[a(\mathbf{x})\left(\frac{\mu_{couple}(\mathbf{x})}{2}+\mu^m_{single}(\mathbf{x})+\mu^f_{single}(\mathbf{x})\right)\right]. \tag{8}$$

- The goods market clears:

$$\sum_{\mathbf{x}}\left[c(\mathbf{x})\left(\frac{\mu_{couple}(\mathbf{x})}{2}+\mu^m_{single}(\mathbf{x})+\mu^f_{single}(\mathbf{x})\right)\right]+K'+G=Y+(1-\delta)K. \tag{9}$$

- An equation for the lump-sum bequest transfer holds:

$$\sum_{\mathbf{x}}\left[tr^{*}\left(\mu_{couple}(\mathbf{x})+\mu_{single}^{m}(\mathbf{x})+\mu_{single}^{f}(\mathbf{x})\right)\right]=$$
$$\sum_{\mathbf{x}}\left[\left(1-\Phi_{j}^{m}\right)\left(1-\Phi_{j}^{f}\right)a'(\mathbf{x})\frac{\mu_{couple}(\mathbf{x})}{2}+\left(1-\Phi_{j}^{m}\right)a'(\mathbf{x})\mu_{single}^{m}(\mathbf{x})+\left(1-\Phi_{j}^{f}\right)a'(\mathbf{x})\mu_{single}^{f}(\mathbf{x})\right]. \tag{10}$$

- The government budget constraint holds:

$$G+\sum_{\mathbf{x}}\left[ss(\mathbf{x})\left(\frac{\mu_{couple}(\mathbf{x})}{2}\right)+ss^{m}(\mathbf{x})\mu_{single}^{m}(\mathbf{x})+ss^{f}(\mathbf{x})\mu_{single}^{f}(\mathbf{x})+\right.$$
$$\mathbf{1}_{lf(\mathbf{x})>0}(1-\theta)wd(\mathbf{x})k(\mathbf{x})\left(\frac{\mu_{couple}(\mathbf{x})}{2}+\mu_{single}^{f}(\mathbf{x})\right)+tr_{couple}(\mathbf{x})\frac{\mu_{couple}(\mathbf{x})}{2}+$$
$$\left.tr_{single}^{m}(\mathbf{x})\mu_{single}^{m}(\mathbf{x})+tr_{single}^{f}(\mathbf{x})\mu_{single}^{f}(\mathbf{x})\right]=$$
$$\sum_{\mathbf{x}}\left[\left(\tau^{I}\left[e(\mathbf{x})+ra(\mathbf{x})\right](e(\mathbf{x})+ra(\mathbf{x}))+\tau^{ss}\min\{e^{m}(\mathbf{x}),e^{ss}\}+\tau^{ss}\min\left\{e^{f}(\mathbf{x}),e^{ss}\right\}+\tau^{c}c(\mathbf{x})\right)\left(\frac{\mu_{couple}(\mathbf{x})}{2}\right)+\right.$$
$$\left(\tau^{I}\left[e^{m}(\mathbf{x})+ra(\mathbf{x})\right](e^{m}(\mathbf{x})+ra(\mathbf{x}))+\tau^{ss}\min\{e^{m}(\mathbf{x}),e^{ss}\}+\tau^{c}c(\mathbf{x})\right)\mu_{single}^{m}(\mathbf{x})+$$
$$\left.\left(\tau^{I}\left[e^{f}(\mathbf{x})+ra(\mathbf{x})\right]\left(e^{f}(\mathbf{x})+ra(\mathbf{x})\right)+\tau^{ss}\min\left\{e^{f}(\mathbf{x}),e^{ss}\right\}+\tau^{c}c(\mathbf{x})\right)\mu_{single}^{f}(\mathbf{x})\right]. \tag{11}$$

- The distribution of households across states $\mu_{couple}(\mathbf{x})$ and $\mu_{single}^{g}(\mathbf{x})$ are stationary. That is, $\mu_{couple}=T_{\mu_{couple}}\mu_{couple}$ and $\mu_{single}^{g}=T_{\mu_{single}^{g}}\mu_{single}^{g}$ where $T_{\mu_{couple}}$ and $T_{\mu_{single}^{g}}$ are one-period recursive operators on the distribution for married couples and singles, respectively.

3 Calibration and Model Performance

This section outlines the calibration strategy and examines if the calibrated model matches the labor force participation rates of married couples, especially those of married mothers, and the distribution of children. The model operates under the assumption that the economy is in a stationary equilibrium and is calibrated to reflect the current US economy.

Table 1: Selected Fixed Parameters

Parameter	Description	Values
Demographics		
J	The maximum age	15
J_R	The retirement age	9
I	The maximum age when children live with their parents	5
ω_c	The proportion of married couples	0.739
ω^f_{single}	The proportion of single women	See text
Φ^g_j	Conditional survival probabilities	See text
Labor earning		
η^g_j	Labor efficienty	See text
$\left\{\psi^m, \psi^f\right\}$	AR(1) coefficients	$\{0.942, 0.933\}$
$\left\{\sigma^m_\varepsilon . \sigma^f_\varepsilon\right\}$	Variances of the white noise	$\{0.164.0.135\}$
Preferences and technologies		
σ	Degree of relative risk aversion	2.000
α	Capital share of output	0.360
δ	Capital depreciation rate	4.100% in annual terms
Childcare costs		
d	Childcare costs	See text
θ	The fraction of childcare subsidies	0.750
$\hat{y}$	The income threshold level for childcare subsidies	0.601
Government policy		
τ^{ss}	Social Security tax	10.60%
e^{ss}	Maximum amount of labor earnings	$106,800
τ^c	Consumption tax	5.00%
$\bar{y}$	Mean household income	1.138
$\{\eta_{0,marital,k}, \eta_{1,marital,k}\}$	Coefficients for income tax	See text

Table 2: The Distribution of Education Levels by Marital Status

		Married Couples				Singles	
		Female				Male	Female
		<HS	HS	SC	$\geqq COL$		
Male	$< HS$	0.058	0.024	0.027	0.006	0.127	0.105
	HS	0.002	0.072	0.078	0.030	0.213	0.183
	SC	0.015	0.053	0.169	0.092	0.350	0.389
	$\geqq COL$	0.004	0.016	0.070	0.286	0.310	0.323

Notes: $< HS$, HS, SC, and $\geqq COL$ denote less than high school, high school graduate, some college without a degree, and college degree or higher, respectively. The data is sourced from the 2008 American Community Survey.

3.1 Fixed Parameters

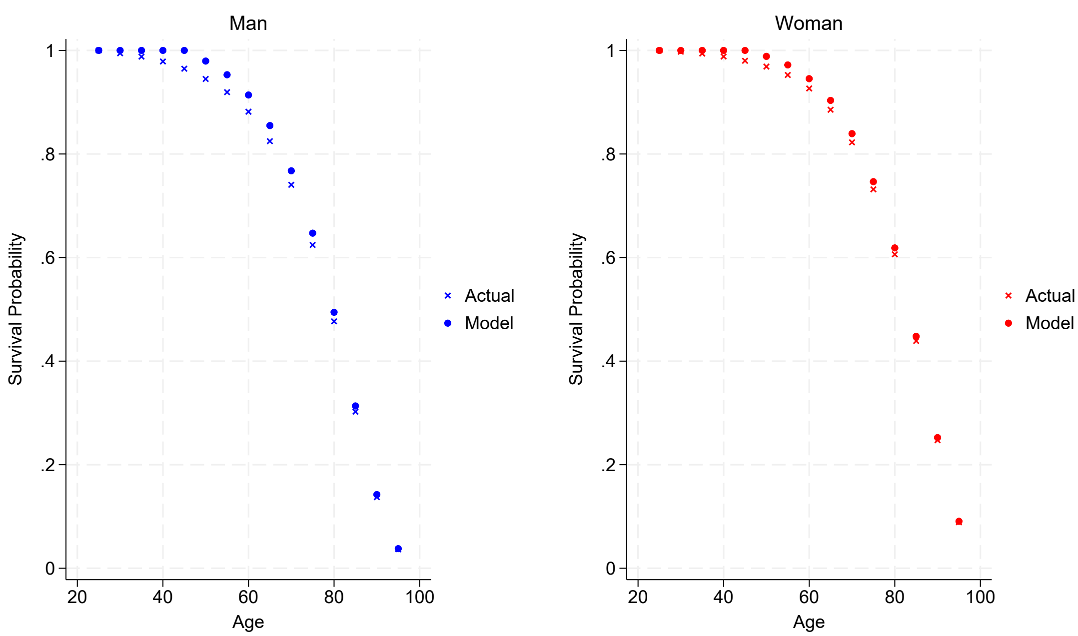
The following section provides a detailed description of the fixed parameters summarized in Table 1 and 2.

3.1.1 Demographics

In the model, there are four education levels: less than high school ($< HS$), high school graduate (HS), some college without a degree (SC), and college degree or higher ($\geq COL$). The distributions of education levels by marital status are sourced from the 2008 American Community Survey (ACS), as reported in Table 2. Each age j represents a five-year period in the data. The maximum age, represented by J, is set to 15 periods. In this model, I assume that the initial period corresponds to age 25, so all households are considered to reach the end of their lifespan by age 100. The retirement age, represented by J_R, is set to 9, corresponding to age 65. This is close to the current retirement age in the US economy, which is 66. Children are assumed to live with their parents until $I = 5$. The proportion of married couples, represented by ω_{couple}, is 0.739. This value reflects the proportion of married individuals as per the 2008 ACS.

For the conditional survival probability, Φ_j^g, I assume that both men and women can survive up to $j = 5$ (age 45) in my model, ensuring that married couples can care for their children until they become independent. Beyond this, the conditional survival probability is computed using the life table from Bell and Miller (2005). Figure 2 compares the unconditional survival probabilities for men and women from both the actual data and the model. This comparison indicates that my assumption does not critically impact the results.

Figure 2: Unconditional Survival Probabilities



Notes: The actual unconditional survival probabilities are sourced from Bell and Miller (2005). In contrast, the model's unconditional survival probabilities are computed under the assumption that no individual passes away before reaching the age of 45.

3.1.2 Labor earning

I employ the method proposed by Borella et al. (2022) to estimate $\eta_j^{g,edu}$. For this estimation, I utilize hourly wage data from the PSID. The hourly wage is determined by dividing annual total labor earnings by annual total work hours.[8] Since labor efficiency in my model depends on factors such as age, gender, education level, and average past labor earnings, I carry out a fixed-effect regression on the logarithm of the hourly wage at age t, denoted as $log\eta_{kt}$:

$$log\eta_{kt} = d_k + f^{g,edu}(t) + \beta_1 log(\bar{e}_{kt} + \delta_e) + \beta_2 (log(\bar{e}_{kt} + \delta_e) \times dummy_{g=f}) + u_{kt}, \tag{12}$$

where d_k is a fixed effect, $f^{g,edu}(t)$ is a gender- and education-specific fifth-order polynomial in age, $\bar{e}_{kt}$ is the average past earnings, and δ_e is the shifter, $dummy_{g=f}$ is a dummy variable that takes a value of 1 if the gender of a sample is a woman. While Borella et al. (2022) include cohort dummy variables due to their focus on the labor force participation rates of specific cohorts, my regression omits them. Notwithstanding the exclusion of these cohort dummies, the resulting coefficients do not change substantially. I set $\delta_e =$ \$5000 based on Borella et al. (2022). The sample period covers ages 24 to 70. The regression results are reported in Table 3. I use the fitted wage per hour $\hat{\eta}_j^{g,data}$ substituting values of $t = 25 + 5 \times (j-1)$ and $\bar{e}_{kt} = \bar{e}_{j-1}^g$.[9]

The idiosyncratic labor efficiency shock, denoted as ε^g, and specific to each gender, is assumed to follow an AR(1) process in the logarithmic form, expressed as follows:

$$ln\varepsilon_t^g = \psi^g ln\varepsilon_{t-1}^g + \nu_\varepsilon^g,$$

where

$$\nu_\varepsilon^g \sim N\left(0, \left(\sigma_\varepsilon^g\right)^2\right).$$

I estimate $\left(\psi_\varepsilon^g, \sigma_\varepsilon^g\right)$ using the same method as Borella et al. (2022).[10] According to the estimation

[8] For observations where the hourly wage is not reported,I impute the missing values using parameters estimated from another fixed-effect regression, segmented by gender. I run this regression in accordance with the method outlined by Borella et al. (2022).

[9] In the computation, I normalize labor efficiency for men at age 25 to one. Importantly, for all individuals at age 25, the value of $\bar{e}_0^g$ is set to 0.

[10] The estimation methods employed are maximum likelihood and standard Kalman filter recursions. For detailed information, refer to Borella et al. (2022).

results, $(\psi_\varepsilon^m, \sigma_\varepsilon^m) = (0.942, 0.164)$ and $\left(\psi_\varepsilon^f, \sigma_\varepsilon^f\right) = (0.933, 0.135)$, respectively. In the computation, the process is discretized using the Rouwenhurst procedure described in Kopecky and Suen (2010).

3.1.3 Preferences and technologies

The utility function for married couples is expressed in the following form:

$$u\left(c^m, c^f, l^m, l^f\right) = \frac{(c^m)^{1-\sigma}}{1-\sigma} + \frac{\left(c^f\right)^{1-\sigma}}{1-\sigma} + \gamma^m \frac{\left(1 - l^m - \mathbf{1}_{l^m>0}\mathbf{1}_{j>5}\theta^m (j-5)^\kappa\right)^{1-\upsilon}}{1-\upsilon} + \gamma^f \frac{\left(1 - l^f - \mathbf{1}_{l^f>0}\mathbf{1}_{j>5}\theta^f (j-5)^\kappa - \mathbf{1}_{j=1}\zeta k\right)^{1-\upsilon}}{1-\upsilon}.$$

As observed, the utility function is separable between consumption and leisure. For the utility derived from consumption, it is assumed that $c^m = c^f = \frac{c}{\chi}$, where c represents total consumption, and χ stands for the equivalence scale in consumption. The equivalence scale adjusts based on household size. Following Citro and Michael (1995), the scale is represented as $\chi = (2+k)^{0.7}$. The utility stemming from leisure is then weighted by γ^g, a factor presumed to be gender-specific.[11] Additionally, there are two more components: $\theta^g (j-5)^\kappa$ and ζk. The first component comes into play when households continue working from $j = 6$ (age 50) onward. It is postulated that this cost rises as households age, governed by the curvature parameter κ. The coefficient, θ^g, is assumed to differ based on gender. This component is included to reflect the observed decline in labor force participation rates for both men and women after reaching the age of 50. The second component comes into play when children are under the age of 5 ($j = 1$). Consistent with existing literature, this element is introduced to capture the labor force participation rates of married women with children under the age of 5. Similarly, the utility function for singles is expressed as follows:

$$u\left(c^g, l^g\right) = \begin{cases} \frac{(c^m)^{1-\sigma}}{1-\sigma} + \gamma^m \frac{\left(1-l^m-\mathbf{1}_{l^m>0}\mathbf{1}_{j>5}\theta^m(j-5)^\kappa\right)^{1-\upsilon}}{1-\upsilon} & \text{if } g = men \\ \frac{\left(c^f\right)^{1-\sigma}}{1-\sigma} + \gamma^f \frac{\left(1-l^f-\mathbf{1}_{l^f>0}\mathbf{1}_{j>5}\theta^f(j-5)^\kappa-\mathbf{1}_{j=1}\zeta k\right)^{1-\upsilon}}{1-\upsilon} & \text{if } g = women. \end{cases}$$

[11] Groneck and Wallenius (2021) utilized a similar setting for γ.

Table 3: Regression Results of the Log of Wage per Hour

Variable	Coefficient	Standard Error
$log\,(\hat{e}_{kt}+\delta_e)$	0.236	0.006
$log\,(\hat{e}_{kt}+\delta_e)\times dummy_{g=f}$	0.085	0.007
$Age/100$	-0.903	0.056
$(Age)^2/100$	4.076	0.280
$(Age)^3/100$	-0.088	0.007
$(Age)^4/100$	0.0009	0.00009
$(Age)^5/100$	-0.000004	0.0000005
$Age/100\times dummy_{g=f}$	-0.087	0.009
$(Age)^2/100\times dummy_{g=f}$	0.315	0.070
$(Age)^3/100\times dummy_{g=f}$	-0.007	0.002
$(Age)^4/100\times dummy_{g=f}$	0.00007	0.00003
$(Age)^5/100\times dummy_{g=f}$	-0.00000003	0.0000002
$Age/100\times dummy_{edu=HS}$	0.018	0.015
$(Age)^2/100\times dummy_{edu=HS}$	-0.095	0.144
$(Age)^3/100\times dummy_{edu=HS}$	0.002	0.005
$(Age)^4/100\times dummy_{edu=HS}$	-0.00001	0.00007
$(Age)^5/100\times dummy_{edu=HS}$	-0.000000004	0.000003
$Age/100\times dummy_{edu=SC}$	0.031	0.014
$(Age)^2/100\times dummy_{edu=SC}$	-0.184	0.130
$(Age)^3/100\times dummy_{edu=SC}$	0.005	0.004
$(Age)^4/100\times dummy_{edu=SC}$	-0.00007	0.00006
$(Age)^5/100\times dummy_{edu=SC}$	0.00000003	0.000003
$Age/100\times dummy_{edu=\geq COL}$	0.019	0.014
$(Age)^2/100\times dummy_{edu=\geq COL}$	-0.071	0.132
$(Age)^3/100\times dummy_{edu=\geq COL}$	0.004	0.004
$(Age)^4/100\times dummy_{edu=\geq COL}$	-0.00007	0.00006
$(Age)^5/100\times dummy_{edu=\geq COL}$	0.00000004	0.000003
Constant	7.601	0.433
N	$132,634$	
R^2	0.391	

Table 4: Calibration Results

Parameter	Value	Target Moment	Data	Model
υ	3.296	The average work hours relative to the total hours	0.364	0.372
γ^m	0.841	LFP rate for married men at age 45	0.969	0.978
γ^f	1.041	LFP rate for married women without children at age 45	0.782	0.776
θ^m	0.002	LFP rate or married men at age 50	0.946	0.937
θ^f	0.003	LFP rate for married women without children at age 60	0.444	0.442
κ	2.790	LFP rate for married men at age 60	0.801	0.801
ζ	0.075	LFP rate for married women with children at age 25	0.567	0.547
ϕ_1	0.515	The proportion of married couples having two children	0.367	0.360
$\phi_2^{edu^f \in \{<HS,HS\}}$	3.326	The proportion of married couples with $edu^f \in \{<HS, HS\}$ having one child	0.176	0.237
$\phi_2^{edu^f \in \{SC,\geq COL\}}$	3.077	The proportion of married couples with $edu^f \in \{SC, \geq COL\}$ having one child	0.225	0.344
$\Xi^{edu^f \in \{<HS,HS\}}$	0.005	The proportion of married couples with $edu^f \in \{<HS, HS\}$ having no children	0.111	0.097
$\Xi^{edu^f \in \{SC,\geq COL\}}$	0.003	The proportion of married couples with $edu^f \in \{SC, \geq COL\}$ having no children	0.188	0.186
β	$(0.964)^5$	The capital-output ratio for the US	3.000	2.998
A	1.991	Normalize the aggregate output to 1	–	–
d^*	0.036	The proportion of average income for employed households	8.910%	8.898%
d^{**}	0.050	The proportion of average income for employed households	6.640%	6.627%

Notes: The data sources are the PSID, the 2008 CPS, and the SIPP. The detailed descriptions are provided in the text.

Next, following Bick (2016), the benefit derived from having k children is specified as follows:

$$B\left(k, edu^f\right) = \phi_2^{edu^f} \frac{(1+k)^{\phi_1}}{1-\phi_1} - \mathbf{1}_{k>0} \Xi^{edu^f}.$$

Unlike Bick (2016), I assume that ,ϕ_2 and Ξ vary based on the education levels of wives. In practice, these two parameters vary depending on whether their education level exceeds that of a high school graduate.

The inverse of the intertemporal elasticity of substitution for consumption, denoted as σ, is set to 2.000, a value commonly used in literature. The parameters $\left\{\upsilon, \gamma^m, \gamma^f, \theta^m, \theta^f, \kappa, \zeta\right\}$ are calibrated to match the average annual work hours and labor force participation rates of married men and women—with and without children—at specific ages. For the average annual work hours, I normalize the annual total hours, 5475 hours, to one. For labor force participation rates, I use six target values: these include the rates of married men at ages 45, 50, and 60; the rates of married women without children at ages 45 and 60; and the rate of married women with children at age 25. All the moments are obtained from the PSID. Although not entirely perfect, the model effectively replicates these labor force participation rates, as shown in Table 4. Additionally, I calibrate the parameters $\left\{\phi_1 \phi_2^{edu^f \in \{<HS,HS\}}, \phi_2^{edu^f \in \{SC,\geq COL\}}, \Xi^{edu^f \in \{<HS,HS\}}, \Xi^{edu^f \in \{SC,\geq COL\}}\right\}$ to match the distributions of children. These moments are sourced from the 2008 CPS. Again, Table 4

shows that my model aligns reasonably well with the observed distribution of children.

I calibrate the discount factor, denoted as β, to align closely with the capital-output ratio for the US, set at 3.000 on an annual basis. The outcome suggests that $\beta = (0.964)^5$, resulting in a capital-output ratio of 2.998 in the model. With respect to technologies, the parameter for capital income share, denoted as α, is set to 0.360, a value commonly used in the literature. The capital depreciation rate is fixed at 4.100% on an annual basis, mirroring the average depreciation rate of the capital stock. Lastly, the technology level of the production function, denoted as A, is set to 1.991. This ensures that the output equals unity in the baseline economy.

3.1.4 Childcare services

In my model, childcare costs are incurred only for the first three periods (i.e., until children reach the age of 15); beyond that, childcare costs are set to 0. I use data from the Survey of Income and Program Participation (SIPP) for data on childcare services, denoted as d. The provision of childcare services is assumed to differ only between periods when children are under the age of 5 or between the ages of 6 and 14. This assumption aligns with the calibration strategy I will elaborate on later.

My calibration strategy is based on the methodology of Guner et al. (2020). I calibrate two childcare services for married couples with high school-educated wives: one when children are under the age of 5, denoted by d^*, and the other when children are between the ages of 6 and 14, denoted by d^{**}. The calibration target values are set at 8.910% and 6.640% of the average household income, representing childcare expenditures for children under age 5 and those between ages 6 and 14, respectively. These percentages derive from data reported by Laughlin (2013).[12] The calibration result suggests $d^* = 0.036$ and $d^{**} = 0.050$, with the targeted values in my model being 8.898% and 6.627%, respectively. For the remaining childcare services, I multiply the free parameters by the values given in Table 5, which are derived from the SIPP. Lastly, I assume the government subsidizes 75% of childcare costs, based on evidence that households, on average, pay 25% of total childcare expenses when receiving subsidies. Following the approach of Guner et al. (2020), I aimed to calibrate the income threshold level, denoted as $\hat{y}$, using the proportion of households that receive childcare subsidies (5.500%). However, my model might overestimate $\hat{y}$ because it assumes that only married couples have children. To overcome this concern, I adopted the value of $\hat{y} = 0.601$ from Kotera (2023), a study that examines the impact of auxiliary benefits on the labor force participation rate of

[12] The details are available from `https://www.census.gov/data/tables/2008/demo/2011-tables.html`.

Table 5: Differences in Childcare Costs

	Children under the age of 5	Children between the ages of 6 and 14
$< HS$	1.002	0.813
HS	1.000	1.000
SC	1.138	1.063
$\geq COL$	1.715	1.442

Notes: Each entry displays childcare costs for both younger and older children. For comparison, I normalize the childcare costs for younger children and for older children in married couples where the wife is high school-educated to a value of one. The data is sourced from the SIPP.

married mothers. The model environment of Kotera (2023) is very similar but assumes that both married couples and single women have children.

3.1.5 Government policy

Social Security system

The calculation of Social Security benefits is determined by the following formula:

$$ss\left(\overline{e}_{j_R-1}\right) = \begin{cases} 0.9 \times \overline{e}_{j_R-1} & \text{if } \overline{e}_{j_R-1} < \$9,132 \\ \$8,219 + 0.32 \times \left(\overline{e}_{j_R-1} - \$9,132\right) & \text{if } \$9,132 \leqq \overline{e}_{j_R-1} < \$55,032 \\ \$23,199 + 0.15 \times \left(\overline{e}_{j_R-1} - \$55,032\right) & \text{if } \overline{e}_{j_R-1} \geqq \$55,032. \end{cases}$$

This formula mirrors the actual one utilized in the US in 2010. The average past earnings are capped at $e^{ss} = \$106,800$, meaning the maximum amount of benefits one could receive is $\$35,739$.

Additionally, married couples and widows are eligible for spouse or survivor benefits. Consequently, their Social Security benefits are calculated as follows:

$$ss = \begin{cases} 0.5 \times ss^{*}\left(\overline{e}^{*}_{j_R-1}\right) & \text{if } ss\left(\overline{e}_{j_R-1}\right) < 0.5 \times ss^{*}\left(\overline{e}^{*}_{j_R-1}\right) \\ ss\left(\overline{e}_{j_R-1}\right) & \text{otherwise }, \end{cases}$$

Table 6: Prameters for Income Taxation

	Single				Couple			
	No Children	One Child	Two Children	Three Children	No Children	One Child	Two Children	Three Children
η_0	0.121	0.077	0.048	0.037	0.096	0.089	0.073	0.058
η_1	0.035	0.042	0.028	0.022	0.054	0.061	0.067	0.060

if they receive spousal benefits and

$$ss = \begin{cases} ss^*\left(\overline{e}^*_{j_R-1}\right) & \text{if } ss\left(\overline{e}_{j_R-1}\right) < ss^*\left(\overline{e}^*_{j_R-1}\right) \\ ss\left(\overline{e}_{j_R-1}\right) & \text{otherwise ,} \end{cases}$$

if they receive survivor benefits, where ss^* denotes Social Security benefits for the other (deceased) household member. As shown, spouses are entitled to 50% of the household heads' Social Security benefits, while widows are entitled to 100% of these benefits.

Tax system

The Social Security tax rate, denoted as τ^{ss} and applied to the minimum of $\{e, e^{ss}\}$ is set at 10.60%. The consumption tax rate, denoted as τ^c is set at 5.00%, as per the existing literature (e.g., Mendoza et al. (1994)). For income taxation, I employ the following function proposed by Guner et al. (2014):

$$\tau^I\left[ra + e^m + e^f\right] = \eta_{0,marital,k} + \eta_{1,marital,k} log\left(\frac{ra + e^m + e^f}{\overline{y}}\right),$$

where $\overline{y}$ represents the mean household income in the baseline model, which is set at 1.104.[13] It is important to note that the parameters η_0 and η_1 vary based on marital status denoted as $marital \in \{single, couple\}$and the number of children, denoted by k. I use the parameters estimated by Guner et al. (2014). A summary of all the cases is provided in Table 6.

Tax credits

The government provides three types of tax credits: the EITC, the CTC, and the CDCTC. The main features of each are detailed below.

[13]This level is equivalent to \$48,929.

Table 7: Key Elements of the EITC by Marital Status and Number of Children

	Married				Single			
	No Children	One Child	Two Children	Three Children	No Children	One Child	Two Children	Three Children
Credit Rate	0.0765	0.340	0.400	0.450	0.0765	0.340	0.400	0.450
Phase-Out Rate	0.0765	0.1598	0.2106	0.2106	0.0765	0.1598	0.2106	0.2106
Bend 1	$5,980	$8,970	$12,590	$12,590	$5,980	$8,970	$12,590	$12,590
Bend 2	$12,490	$21,460	$21,460	$21,460	$7,480	$16,450	$16,450	$16,450
Bend 3	$18,470	$40,545	$45,372	$48,362	$13,460	$35,535	$40,363	$43,352

EITC

The EITC is a refundable tax credit intended for low-income families, who must have earned income to be eligible. However, their investment income should not exceed a specific limit; in 2010, this limit was set at $3,100. The amount of the credit is determined by the total labor earnings. For instance, the credit for married couples without children can be calculated using the following formula:

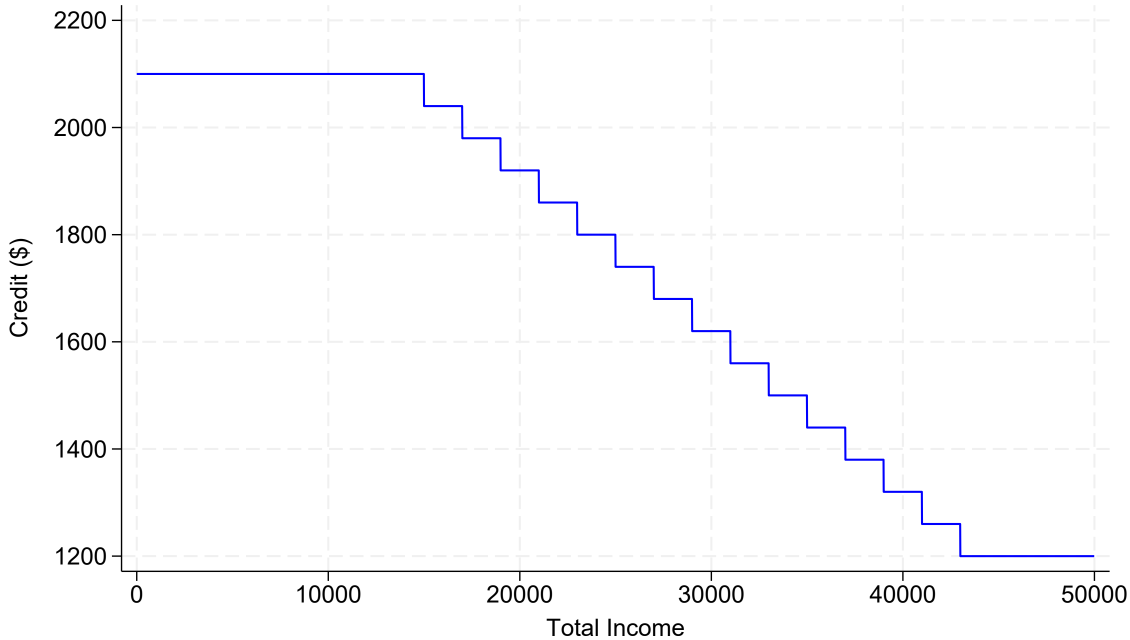
$$EITC = \begin{cases} \underbrace{0.0765}_{\text{credit rate}} \times \left(e^m + e^f\right) & \text{if } e^m + e^f < \underbrace{\$5,980}_{\text{bend 1}} \\ 0.0765 \times \$5,980 & \text{if } \$5{,}980 \leqq e^m + e^f < \underbrace{\$12,490}_{\text{bend 2}} \\ 0.0765 \times \$5,980 - \underbrace{0.0765}_{\text{phase-out rate}} \times (e^m + e^f - \$12,490) & \text{if } \$12{,}490 \leqq e^m + e^f < \underbrace{\$18,470}_{\text{bend 3}} \\ \$0 & \text{if } e^m + e^f \geq \$18,470. \end{cases}$$

In these equations, the key components are the credit rate, phase-out rate, and three threshold levels (referred to as bend 1, bend 2, and bend 3). These elements depend on the marital status and the number of dependent children under the age of 19. Table 7 displays all the cases.

CTC

The CTC is a non-refundable tax credit offered to low-income households with dependent children under the age of 19. If a household's income is below a certain threshold, it receives $1,000 per child. Currently, the threshold is set at $110,000 for married couples and $75,000 for singles. If a household's income exceeds the threshold, the credit is incrementally reduced by 5% for each additional income level. Therefore, the equations for the CTC can be expressed as follows:

Figure 3: The CDCTC for Households with Two Children



Note: This is an example where $\min\left\{\$3,000 \times \min\{k,2\}, pdk, e^m, e^f\right\} = \$3,000 \times 2 = \$6,000$.

$$CTC = \begin{cases} \$1,000 \times k & \text{if } ra + e < \$110,000 \\ \max\{(\$1,000 \times k - 0.05 \times (ra + e - \$110,000)), \$0\} & otherwise, \end{cases}$$

for married couples and

$$CTC = \begin{cases} \$1,000 \times k & \text{if } ra + e^f < \$75,000 \\ \max\left\{\left(\$1,000 \times k - 0.05 \times \left(ra + e^f - \$75,000\right)\right), \$0\right\} & otherwise, \end{cases}$$

for singles. As stated, the CTC is a non-refundable credit. Consequently, the actual amount of the CTC (denoted by CTC_{actual}) could be lower, depending on the total tax liabilities and any child-care credits.[14] To bridge this gap, households can claim the Additional Child Tax Credit (ACTC). However, to qualify, their

[14] I will provide a detailed calculation in the next section.

earned income must exceed \$3,000.Below is the ACTC calculation for married couples.

$$ACTC = \begin{cases} \$0 & \text{if } e < \$3,000 \\ \min\{(e - \$3,000) \times 0.15, CTC - CTC_{\text{actual}}\} & otherwise. \end{cases}$$

The same equation is also applicable to single individuals.

CDCTC

The CDCTC is also a non-refundable credit.[15] Furthermore, households can only receive this credit if all household members are employed. This condition is crucial compared to the other tax credits.

In principle, the amount of the CDCTC is calculated as follows:

$$CDCTC = \begin{cases} \min\left\{\$3,000 \times \min\{k,2\}, pdk, e^m, e^f\right\} \times 0.35 & \text{if } ra + e^m + e^f < \$15,000 \\ \min\left\{\$3,000 \times \min\{k,2\}, pdk, e^m, e^f\right\} \times \rho & \text{if } ra + e^m + e^f \geqq \$15,000, \end{cases}$$

where

$$\rho = \max\left(0.35 - 0.01 \times \left(\text{integer}\left(\frac{ra + e^m + e^f - \$15,000}{\$2000}\right) + 1\right), 0.2\right).$$

Note that if the total income is less than $\hat{y}$, households are only liable for θd. Consequently, the CDCTC might decrease accordingly. Figure 3 shows an example of the CDCTC. A similar equation applies to singles.

[15] Here is a calculation for the actual CTC and CDCTC. Let us denote the total tax liabilities as TL. Then, the actual CDCTC, noted as $CDCTC_{\text{actual}}$, is calculated using the following equation:"

$$CDCTC_{\text{actual}} = \begin{cases} TL & \text{if } CDCTC \geqq TL \\ CDCTC & \text{otherwise} \end{cases}.$$

Then, the amount of CTC_{actual} depends on whether the sum of the CTC and the CDCTC exceeds the total tax liabilities. If $CTC + CDCTC \geqq TL$, the total actual credit equals TL. Therefore, the total actual credit is

$$CTC_{\text{actual}} = \begin{cases} 0 & \text{if } CDCTC_{\text{actual}} \geqq TL \\ TL - CDCTC_{\text{actual}} & \text{if } CDCTC_{\text{actual}} < TL, CTC \geqq TL - CDCTC_{\text{actual}} \\ CTC & \text{if } CDCTC_{\text{actual}} < TL, CTC < TL - CDCTC_{\text{actual}} \end{cases}.$$

Conversely, if $CTC + CDCTC < TL$, the total actual credit equals CTC.

3.2 Model Performance

How effectively does the calibrated model replicate non-targeted moments? I specifically examine three non-targeted moments. The first one is the fertility rate. In my baseline model, the fertility rate is 1.511, which is close to, yet somewhat lower than, the actual rate. As of 2022, the U.S. fertility rate stands at 1.782. This underestimation primarily stems from an overestimation of the proportion of married couples with college-educated wives having one child, as indicated in Table 4.

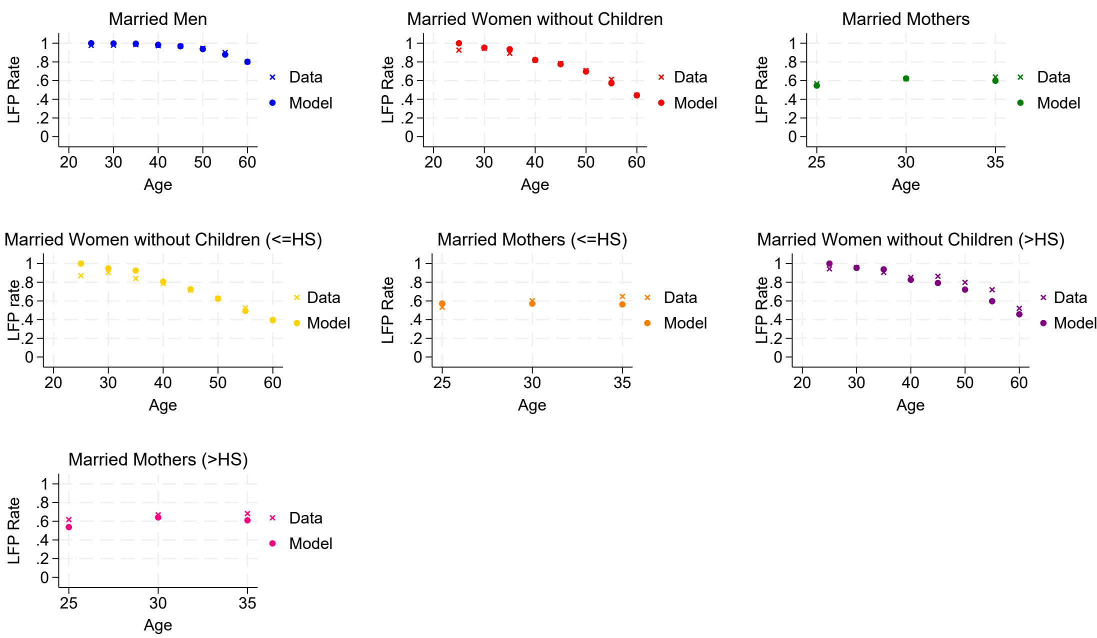
The next non-targeted moment is the labor supply of married couples. Figure 4 illustrates the labor force participation rates for three groups: married men, married women without children, and married mothers, over the life cycles. For married women, I compare these rates from the data with those from the baseline model based on wives whose education level is above high school graduation. The data source is the PSID. Notice that the labor force participation rates of married mothers are plotted only up to the age of 35, as there are no households to care for children under 15 in my model. Overall, the model matches the labor force participation rates reasonably well. In particular, it accurately reflects the participation rates of married mothers across all groups.

Lastly, the baseline model can accurately reflect the fraction of elderly women receiving spouse and survivor benefits. For this, I utilize data derived from the SSA Annual Statistical Supplement, focusing on retirement statistics from 2022. It is important to note that the figures in the data represent the proportions of women aged 62 and older, while my model calculates the proportions for women aged 65 and older. In the data, 41.37% of elderly women receive the auxiliary benefits, compared to 37.41% in the baseline model

4 Simulation

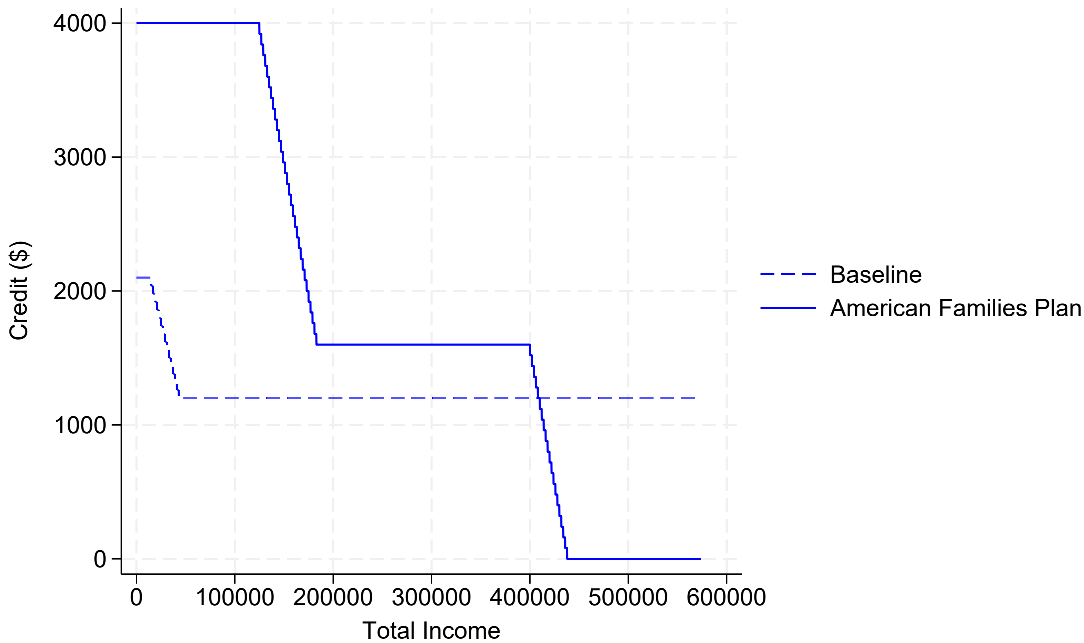
This section conducts simulations using the baseline model introduced in Sections 2 and 3. The main objective is to quantify the macroeconomic effects of the American Families Plan. Section 4.1 outlines the specifics of the American Families Plan. Section 4.2 explores the long-term effects under two scenarios: one based on the baseline model, and another that excludes the impacts on fertility. Section 4.3 delves into the transition dynamics of the policy between the two simulations. Finally, Section 4.4 compares the welfare effects. In the simulations, the survival probabilities for both men and women are held constant across all ages. Additionally, government expenditures, G, are assumed to remain constant at the baseline

Figure 4: Labor Force Participation Rates of Married Couples over the Life Cycle (Data and Model)



Notes: The data source is the PSID. “<HS”represents individuals with an education level below high school graduation, whereas “≧HS” represents those with an education level of high school graduation or higher. The labor force participation rates for married mothers are plotted only up to age 35, as beyond this age, none of the households in my model are caring for children under the age of 15.

Figure 5: The CDCTC for Households with Two Children (Baseline vs American Families Plan)



Note: This is an example where $\min\left\{\$3,000 \times \min\{k,2\}, pdk, e^m, e^f\right\} = \$3,000 \times 2 = \$6,000$ in the baseline and $\min\left\{\$4,000 \times \min\{k,2\}, pdk, e^m, e^f\right\} = \$4,000 \times 2 = \$8,000$.

level.[16] Under this assumption, if government spending exceeds government revenue, an additional tax can be imposed to balance the budget. Conversely, the government provides a lump-sum transfer if the opposite situation occurs.

4.1 The Details of the American Families Plan

The American Families Plan encompasses the expansion of child-related transfers.[17] It is important to note that this paper concentrates solely on the permanent changes to the child tax credit and childcare subsidy programs, as described below.[18]

- **EITC**: The limit for investment income is raised to $\$10,300$. Additionally, the expansion of the EITC for childless households, introduced in the American Rescue Plan, has been made permanent.

[16]The share of government expenditures in the baseline model is 11.48%.

[17]See https://www.whitehouse.gov/briefing-room/statements-releases/2021/04/28/fact-sheet-the-american-families-plan/ for the complete details of the plan.

[18]Therefore, this paper does not include the policy for the CTC. In the American Rescue Plan, the CTC increases for child under 6 from \$2,000 to \$3, 600 and for child over 6 from \$2,000 to \$3,000. Additionally, this program has become refundable. The American Families Plan extends this policy for another five years. However, since the US government will revert to the standard CTC program afterwards, this extension is temporary.

- **CDCTC**: In the American Rescue Plan, this program is made refundable, and the CDCTC is expanded based on the following equations

$$CDCTC = \begin{cases} \min\left\{\$4,000 \times \min\{k,2\}, pdk, e^m, e^f\right\} \times 0.5 & \text{if } ra + e^m + e^f < \$125,000 \\ \min\left\{\$4,000 \times \min\{k,2\}, pdk, e^m, e^f\right\} \times \max\{\rho_1, 0.2\} & \text{if } \$125,000 \leqq ra + e^m + e^f < \$400,000 \\ \min\left\{\$4,000 \times \min\{k,2\}, pdk, e^m, e^f\right\} \times \max\{\rho_2, 0\} & otherwise, \end{cases}$$

where

$$\rho_1 = \max\left(0.5 - 0.01 \times \left(\text{integer}\left(\frac{ra + e^m + e^f - \$125,000}{\$2000}\right) + 1\right), 0.2\right),$$

$$\rho_2 = \max\left(0.2 - 0.01 \times \left(\text{integer}\left(\frac{ra + e^m + e^f - \$400,000}{\$2000}\right) + 1\right), 0\right).$$

The American Families Plan makes this policy permanent. Figure 5 compares examples of the CDCTC in both the baseline model and the American Families Plan.

- **Childcare subsidies**: The American Families Plan ensures that no one earning under 150% of (state) median income spends more than 7% on childcare for children under age 5. [19]

4.2 Long-Run Effects of the American Families Plan

4.2.1 Baseline result

Table 8 summarizes the long-run effects of the American Families Plan based on the baseline model, labeled as Simulation I. As shown in Table 8, there is a significant rise in fertility. Specifically, my simulation suggests that the American Families Plan boosts the fertility rate by 0.357. This positive fertility effect is accompanied by an increase in the labor force participation rate of married mothers. The labor supply of married mothers between the ages of 25 and 35 rises by 9.222%. Therefore, by expanding the CDCTC and childcare subsidies, a larger fraction of married mothers can enter the workforce. As a result, married couples are in a better position to afford more children.

As the fertility rate increases, the size of the younger generation becomes relatively larger. This demographic change influences macroeconomic variables, and equilibrium prices change accordingly. Con-

[19] In the baseline model, the median household income is $54,880.

Table 8: Long-Run Effects of the American Families Plan

	Baseline	Simulation I	Simulation II
The American Families Plan	No	Yes	Yes
Effect on Fertility	–	Yes	No
Fertility rate	1.511	1.868	1.511
LFP rate of married mothers	58.93%	68.15%	66.33%
Aggregate capital per capita	–	−0.318%	+0.352%
Aggregate labor per capita (Men)	–	+8.495%	−0.680%
Aggregate labor per capita (Women)	–	+9.338%	+1.940%
Consumption per capita	–	+2.881%	+0.283%
Equilibrium interest rate on an annual basis	7.137%	7.611%	7.120%
Equilibrium wage rate	–	−2.840%	+0.130%
Total Spending on Social Security	–	−20.850%	−0.018%
Additional tax on income	–	0.00%	0.396%
Welfare effect (Single Man)	–	−1.697%	−0.099%
Welfare effect (Single Woman)		−2.536%	−0.053%
Welfare effect (Married Couple)	–	1.062%	1.587%

Notes: The second column presents Simulation I, in which the American Families Plan is implemented, while the third column presents Simulation II, conducting the same analysis but with the effect on fertility excluded. The percentage values for capital per capita, labor per capita, consumption per capita, the equilibrium wage rate, and benefit spending per capita represent deviations from the baseline economy. Welfare effect is defined as the consumption equivalence for newborns under a veil of ignorance.

versely, Social Security expenditures decrease because the elderly are the recipients of these benefits.[20] Consequently, although the expansion of child-related transfers increases spending, there is no need for the government to impose an additional income tax. Instead, all households receive lump-sum transfers.

4.2.2 Model without the effect on fertility

To determine whether the positive effect on the fertility rate significantly contributes to the macroeconomic effects of the American Families Plan, I conduct another simulation in which the effect of fertility is excluded. This is labeled as Simulation II. Table 8 presents the results of this simulation. Even though the fertility rate remains constant, the labor force participation rate of married mothers increases by nearly the same magnitude, at 7.400%. However, due to the lack of demographic change, all macroeconomic variables except for aggregate capital per capita show less significant increases, and equilibrium prices are affected differently. Additionally, the expansion of child-related transfers leads to increased government spending. As a result, the government has to impose an additional 0.396% tax on income.

[20] Incidentally, the fraction of elderly women receiving spouse and survivor benefits is 36.62% in this simulation.

4.3 Transition Dynamics of the American Families Plan

I calculate transition dynamics to assess the short-run effects of the American Families Plan. In this analysis, I assume that the initial period is a stationary equilibrium in the baseline economy. The government then announces the American Families Plan before a new cohort enters the economy. Consequently, new married couples make decisions regarding the number of children after the announcement. I compare the transition dynamics between the baseline model and a model excluding the impact on fertility, similar to the previous section.

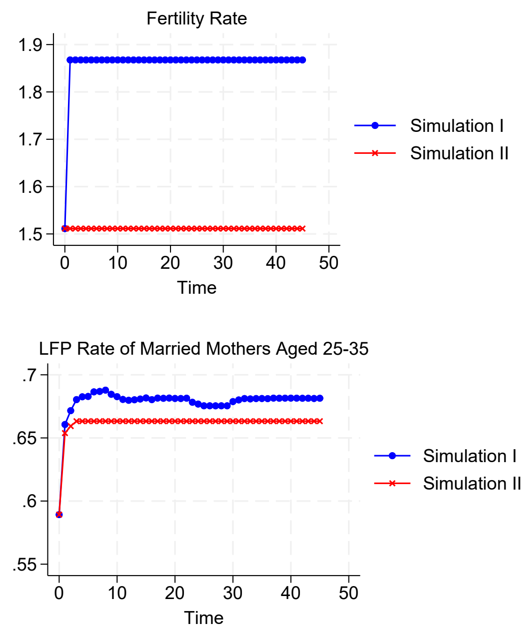
4.3.1 Baseline result

Figure 6 displays the transition dynamics of the fertility rate, the old-age dependency ratio, and the labor force participation rate of married mothers aged 25 to 35 after the implementation of the American Families Plan, referred to as Simulation I. In this context, the old-age dependency ratio is defined as the proportion of individuals aged 65 and over to those aged 25 to 60. As depicted, the fertility rate and the labor force participation rate of married mothers jump and quickly reach the new stationary equilibrium level. However, since the children enter the economy after five periods (25 years), no demographic shift occurs during this interval. After the interval, the demographic shifts, and the old-age dependency ratio declines. From period 20 onward, it stabilizes.

Next, Figure 7 shows the transition dyanamics of other macroeconomic variables. Notably, households accumulate more assets during the first five periods. This is because they anticipate a future increase in the young population and a subsequent reduction in transfers from bequests. Consequently, despite a higher percentage of working married mothers, households cannot sufficiently increase consumption, and an additional income tax is levied. In the period 5, an additional 1.033% income tax is imposed.

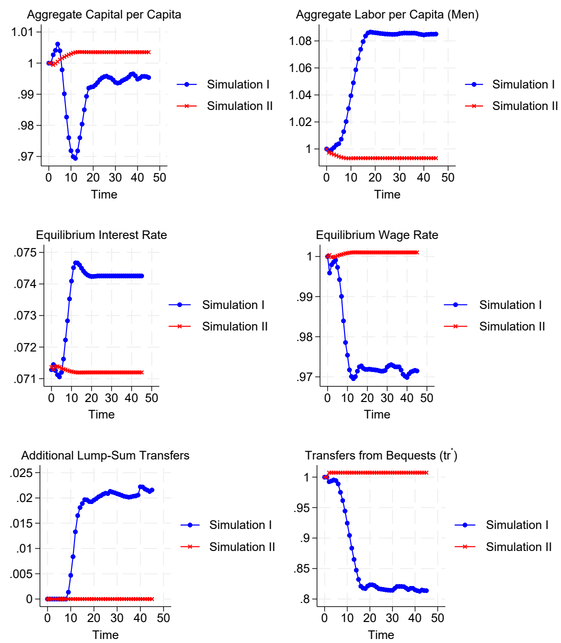
After the demographic changes, the size of the young generation increases, leading to a reduction in total Social Security spending. As a result, from period 12 onward, the government no longer needs to impose an additional income tax and begins to provide lump-sum transfers. On the flip side, transfers from bequests decrease, prompting households to deaccumulate their assets. However, asset accumulation resumes once households start to receive the lump-sum transfers.

Figure 6: Transition Dynamics of the American Families Plan



Notes: Each panel illustrates the dynamics of the fertility rate, the old-age dependency ratio, and the labor force participation rate of married mothers aged 25 to 35 under two scenarios. In the first scenario, Simulation I, the American Families Plan is implemented. In the second scenario, Simulation II, the same policy is conducted with the fertility effect excluded.

Figure 7: Transition Dynamics of the American Families Plan (Continued)



Notes: Each panel illustrates the dynamics of key macroeconomic variables under two scenarios. In the first scenario, Simulation I, the American Families Plan is implemented. In the second scenario, Simulation II, the same policy is conducted with the fertility effect excluded. All variables, with the exception of equilibrium interest rate, additional income tax, and lump-sum transfers, their initial values are normalized to one.

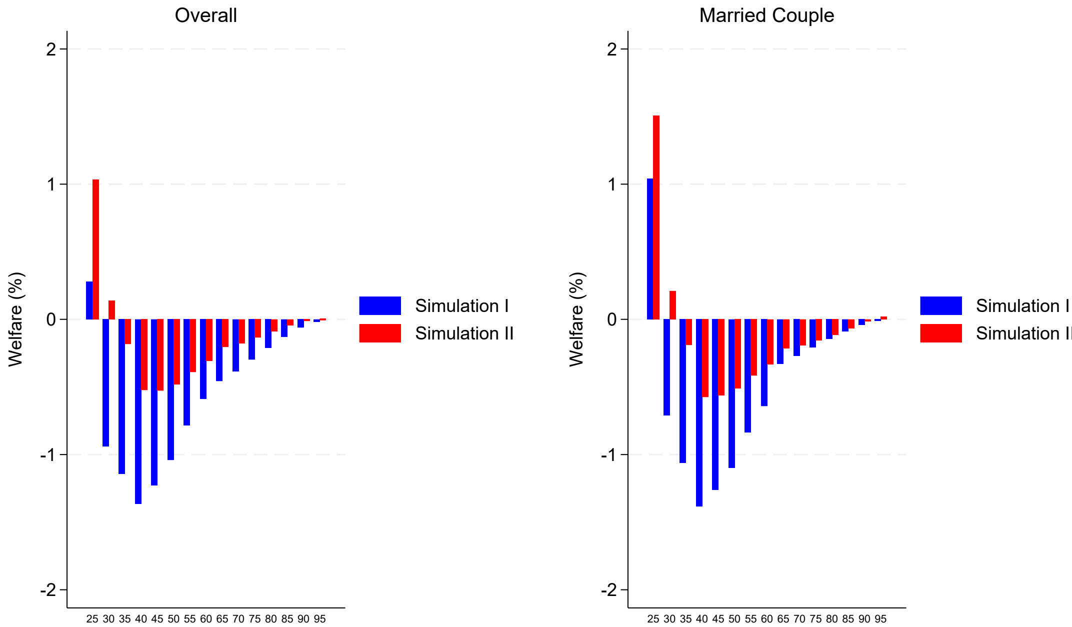
4.3.2 Model without the effect on fertility

How do the transition dynamics of macroeconomic variables change if the effect on the fertility rate is excluded? Figure 6 and 7 present the results, labeled as Simulation II. In this scenario, the trends in the labor force participation rate of married mothers are similar to those in Simulation I. However, in the absence of a demographic shift, the increased labor supply from married mothers solely influences the economic outcomes. As a result, other macroeconomic variables change modestly over time period. Thus, excluding the fertility rate significantly affects the transition dynamics of the American Families Plan.

4.4 Welfare Comparison

What is the welfare effect of the American Families Plan in the two scenarios? Here, the welfare effect is defined as the consumption equivalence for newborns under a veil of ignorance. Table 8 shows the long-run welfare effects of Ameican Families Plan in the two simulations. My simulation results reveal that every

Figure 8: Welfare Effects in the Current Generation



Notes: Each bar in each panel represents the welfare effects of the American Families Plan on the current generation. The left panel pertains to the overall case, while the right panel is specific to married couples. Welfare effect is defined as the consumption equivalence for newborns under a veil of ignorance. This figure portrays two scenarios. In the first, labeled as Simulation I, the American Families Plan is implemented. In the second, Simulation II, the policy is analyzed with the impact on fertility excluded.

type of household experiences reduced welfare effects when the impact on fertility is considered. This reduction is attributed to the presence of lump-sum transfers from leaving bequests. As the population size increases in Simulation I, the lump-sum transfers drop by 13.200%, leading to a decrease in welfare.

Next, Figure 8 illustrates the welfare effects for married couples in the current generation.[21] In Simulation I, the welfare effects are negative for all cohorts except for the initial one, and they are more pronounced than those in Simulation II. The cohort aged 40 experiences the most significant negative effect, at 1.406%, in Simulation I. Again, this is largely attributed to the reduction in transfers from bequests, a consequence of demographic shifts. This effect outweighs that of the imposition of additional income tax. Indeed, as presented in the previous section, an additional income tax is levied across the time period in Simulation II.

In summary, excluding the impact of fertility could result in an overestimation of the welfare effect for both current and future generations.

[21] We obtain a similar tendency even though single men and women are included.

5 Conclusion

This paper delves into the macroeconomic implications of the American Families Plan. A central focus of this analysis is the influence on fertility. I then develop an overlapping generations model with heterogeneous households in a general equilibrium framework. The key feature of this model is its inclusion of children: only married couples can make a decision of the number of children. The model also integrates tax credits and childcare subsidy programs. The model is calibrated to closely align with the current US economy, capturing labor force participation rates of married couples — notably among married mothers — over the life cycle and mirrors the distribution of children. The simulation results suggest that the American Families Plan markedly boosts the fertility rate, coinciding with a rise in the labor force participation of married mothers. Such demographic shifts bolster aggregate variables such as aggregate capital and labor. Furthermore, total spending on Social Security declines, and thereby the government does not have to impose an additional tax. These pronounced economic outcomes are primarily attributable to fertility influences. Without this factor, the improvements in macroeconomic variables are less significant. Furthermore, the demographic changes play a crucial role in the transition dynamics of macro variables. Since there is a delay before children enters the economy, there is no demographic shift for the first five periods, which significantly affects the transition dynamics of macroeconomic variables. However, the welfare effect diminishes when the influence of the fertility rate is considered. Hence, the welfare effect of the American Families Plan might be overly evaluated if the impact on fertility is neglected.

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