The Macroeconomic Consequences of Family Policies

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Abstract

This paper studies the macroeconomic consequences of family policies in a heterogeneous-agent general equilibrium overlapping generations model. The model features endogenous fertility, child human capital formation, a multi-period demographic structure, and age-dependent government transfers. I show that fertility elasticities across the human capital distribution play a central role in shaping the policy implications through the quantity-quality trade-off, composition effects, and demographic structure effects. I calibrate the model to match the U.S. data and validate it using empirically estimated fertility elasticities. In policy counterfactuals, I find that baby bonuses and paid leaves raise fertility and average welfare at the expense of human capital. In contrast, public education expansion reconciles fertility, human capital, and welfare objectives. The results also underscore the large distributional consequences of family policies in the cross-section and along the transition path.

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1 Introduction

Family policies—a set of policy instruments that promote family formation, reproduction, and child-rearing—are becoming increasingly important in many economies around the world. These policies play a key role in addressing population aging and its potential negative impacts on the sustainability of the public pension system, a burgeoning issue faced by many developed countries, and long-term economic growth (Jones 2020). Additionally, family policies are seen as an effective way to improve children's outcomes and reduce inequalities by relaxing low-income parents' credit constraints (Schanzenbach et al. 2021). From an economic efficiency perspective, family policies can also address the externalities related to childbearing and child-rearing decisions (Schoonbroodt and Tertilt 2014, Córdoba and Ripoll 2016).

Although family policies can be found in many economies already, there have been few studies evaluating their long-run aggregate and distributional implications despite a large number of papers studying labor market or fertility responses.[1] Such evaluations are important but challenging for several reasons. First, as family policies affect population growth, it is essential to track the changing population size and demographic structure to fully understand their dynamic benefits and costs. Second, one needs to consider the impacts of these policies on the human capital distribution of future populations, which evolves endogenously in response to current policies due to intergenerational linkages. Lastly, and more traditionally, both the demographic and human capital channels have general equilibrium effects, altering budget-balancing tax rates and factor prices.

This paper confronts these challenges and provides an inexpensive computational laboratory to evaluate the macroeconomic implications of several commonly used family and education policies, including cash rewards for childbirth (baby bonus), public education expansion, and paid parental leaves. I develop a model that incorporates many of the most crucial ingredients that affect the channels of family policies, such as endogenous fertility and child investments, parental heterogeneities, a multi-period life cycle with age-dependent government transfers, and endogenous labor supply. The inclusion of these elements enables the examination of three key policy trade-offs outlined below.

First, family policies affect both the quantity and quality of children. From a policy perspective, both margins are important as they correspond to the two main goals of family policies: raising fertility and enhancing children's outcomes, respectively. Importantly, the two margins are closely linked by the *quantity-quality trade-off* à la Becker and Lewis (1973), whereby a higher quantity raises the marginal costs of quality. This implies that policies aimed at raising fertility may have unintended consequences on human capital, and vice versa.

Second, heterogeneities across parents affect the consequences of family policies through *com-*

[1] See Hegewisch and Gornick (2013) and Doepke et al. (2022) for recent reviews.

position effects. As demonstrated by the model and data, parents respond differently to the same policy in terms of their fertility and child quality decisions. Some parents increase their fertility more than others, resulting in their children comprising a larger share of the future population. As parents and children tend to share similar traits, such as human capital, due to intergenerational linkages, aggregate variables are more heavily influenced by the traits of parents with stronger fertility responses. Therefore, the policy effects on aggregate human capital differ from averaging the short-run treatment effects within households because the weights change endogenously.

Third, family policies interact with the existing tax and transfer system in an important way, a channel that I call the *demographic structure effects*. Following an increase in the population growth rate, the burden of pension and Medicare payments is alleviated, tax revenues from the working-age population rise, but public expenditures for children increase. Despite being one of the most important benefits that governments have in mind when implementing family policies, the quantitative feasibility of this channel and its distributional implications along the transition path have been little studied. This paper aims to fill this gap in the literature.

I argue that fertility elasticities across the human capital distribution play a central role in determining the strength of the aforementioned mechanisms. First, the aggregate fertility elasticity provides insight into how much children's human capital will be affected for an average household under different policies, due to the quantity-quality trade-off. Second, the differential fertility elasticities by parents' human capital determine the magnitude of the composition effects. Lastly, the effectiveness of demographic effects in relieving the burden of pension payments depends on both the average and differential fertility responses.

I therefore discipline fertility elasticities in two ways. First, I calibrate the model to match the U.S. economy in 2010 and identify the elasticity of intergenerational substitution (EGS), a key parameter affecting fertility elasticities.[2] Second, I show that the model's predictions align with a collection of empirical estimates, including my own evaluation of the Alaska Permanent Fund Dividend (APFD), a cash transfer policy that implicitly encourages parents to have more children. Given the important role of the quantity-quality trade-off and hence child human capital formation, I also validate the model's predictions on the returns to education investments using quasi-experimental evidence from García et al. (2020) and the meta-analysis by Jackson and Mackevicius (2024).

I use the calibrated model to analyze three policies: baby bonus, education expansion, and paid parental leave to show the versatility of the framework and compare the different instruments that the government could adopt. I show that a baby bonus of $30,000 boosts the average fertility rate in the U.S. from 1.92 children per woman to 2.0 children per woman. The amount of this transfer is 1% of GDP and similar to the expansions of the maximum payment of the Child Tax Credit (CTC) from

[2] As defined in Córdoba et al. (2016) and Córdoba and Ripoll (2019), the elasticity of intergenerational substitution (EGS) quantifies the inter-personal willingness to substitute consumption across generations.

2010 to 2021 in net present value, taking the American Rescue Plan Act of 2021 into account. I find that parents with lower human capital respond more strongly to the baby bonus, raising fertility by a greater proportion. However, such a child benefit reduces child human capital and exacerbates inequality in the long run. Surprisingly, long-run average welfare—measured by the average utility of newborns under the veil of ignorance in the baseline analysis—increases by 0.4% in consumption equivalents despite lower human capital. The main driver of the welfare gain is the re-distribution benefits of the baby bonus that shift resources from households with low marginal utilities to those with high marginal utilities, such as from the old to the young, from the rich to the poor, and from those without children to those with children. Furthermore, the baby bonus policy induces a large change in the composition of government expenditures, where pension and Medicare payments are replaced by the baby bonus and additional public education expenditures.

When I analyze the transition path of the baby bonus, I find that the welfare consequences for existing agents are vastly different from those in the transition or in the long-term steady state. During the initial decades of transition, the government needs to finance both direct policy expenses and higher child-related public expenditures as children constitute a larger proportion of the population. While the old-age dependency ratio gradually decreases, the total dependency ratio exceeds the long-term level for a few decades before converging. Therefore, even though the policy leads to long-run gains, whether it will be implemented depends on how these additional tax burdens fall on agents in the current economy and those along the transition path.

I also use the model to evaluate alternative policies, including public education expansions and paid parental leaves. I find that education expansion is able to reconcile four potentially contradictory objectives: boosting fertility, improving children's outcomes, raising average welfare, and reducing income inequality. This is because (1) when parents are altruistic, the improvement in their descendants' welfare incentivizes them to have more children,[3] and (2) the composition effect due to potential mothers having higher human capital is not strong enough to overturn the previous channel because the fertility-income profile is relatively flat. On the other hand, paid parental leave—where the payment is proportional to parents' wages—has a mild fertility effect under the same aggregate policy budget, but it also has a much smaller negative impact on children's human capital compared with the baby bonus.

Besides these specific policy counterfactual results, the analysis also offers three lessons that could be useful for family policy design and analysis in general. First, I show that the criterion of first-order stochastic dominance (FOSD) in human capital distribution is neither necessary nor sufficient for higher welfare, in contrast to the results in Chu and Koo (1990). Solely focusing on the human capital distribution consequences misses the important re-distribution and general equilibrium implications of family policies and tends to result in misleading recommendations such

[3] In Appendix B.2, I discuss the sensitivity of this result with respect to the assumption of dynastic altruism.

as selectively promoting or restricting fertility among parents with certain traits.[4]

Second, I show that a unified model with both quantity and quality of children is essential to integrate two strands of the empirical literature—one focusing on the effects of income transfer or education investments on children's human capital formation, and the other focusing on fertility responses to policies. The former literature estimates within-child effects, while the latter literature sheds light on the potential quantity-quality trade-off and between-child composition effects. Therefore, while these estimates are extremely important in informing the partial-equilibrium effects of policies and model parameterization, they miss out on predicting the aggregate consequences, either in the short run or in the long run, if used in isolation.

Third, I argue that it is crucial to think about the interaction between family policies and other existing institutions, such as education, taxation, pension, and other old-age transfers, for instance Medicare. Because family policies change fertility and hence the demographic structure of the whole economy, the interaction effects of family policies and other policies could be of first-order importance for all kinds of aggregate variables. This paper provides a first step in evaluating such interaction effects quantitatively.

Related Literature

This paper is closely related to the macroeconomic literature that studies economies with endogenous fertility choices and the effects of related policies. Notable examples include Barro and Becker (1989), de La Croix and Doepke (2003), Erosa et al. (2010), Liao (2013), Córdoba et al. (2019), Jones (2020), Kurnaz and Soytas (2019), and Ortigueira and Siassi (2022), among others (see Greenwood et al. 2017, Guo et al. 2022, and Doepke et al. 2022 for recent reviews). This paper makes three contributions to the literature. First, I demonstrate that in a setting with a multi-period life cycle and old-age transfers, family policies that lower human capital do not necessarily reduce average welfare due to demographic structure effects. This result contrasts with previous studies that abstract from these modeling ingredients, e.g., Chu and Koo (1990) and Kim et al. (2021). Second, I show that fertility elasticities are critical moments governing fertility-related mechanisms in this class of models and merit greater attention. Motivated by this theoretical observation, I conduct and utilize empirical estimates of fertility elasticities to discipline the model's quantitative predictions, ensuring consistency with the cross-sectional joint distribution of fertility and income as well as comparative statics under various policies. Third, I provide a novel framework tailored to analyzing the key trade-offs in family policies and their interactions with other taxes and transfers. In

[4] Córdoba and Liu (2016) make a related point by arguing that stochastic dominance criteria is insufficient for welfare increase because with dynastic altruism, policies restricting fertility reduces the set of feasible choices and hence the welfare of all individuals in all generations.

this regard, the models in Manuelli and Seshadri (2009), Daruich and Kozlowski (2020), and Kim et al. (2021) are the most closely related, albeit addressing different research questions. Specifically, Manuelli and Seshadri (2009) incorporate endogenous fertility, human capital, and life span to study the role of productivity and taxes in shaping fertility across countries. My paper differs by adding heterogeneities in human capital across parents to examine composition effects and income inequality. Daruich and Kozlowski (2020) develop an Aiyagari-Bewley-Huggett framework to study how fertility choices affect intergenerational mobility through family transfers. My approach differs by including endogenous child human capital formation, enabling the model to address children's labor market outcomes and the dynamic effects of policies, as children with higher human capital become better parents. Kim et al. (2021) builds a novel model of the quantity-quality trade-off with status externalities to explain the fertility-income relationship in South Korea and conduct policy counterfactuals such as baby bonuses and education taxes. My paper differs by modeling a multi-period life cycle and including old-age transfers, which are among the key features allowing the model to generate higher average welfare in the long run despite deteriorating aggregate human capital.

This paper also contributes to the literature evaluating the impacts of transfers to parents on children's lifetime outcomes, social mobility, and inequality (Dahl and Lochner 2012; Daruich 2018; Abbott et al. 2019; Mullins 2019; García et al. 2020). The conventional wisdom in this literature is that transfers to families have positive impacts on children, including improved health, educational attainment, and reduced criminal behavior (Schanzenbach et al. 2021). My paper incorporates endogenous fertility responses while leveraging estimates from this literature to quantify the human capital formation component of the model. Including the fertility margin allows me to study the policy impacts on all children, including those induced to be born by the policy itself. I show that under empirically plausible fertility elasticities, introducing the "extensive margin" of fertility choice could reverse the predicted policy effects on average child outcomes and income inequality in many cases. Most importantly, beyond the quantity-quality trade-off *within* households, the composition effects induced by heterogeneous fertility responses *between* households create a gap between observed short-run treatment effects and equilibrium long-run outcomes. This gap needs to be considered in policy evaluations and counterfactuals. In particular, government transfers tied to the number of children, such as the Child Tax Credit (CTC) or Universal Basic Income, may have unintended consequences.

Finally, this paper relates to empirical studies on the fertility effects of family policies (e.g., Milligan 2005; Haan and Wrohlich 2011; Drago et al. 2011; González 2013; Laroque and Salanié 2014; Gaitz and Schurer 2017). These studies leverage variations from historical policies to examine how government transfers affect fertility choices among an existing group of potential parents. My paper contributes by providing a structural method to project the fertility effects of family policies across households and over time, accounting for changes in the underlying distribution of parents.

The rest of the paper is organized as follows. In Section 2, I present the quantitative model. Section 3 describes the calibration of the model in detail. Section 4 conducts validation exercises. Section 5 presents the baby bonus counterfactual. Section 6 studies education expenditure expansion and paid parental leave. Section 7 concludes.

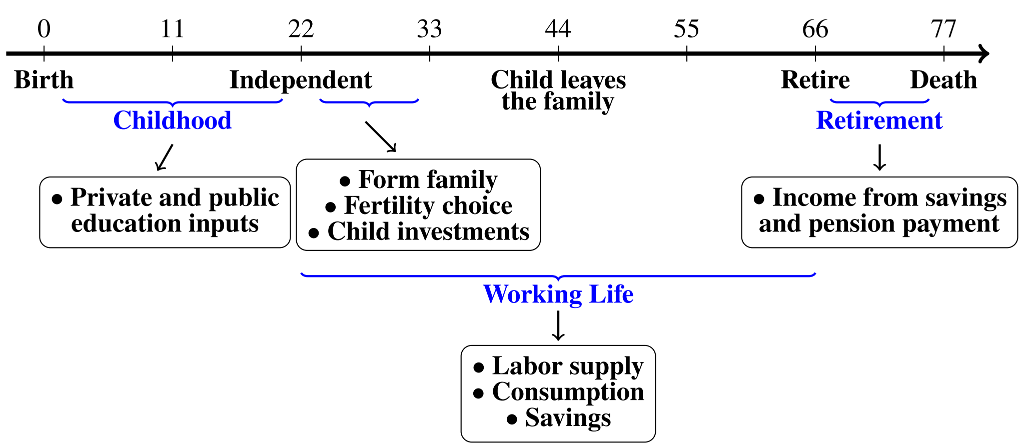
2 Model

I develop a general equilibrium overlapping generations (GE-OLG) model to evaluate the macroeconomic and distributional implications of family policies. The economy consists of single and married households making decisions over consumption, savings, labor supply, fertility (child quantity), and education investments (child quality), where education investments encompass both monetary and time inputs. Parents are heterogeneous in their human capital and face idiosyncratic uninsurable shocks under credit constraints. Representative firms hire labor and rent capital from households. The government levies labor, capital, and consumption taxes to finance public education, old-age transfers (including pensions and Medicare), family policies, and other expenditures.

2.1 Households

The economy is populated by overlapping generations of individuals living up to 77 years. The life cycle is divided into seven periods, indexed by $j \in \{0, 1, 2, \ldots, 6\}$, each spanning 11 years. Period j corresponds to ages $j \times 11$ to $(j + 1) \times 11$.

Figure 1: Agents' Life Cycle



Notes: This figure plots the life cycle and main events of agents in the model.

Figure 1 illustrates the life cycle of agents in the model. During the first two periods (ages 0–22), children are passive, receiving human capital investments from their parents and the government. These investments, combined with idiosyncratic ability draws and parental spillovers, determine the children's initial human capital h. At the beginning of the third period (age 22), individuals become independent and draw a permanent family structure type $x \in \{M, SF, SM\}$, representing married couples, single females, and single males, respectively. The marriage probability $\mathbb{P}(h)$ depends on an individual's human capital h. Single males remain childless, while married households and single females decide their fertility.[5]

From ages 22 to 66, adults participate in the labor market, with earnings determined by market wages, hours worked, and human capital. Human capital evolves stochastically according to an age-specific law of motion, subject to idiosyncratic, uninsurable shocks. Individuals derive utility from consumption and disutility from labor supply, with those who have children also deriving utility from altruism. Following the Aiyagari-Bewley-Huggett framework, adults face credit constraints, preventing borrowing against their own or their children's future income, which incentivizes precautionary and life-cycle savings. Agents retire at the beginning of period 6 (age 66), receiving income from savings and pension payments for the remainder of their lives.

Below, I present the optimization problem for married couples. The optimization problems for single females and males are analogous and are detailed in Appendix A.

Married Couples from 22 to 33

For married households, I use symbols ♀, ♂, and k to denote variables related to the wife, husband, and child(ren), respectively. Parents with human capital h make decisions over consumption c, savings a', labor supply l, fertility n, consumption per child c_k, and investments in children's human capital, including time input e and monetary input m per child. Each child also imposes a fixed time cost χ on the family.[6]

Following Guner et al. (2020), the optimization problem of married households is given by

$$V_2^M(h) = \max_{c_♀, c_♂, c_k, a', l_♀, l_♂, n, e, m \geq 0} \quad u(c_♀, l_♀ + n(\chi + e)) + u(c_♂, l_♂) + \beta \mathbb{E} V_3^M(a', h', n, h_k) + 2\mathcal{Q}(n) u(c_k, 0) \tag{1}$$

[5]In Appendix B.3, I discuss how the results will change if parent(s) could also decide the timing of fertility.

[6]To ensure tractability, I make three simplifying assumptions. First, I assume perfectly assortative matching in the marriage market and unitary household decision-making, requiring only a one-dimensional human capital h for the household. Second, I adopt a "separate sphere" assumption (Lundberg and Pollak 1993) where mothers bear childcare responsibilities. Guner et al. (2020) also make this assumption by only letting mother bear the fixed time cost of children. Lastly, following a large class of fertility models in the literature, I assume that the number of children is a continuous choice variable for parents.

subject to

$$\underbrace{a'}_{\text{savings}} + \underbrace{c_{♀} + c_{♂} + n(c_k + m)}_{\text{total expenditures}} = \underbrace{y - \mathcal{T}^M(y, 0, c_{♀} + c_{♂} + n(c_k + m), n)}_{\text{income net of taxes}} + \underbrace{n \cdot (\mathcal{B} + wh\mathcal{P})}_{\text{child-related subsidies}} \tag{2}$$

$$y = wh \cdot (\upsilon l_{♀} + l_{♂}) \tag{3}$$

$$h_k = \mathcal{H}(h, e, m, \epsilon, \mathcal{E}) \tag{4}$$

$$h' = L_2(h, z') \tag{5}$$

In the objective function (1), the couple derives utility from consumption $c_{♀}$ and $c_{♂}$, disutility from total hours worked—for women, this includes labor supply $l_{♀}$ and time devoted to child-rearing and education $n(\chi + e)$—altruism from children's consumption c_k, and the expected continuation value $\mathbb{E}V_3(\cdot)$. Following Barro and Becker (1989), $\mathcal{Q}(n)$ is a positive, strictly increasing, and concave function governing the degree of intergenerational altruism.

Equation (2) specifies the household's budget constraint. For young parents, income primarily comes from earnings y net of taxes $\mathcal{T}^M(\cdot)$, which depend on labor income, asset position, total consumption, and the number of children. For each child, the couple receives baby bonuses $\mathcal{B}$ and paid parental leave $\mathcal{P}$, the latter scaling with the parents' wage. Expenditures include savings a', parental consumption $c_{♀}$ and $c_{♂}$, children's consumption c_k, and monetary investments in children's human capital m.

Equation (3) indicates that household labor earnings y depend on the market wage w, human capital h, and hours worked by both spouses $l_{♀}$ and $l_{♂}$, with υ capturing the gender wage gap.

Equation (4) represents the child human capital production function, where children's human capital h_k depends on parental human capital h, parental time input e, monetary input m, idiosyncratic ability shock ϵ, and government expenditure $\mathcal{E}$.

Equation (5) describes the age-dependent law of motion for the couple's human capital, where next-period human capital h' depends on current human capital h and an idiosyncratic, uninsurable shock z' realized at the start of the next period.

Married Couples from 33 to 44

The maximization problem for parents aged 33 to 44 is given by

$$\begin{aligned} V_3^M(a, h, n, h_k) = \max_{c_{♀}, c_{♂}, c_k, a', l_{♀}, l_{♂} \geq 0} \quad & u(c_{♀}, l_{♀}) + u(c_{♂}, l_{♂}) + \beta \mathbb{E} V_4^M(a', h') \\ & + 2\mathcal{Q}(n)\left(u(c_k, 0) + \mathbb{P}(h_k) \cdot \frac{V_2^M(h_k)}{2} + (1 - \mathbb{P}(h_k)) \cdot \frac{V_2^{SF}(h_k) + V_2^{SM}(h_k)}{2}\right) \end{aligned} \tag{6}$$

subject to

$$a' + c_{\female} + c_{\male} + nc_k = (1+r)a + y - \mathcal{T}^M(y, a, c_{\female} + c_{\male} + nc_k, n)$$

$$y = wh \cdot (\upsilon l_{\female} + l_{\male})$$

$$h' = L_3(h, z')$$

In the objective function (6), the couple derives utility from consumption $c_{\female}$ and $c_{\male}$, disutility from labor supply $l_{\female}$ and $l_{\male}$, and altruism from their children's consumption c_k and continuation value, weighted by marriage probabilities $\mathbb{P}(h_k)$. At this stage, the couple no longer incurs childcare costs or makes human capital investments.

Married Couples from 44 to 66

For periods $j \in \{4, 5\}$, households solve a standard consumption-savings problem with endogenous labor supply and idiosyncratic human capital shocks:

$$V_j^M(a, h) = \max_{c_{\female}, c_{\male}, a', l_{\female}, l_{\male} \geq 0} \quad u(c_{\female}, l_{\female}) + u(c_{\male}, l_{\male}) + \beta \mathbb{E} V_{j+1}^M(a', h')$$

subject to

$$c_{\female} + c_{\male} + a' = (1+r)a + y - T^M(y, a, c_{\female} + c_{\male}, 0)$$

$$y = wh(\upsilon l_{\female} + l_{\male})$$

$$h' = L_j(h, z')$$

Since children have left the household, the couple no longer chooses c_k and does not receive favorable tax treatment.

Married Couples from 66 to 77

At $j = 6$, the retired couple receives pension income and consumes remaining resources:

$$V_6^M(a, h) = \max_{c_{\female}, c_{\male} \geq 0} \quad u(c_{\female}, 0) + u(c_{\male}, 0)$$

subject to

$$c_{\female} + c_{\male} = (1+r)a + y - T^M(y, a, c_{\female} + c_{\male}, 0)$$

$$y = \prod(\upsilon wh) + \prod(wh)$$

Pension income $\prod(\cdot)$ for each spouse depends on their end-of-working-life human capital h.

2.2 Firms

A representative firm produces final goods using a Cobb-Douglas technology:

$$Y = AK^{\alpha}H^{1-\alpha}. \tag{7}$$

In Equation (7), K is aggregate capital, H is total efficiency units employed, and total factor productivity A is normalized to one.[7]

Capital depreciates at rate δ_K. In competitive factor markets, the equilibrium wage and risk-free interest rate are:

$$r = \alpha\left(\frac{K}{H}\right)^{\alpha-1} - \delta_K \quad \text{and} \quad w = (1-\alpha)\left(\frac{K}{H}\right)^{\alpha}.$$

2.3 Government

The government collects revenues from labor, capital, and consumption taxes to fund public education, family policies, old-age transfers, and other invariant expenditures, maintaining a balanced budget each period. I assume that besides pension payments, the government also has an obligation of Medicare expenditures on retirees.

Using $\{\mu_j\}_{j=0}^{6}$ to denote the distribution of households across the state space conditional on age and $\{\omega_j\}_{j=0}^{6}$ for the fraction of each age group ($\sum_{j=0}^{6}\omega_j = 1$), the government budget is:

$$\begin{aligned}\underbrace{\sum_{j=2}^{6}\omega_j \int \mathcal{T}^x(y_j^*, a_j^*, c_j^*, n_j^*)\, d\mu_j}_{\text{labor, capital, and consumption taxes}} = \underbrace{(\omega_0+\omega_1)\cdot\mathcal{E}}_{\text{public education expenditures}} + \underbrace{\omega_6\cdot\left(\int \Pi\, d\mu_6 + \mathcal{M}\right)}_{\text{pension and Medicare payments}} \\ \underbrace{+\,\omega_2\left(\underbrace{\int n^*\cdot\mathcal{B}\, d\mu_2}_{\text{baby bonus}} + \underbrace{\int whn^*\cdot\mathcal{P}\, d\mu_2}_{\text{paid parental leaves}}\right)}_{\text{family policy expenditures}} + \underbrace{\sum_{j=2}^{6}\omega_j\cdot\Xi}_{\text{other spending}}.\end{aligned} \tag{8}$$

2.4 Equilibrium

Let t denote time. The equilibrium is defined as a tuple of:

- decision rules $\{c_{♀,t}^*(\cdot), c_{♂,t}^*(\cdot), c_{k,t}^*(\cdot), a_t'^*(\cdot), l_{♀,t}^*(\cdot), l_{♂,t}^*(\cdot), n_t^*(\cdot), e_t^*(\cdot), m_t^*(\cdot)\}_{t=0}^{\infty}$,
- prices $\{w_t^*, r_t^*\}_{t=0}^{\infty}$,

[7]I abstract from population externalities such as pollution (Bohn and Stuart, 2015) or idea creation (Jones, 2020; Peters, 2022) because the literature on measuring these externalities is still developing. Including these elements would alter the output and welfare results in predictable ways.

- government policies $\{\mathcal{T}_t(\cdot), \mathcal{B}_t, \mathcal{P}_t, \mathcal{E}_t, \mathcal{M}_t, \Xi_t, \Pi_t(\cdot)\}_{t=0}^{\infty}$, and
- distribution of agents $\{\{\mu_{j,t}\}_{j=0}^{6}, \{\omega_{j,t}\}_{j=0}^{6}\}_{t=0}^{\infty}$,

such that households maximize utility subject to idiosyncratic shocks, prices clear labor and capital markets, the government balances its budget each period, and the distribution of agents evolves according to household decisions, exogenous human capital shocks z, and child ability shocks ϵ.

Let $s = \{x, h\}$ denote the state variable of parents at $j = 2$. The aggregate fertility rate is:

$$N_t = \int n^*(s)\, d\mu_2(s). \tag{9}$$

The evolution of the children's human capital distribution is:

$$\mu'_{2,t+2}(h) = \frac{1}{N_t} \iint n_t^*(s) \mathbb{1}_{h_k^*(s,\epsilon)<h}\, d\mu_{2,t}(s)\, d\mathcal{N}(\epsilon), \tag{10}$$

where $\mathcal{N}(\cdot)$ is the distribution of child ability shocks ϵ, and $h_k^*(s,\epsilon)$ is the human capital of a child with ability shock ϵ and parental state s. The subscript $t+2$ reflects the two-period lag for children to enter the economy.

In a stationary equilibrium, decision rules, prices, and distributions are time-invariant, though population size may vary if the aggregate fertility rate deviates from replacement. In the quantitative part of the paper, I verify the existence and uniqueness of the stationary equilibrium numerically in the parameter space that I focus on.

2.5 Welfare

To compare government policies, I adopt an average utilitarian welfare metric, defining long-run social welfare $\mathcal{W}$ as the expected utility of newborns under the veil of ignorance. Let $\mathcal{V}(h_k)$ denote the ex-ante utility of a child with human capital h_k before the family structure draw:

$$\mathcal{V}(h_k) = \mathbb{P}(h_k) \cdot \frac{V_2^M(h_k)}{2} + (1 - \mathbb{P}(h_k)) \cdot \frac{V_2^{SF}(h_k) + V_2^{SM}(h_k)}{2} \tag{11}$$

The average welfare is:

$$\mathcal{W} = \int \mathcal{V}\, d\mu_2, \tag{12}$$

where $\mathcal{V}$ and μ_2 are endogenous equilibrium objects. Changes in $\mathcal{W}$ are converted to consumption equivalents for welfare comparisons. Since $\mathcal{W}$ does not capture effects on agents alive at policy implementation or during the transition, these are analyzed in Section 5.2. Alternative welfare measures are discussed in Section 5.3 and Appendix D.

2.6 The Role of Government

Government policies may enhance welfare in the economy for three reasons. First, childbearing and child-rearing generate fiscal externalities, as parents do not internalize the impact of their fertility or child human capital investments on the future tax base and government revenues. Parents take the age structure $\{\omega_j\}_{j=0}^{6}$, distribution $\{\mu_j\}_{j=0}^{6}$, factor prices, and tax rates as given, but these adjust when fertility and education decisions change en masse. Schoonbroodt and Tertilt (2014) argue that, due to parents' lack of property rights over children's future output, equilibrium fertility is suboptimal. In a model with heterogeneous agents and public transfers, equilibrium fertility may be too high or too low depending on parental characteristics. However, policy implications are not straightforward. While intergenerational persistence of human capital might suggest restricting fertility among low-income households (Chu and Koo, 1990), I demonstrate in subsequent sections that, besides ethical concerns, this view is incorrect as it overlooks demographic structure effects and redistributive implications.

Second, credit constraints prevent parents from borrowing against their own or their children's future income to finance current expenditures, such as child human capital investments. Government policies, through in-cash or in-kind transfers, can address these intertemporal inefficiencies (Córdoba and Ripoll, 2016; Daruich, 2018; Abbott et al., 2019).

Third, government policies can enhance welfare by redistributing resources from agents with low marginal utilities to those with high marginal utilities, particularly from old, affluent households to young, low-income households with children. Under average utilitarianism, such redistribution increases ex-ante welfare.

2.7 Discussion of Mechanisms

In this section, I elucidate the mechanisms through which family policies influence the economy, emphasizing how the model's features—particularly endogenous fertility and demographic structure—generate predictions distinct from those of standard models lacking these elements. The discussion focuses on three key channels: the quantity-quality trade-off, composition effects, and demographic structure effects.

Quantity-Quality Trade-Off

Consider the impact of an increase in the baby bonus $\mathcal{B}$ on private monetary investment in child human capital formation m, which influences expected child human capital $\mathbb{E}h_k$.

The first-order condition for m is given by

$$\underbrace{MU_c \cdot n}_{\text{marginal costs of } e} = \underbrace{\mathcal{Q}(n) \times \frac{\partial \mathcal{V}}{\partial \mathbb{E}h_k} \times \frac{\partial \mathbb{E}h_k}{\partial m}}_{\text{marginal benefits of } e}. \qquad \text{FOC } [m]$$

When fertility is exogenous (i.e., n is fixed), an increase in $\mathcal{B}$ acts as a pure income transfer, unambiguously increasing m due to income effects. As the marginal utility of consumption MU_c decreases, m must rise to satisfy the first-order condition, leading to higher expected child human capital $\mathbb{E}h_k$.

However, when fertility is endogenous, an increase in $\mathcal{B}$ represents a price change, rendering the effect on m ambiguous. Higher fertility n due to more generous child benefits affects the first-order condition in three ways. First, it increases parental altruism $\mathcal{Q}(n)$ on the right-hand side, encouraging higher investments. Second, rising fertility may offset income effects through MU_c, as raising additional children is costly, depending on the relative magnitudes of income and fertility changes. Third, the marginal cost of m rises proportionally with n due to their interaction in the budget constraint (Equation (2)).[8] Incorporating endogenous fertility allows for the possibility that m—and thus child human capital h_k—may decrease when family policies become more generous. This logic also applies to time investments e.

Composition Effects

Parents, differing in human capital h, respond heterogeneously to family policies such as baby bonuses $\mathcal{B}$, parental leave $\mathcal{P}$, or public education expenditures $\mathcal{E}$. Children from families with stronger fertility responses constitute a larger share of the future population. Coupled with the intergenerational transmission of traits, these differential fertility responses generate *composition effects*, causing aggregate variables to shift toward the characteristics of households with the largest fertility increases. In the past literature, the composition effect has been investigated in the context of aggregate variables like economic growth (de La Croix and Doepke, 2003) and public opinion on family values (Vogl and Freese, 2020).

In the context of this paper, the average human capital of children in the economy is given by

$$\underbrace{\overline{h}_k}_{\text{average } h_k} = \iint \underbrace{\frac{n^*(s)}{N}}_{\text{fertility weight}} \cdot \underbrace{h_k^*(s,\epsilon)}_{\text{individual child's } h_k} \, d\mu_2(s)\, d\mathcal{N}(\epsilon), \qquad (13)$$

[8] Becker and Lewis (1973) termed this last effect the quantity-quality trade-off. Here, I extend the term to encompass the overall effect of increased fertility on child quality. While studies like Black et al. (2005) and Angrist et al. (2010) find limited evidence of this trade-off using twin births as instruments, Mogstad and Wiswall (2016) challenge these findings by relaxing linear specification constraints, identifying a trade-off for larger families and complementarities for smaller ones.

where N is the aggregate fertility rate defined in Equation (9). Family policies alter fertility weights $n^*(s)/N$ across households. Even if individual child human capital $h_k^*(s, \epsilon)$ remains unchanged for a given household, $\overline{h}_k$ shifts toward families with increasing fertility weights.

Moreover, as children mature into parents, $\overline{h}_k$ is further influenced by *dynamic composition effects* because the distribution μ_2 is endogenous. This aligns with Daruich (2018), who argues that early childhood education investments yield greater long-term benefits than short-term ones. Theoretically, composition effects allow for the possibility that aggregate human capital declines even when policies positively affect individual children's human capital within each household (Pop-Eleches, 2006; Kim, 2024).

Demographic Structure Effects

With endogenous fertility, family policies alter the population growth rate, thereby reshaping the demographic structure $\{\omega_j\}_{j=0}^{6}$. Besides affecting the supply of labor and capital, changing demographic structure has significant implications for the government budget constraint (Equation (8)), as the demographic structure determines the weighting of revenue and expenditure components.

Most macroeconomic models with endogenous fertility assume two-period-lived agents. In such models, higher population growth unambiguously increases the fiscal burden, as fewer tax-paying adults finance public education for more children, necessitating higher tax rates. However, many developed countries implementing family policies anticipate *lower* tax rates in the long run. The critical missing element in prior models is the presence of retired households receiving pension and Medicare payments.

In a multi-period life cycle model, the effect of higher population growth on budget-balancing tax rates is ambiguous, depending on the age-specific profile of net government transfers. Holding human capital distribution constant, higher fertility reduces tax rates in the long run if old-age payments outweigh child-related expenditures. This mechanism generates perpetual welfare gains because under a pay-as-you-go (PAYG) pension system, growing cohort sizes benefit all households. Additionally, as the government relies on distortionary tax instruments, lower tax rates may improve efficiencies of labor supply and child human capital investments. I call these effects *demographic structure effects* in the general equilibrium.

Summary of Mechanisms

The model integrates a unique combination of features, enabling it to capture three critical mechanisms through which family policies affect the economy: the quantity-quality trade-off, composition effects, and demographic structure effects. The quantitative impact of these mechanisms hinges on fertility responses to policies (fertility elasticities). If fertility were fixed, family policies would produce (1) pure income effects on child outcomes, (2) no composition effects, and (3) no demographic structure effects. Thus, accurately estimating fertility elasticities is a central quantitative task.

In Section 3, I discipline fertility elasticities using calibrated model parameters. In Section 4, I demonstrate that the model's fertility response predictions align with empirical evidence.

3 Calibration

This section outlines the parameterization, calibration procedures, and model fit. Following standard practice, some parameters are set exogenously, either adopting conventional values or aligning with observable data. The remaining parameters are calibrated within the steady-state model to match moments for the United States in the year 2010 (or as close in time as possible), ensuring the model accurately reflects key economic, demographic, and institutional patterns.

3.1 Preferences

Agents derive utility from consumption and experience disutility from labor supply. The utility function $u(c, l)$ is specified as

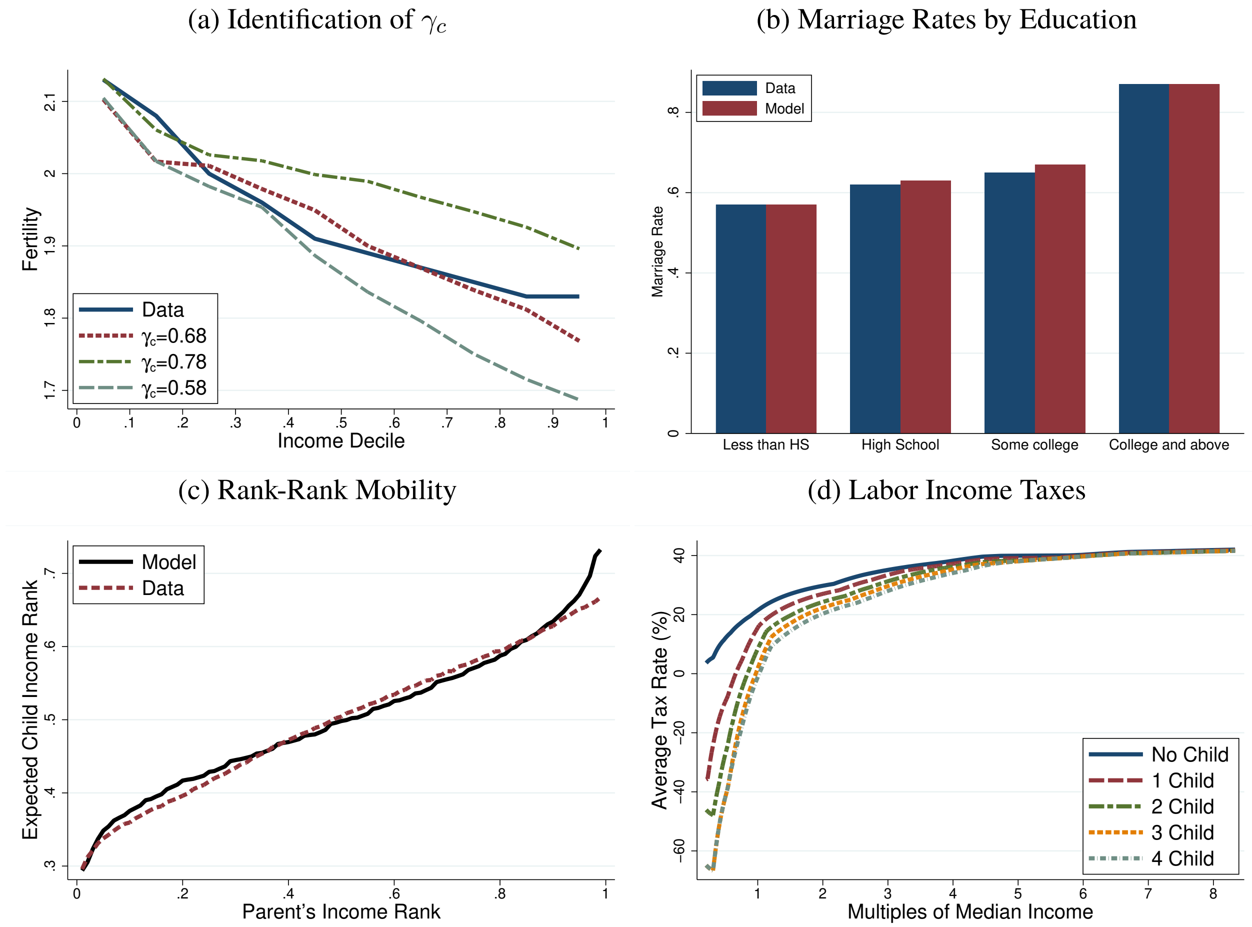
$$u(c,l) = \frac{c^{1-\gamma_c}}{1-\gamma_c} - \iota \frac{l^{1+\gamma_l}}{1+\gamma_l}. \tag{14}$$

The parameter γ_c governs both the intertemporal elasticity of substitution and the elasticity of intergenerational substitution (EGS), as defined in Córdoba et al. (2016) and Córdoba and Ripoll (2019).[9]

The parameter γ_c influences fertility elasticity, as higher values accelerate the decline in marginal utility from altruism toward children's value function $\mathcal{V}$. A lower shadow price of children thus amplifies fertility responses to balance the first-order condition. Following Córdoba et al. (2016), γ_c is identified by its effect on the income-fertility profile: higher γ_c reduces the marginal utility of consumption for wealthier parents, making fertility a more attractive adjustment margin, leading to a flatter income-fertility relationship. I set $\gamma_c = 0.68$ to match the observed fertility-income relationship from the Current Population Survey (CPS) June Fertility Supplement (2008–2014), as illustrated in Figure 2a. Given the important role of γ_c, I show how the main results will change when γ_c is reduced by 0.05, holding other parameters unchanged, in Appendix B.6.

[9] The EGS captures intergenerational interactions, differing in magnitude and interpretation from the elasticity of intertemporal substitution (EIS) used in business cycle models to reflect risk aversion. With separable utilities for own consumption and altruism, assuming identical EIS and EGS ensures the existence of long-run steady states (Barro and Becker, 1989; Soares, 2005). For recent models with non-separable utilities, see Córdoba and Ripoll (2019).

Figure 2: Model Calibration



Notes: Figure 2a illustrates the relationship between household income and fertility in the model for different γ_c values, compared to data from the CPS June Fertility Supplement (2008–2014). Fertility is measured as the number of live births for women aged 40–55, plotted against household income deciles. Model fertility is adjusted for stationarity to match the U.S. total fertility rate of 1.92 children per woman in 2010.
— Figure 2b shows marriage rates for women aged 25–35 with children, using 2010 American Community Survey (ACS) data. To align education groups with model income deciles, I compute average income ranks for each education group using CPS-ASEC data (2008–2014).
— Figure 2c compares model-predicted relationship between parents' income rank and children's expected income rank with the estimates from Chetty et al. (2014).
— Figure 2d displays average tax rates by household income and number of dependent children, calculated using TAXSIM.

In Equation (14), ι governs labor supply disutility, and γ_l determines the Frisch labor supply elasticity. I set $\gamma_l = 3$, consistent with Meghir and Phillips (2010), and calibrate $\iota = 25$ to match average weekly hours worked (34 hours) from the CPS Annual Social and Economic Supplement (CPS-ASEC, 2008–2014).

Motivated by the exponential discounting approach in Córdoba et al. (2016), the altruism function $\mathcal{Q}(n)$ is parameterized as

$$\mathcal{Q}(n) = 1 - \exp(-\psi n) \tag{15}$$

which is positive, increasing, and concave, satisfying Barro and Becker (1989). To be compatible with $\mathcal{Q}(n)$, value of children $\mathcal{V}(\cdot)$ needs to be positive. I checked that this condition is satisfied in the equilibrium. Because higher ψ reduces altruism for additional children and hence lowers fertility, I calibrate $\psi = 1.65$ to match the U.S. total fertility rate of 1.92, computed from age-specific fertility rates in the CPS.[10]

3.2 Family Structure

The probability of marriage at the onset of adulthood depends on initial human capital h, specified as

$$\mathbb{P}(h) = \alpha_0^{\mathcal{M}} + (1 - \alpha_0^{\mathcal{M}}) \cdot (1 - \exp(-\alpha_1^{\mathcal{M}} \cdot h)) \tag{16}$$

Here, $\alpha_0^{\mathcal{M}}$ sets the baseline marriage probability when $h = 0$, and $\alpha_1^{\mathcal{M}}$ governs its sensitivity to human capital. I calibrate $\alpha_0^{\mathcal{M}} = 0.45$ and $\alpha_1^{\mathcal{M}} = 0.70$ to match marriage rates by education for women aged 25–35 with children, using CPS-ASEC data (2008–2014). Education groups (less than high school, high school, some college, college and above) are mapped to income ranks to align data and model moments. Figure 2b shows that marriage rates increase with education. In the model, the marriage gap by income amplifies intergenerational inequality as married households have more resources for child human capital investments.

3.3 Child's Human Capital Production

The child human capital production function is

$$h_k = \mathcal{H}(h, e, m, \epsilon, \mathcal{E}) = \underbrace{Z}_{\text{scalar}} \cdot \underbrace{\epsilon}_{\text{shock}} \cdot (\underbrace{e^{\theta} \cdot m^{1-\theta} + \mathcal{E}}_{\text{investments}})^{\kappa} \cdot \underbrace{h^{\rho}}_{\text{spillover}}, \tag{17}$$

where child ability shock ϵ follows $\log(\epsilon) \sim \mathcal{N}\left(-\frac{\sigma_\epsilon^2}{2}, \sigma_\epsilon^2\right)$.

The scaling parameter $Z = 4.1$ normalizes the median income of young parents to 0.1, corresponding to the 2010 Census household median income of \$50,000. The ability shock dispersion $\sigma_\epsilon = 1.2$ matches earnings dispersion for households aged 22–33 in CPS-ASEC data (2008–2014).

Following Lee and Seshadri (2019), parental time (e) and monetary (m) inputs form a Cobb-Douglas composite investment. I choose $\theta = 0.6$ to match the wage-adjusted time share of total costs (80%) in the first period of children's lives, based on the estimates presented in Figure 7B of Lee and Seshadri (2019), calculated using data from the Panel Study of Income Dynamics Child Development Supplement (PSID-CDS).

[10] See Appendix B.4 for alternative measures of fertility (by income).

The elasticity of child human capital to composite investments, including public education $\mathcal{E}$, is governed by $\kappa = 0.4$. I calibrate κ to match the average educational childcare time calculated by Guryan et al. (2008) using data from the American Time Use Survey (ATUS).[11]

Regarding $\mathcal{E}$, the National Center for Education Statistics (NCES) suggests that the public education expenditure is around \$12,000 per student annually. However, Zheng and Graham (2022) document that local property tax revenues explain about 40% of the public school funding. Therefore, I set $\mathcal{E} = \$12,000 \times 60\%$ because local property tax contributions are better captured by the parental spillovers h^{ρ} in the model.

Non-homotheticity in the production function, owing to public education expenditure $\mathcal{E}$, incentivizes affluent parents to allocate a larger share of their income to monetary investments in child human capital. Coupled with increased spending on children's consumption driven by altruistic motives, the model predicts that total per-child expenditures rise with parental income. Lino (2008) (Table ES1) reports that, compared to low-income married households, middle-income married households spend 1.38 times more per child, and high-income married households spend 2.01 times more. Using the same (annual) income cutoffs, \$45,800 and \$77,100, in model units to define low-, middle-, and high-income married households, I calculate per-child expenditure ratios of 1.40 and 2.2, respectively. These non-targeted moments conform to the empirical estimates from Lino (2008), validating the model's ability to capture income-driven variations in child-related expenditures and hence child outcomes.

The parameter $\rho = 0.24$ captures parental spillovers, calibrated to match rank-rank intergenerational mobility from Chetty et al. (2014). Relative to the total degree of intergenerational persistence of earnings, ρ accounts for about two-thirds, consistent with the results in Lefgren et al. (2012). Figure 2c presents the rank-rank income relationship between parents and children.

3.4 Government Policies

Taxes are parameterized as

$$\mathcal{T}^{x}(y, a, c, n) = y \cdot (1 - \tau_y^{x,n} y^{-\lambda_y^{x,n}}) + \tau_a ar + \tau_c c, \qquad x \in \{M, SF, SM\} \tag{18}$$

where $\{\tau_y^{x,n}, \lambda_y^{x,n}\}$ reflect tax levels and progressivity by marital status and number of children, τ_a is the capital income tax, and τ_c is the consumption tax. I estimate $\{\tau_y^{x,n}, \lambda_y^{x,n}\}$ using TAXSIM

[11] Table 1 in Guryan et al. (2008) reports total educational childcare time for all mothers and mothers with children age below 5. Given that one period is 11 years in the model, I take an average of these two estimates (1.92 hours) as a proxy.

data, applying linear interpolation for non-integer n. The resulting values are:

$$\underbrace{(\tau_y^{M,0}, \tau_y^{M,1}, \tau_y^{M,2}, \tau_y^{M,3}, \tau_y^{M,4})}_{\text{tax level for married households}} = (0.53, 0.51, 0.49, 0.48, 0.49)$$

$$\underbrace{(\lambda_y^{M,0}, \lambda_y^{M,1}, \lambda_y^{M,2}, \lambda_y^{M,3}, \lambda_y^{M,4})}_{\text{tax progressivity for married households}} = (0.15, 0.22, 0.26, 0.29, 0.3)$$

$$\underbrace{(\tau_y^{x,0}, \tau_y^{x,1}, \tau_y^{x,2}, \tau_y^{x,3}, \tau_y^{x,4})}_{\text{tax level for single households}} = (0.51, 0.48, 0.47, 0.46, 0.47), \quad x \in \{SF, SM\}$$

$$(\underbrace{\lambda_y^{x,0}, \lambda_y^{x,1}, \lambda_y^{x,2}, \lambda_y^{x,3}, \lambda_y^{x,4}}_{\text{tax progressivity for single households}}) = (0.13, 0.23, 0.28, 0.32, 0.33), \quad x \in \{SF, SM\}$$

Figure 2d shows that additional children reduce tax burdens, particularly for lower-income households, via programs like the Earned Income Tax Credit (EITC), Dependent Care Tax Credit (DCTC), and Child Tax Credit (CTC). The tax system is progressive, with subsidies for lower-income households and labor income taxes converging to 40% at higher incomes. I set $\tau_a = 0.36$ and $\tau_c = 0.05$ following Trabandt and Uhlig (2011) and Daruich and Fernández (2024).

Pension benefits are approximated using end-of-working-life human capital h to estimate average lifetime income $\widehat{y}$:

$$\widehat{y} = w \cdot \bar{l}_{\text{2 to 6}} \cdot \left(h \cdot \frac{\bar{h}_{\text{2 to 6}}}{\bar{h}_6} \right)$$

Pension benefits follow the U.S. Social Security Old Age Insurance replacement rates:

$$\Pi(h) = \begin{cases} 0.9\widehat{y} & \text{if } \widehat{y} \leq 0.3\overline{y} \\ 0.9(0.3\overline{y}) + 0.32(\widehat{y} - 0.3\overline{y}) & \text{if } 0.3\overline{y} < \widehat{y} \leq 2\overline{y} \\ 0.9(0.3\overline{y}) + 0.32(2 - 0.3)\overline{y} + 0.15(\widehat{y} - 2\overline{y}) & \text{if } 2\overline{y} < \widehat{y} \leq 4.1\overline{y} \\ 0.9(0.3\overline{y}) + 0.32(2 - 0.3)\overline{y} + 0.15(4.1 - 2)\overline{y} & \text{if } \widehat{y} > \overline{y} \end{cases}$$

where $\overline{y} \approx \$70,000$ annually. Medicare spending $\mathcal{M}$ is set to \$11,600 per retiree annually, based on total Medicare spending of \$524 billion for 45 million beneficiaries in 2010.

3.5 Other Parameters

The child time cost $\chi = 0.15$ is set following de La Croix and Doepke (2003), based on Haveman and Wolfe (1995) and Knowles (1999).

Table 1: Calibrated Parameters

Parameter	Interpretation	Value	Source
		Preference and cost	
β	discount factor (annual)	0.99	standard
γ_c	elasticity of substitution	0.68	CPS June Fertility Supplement
ψ	fertility preference	1.65	CPS June Fertility Supplement
ι	disutility of working	25	CPS-ASEC
γ_l	Frisch elasticity	3	Meghir and Phillips (2010)
χ	child time cost	0.15	de La Croix and Doepke (2003)
		Family structure	
$\alpha_0^{\mathcal{M}}$	marriage intercept	0.45	CPS-ASEC
$\alpha_1^{\mathcal{M}}$	marriage slope	0.7	CPS-ASEC
		Tax and pension	
$\tau_y^{x,n}$	tax level	see Section 3.4	TAXSIM
$\lambda_y^{x,n}$	tax progressivity	see Section 3.4	TAXSIM
τ_a	capital tax	0.36	Daruich and Fernández (2024)
τ_c	consumption tax	0.05	Daruich and Fernández (2024)
$\prod(\cdot)$	pension schedule	see text	Daruich and Fernández (2024)
$\mathcal{M}$	Medicare spending	0.02	American Medical Association
		Child human capital production	
Z	human capital scale	4.1	normalization
θ	time share of investment	0.6	Lee and Seshadri (2019)
κ	input productivity	0.4	Guryan et al. (2008)
ρ	direct spillover	0.24	Chetty et al. (2014)
σ_ϵ	ability shock dispersion	1.2	CPS-ASEC
		Wage process	
$\{\zeta\}_{j=2}^5$	wage growth	see Section 3.5	CPS-ASEC
σ_z	human capital shock dispersion	0.6	CPS-ASEC
υ	gender wage gap	0.8	CPS-ASEC
		Firm production function	
A	total factor productivity	1	normalization
α	capital share	0.33	standard
δ_k	capital depreciation (annual)	6.5%	Daruich and Fernández (2024)

Notes: This table lists model parameters. Parameters in red are calibrated endogenously to match data moments, while those in black are set exogenously based on standard values or external estimates.

Adult human capital evolves according to

$$h_{j+1} = L_j(h_j, z') = \exp(z') \cdot \zeta_j \cdot h_j \text{ and} \tag{19}$$

$$\log(z) \sim \mathcal{N}\left(-\sigma_z^2/2, \sigma_z^2\right).$$

Parameters $\{\zeta_j\}_{j=2}^5 = \{1.25, 1.15, 1.1, 1.0\}$ and $\sigma_z = 0.6$ are calibrated to match the life-cycle profile of average earnings and dispersion from CPS-ASEC data (2008–2014), with average earnings relative $j = 2$ being $\{1.25, 1.40, 1.45\}$ for $j = 3, 4, 5$ respectively, and earnings dispersion, measured using the coefficient of variation, $\text{CV}^y_{j=2} = 0.75$ and $\text{CV}^y_{j=5} = 0.90$.

Although the model matches the income Gini coefficient by design, it yields a wealth Gini coefficient of 0.66, below the observed 0.8. This is a known limitation of Aiyagari-Bewley-Huggett models (Benhabib et al., 2017). If I set the model parameters at the baseline value but impose a homogeneous fertility rate at the replacement level, the wealth Gini would be 0.45. Alternatively, if I allow for endogenous fertility choice but impose a homogeneous family structure by parents' human capital, the wealth Gini would be 0.55. These two counterfactual statistics highlight the roles of fertility and family structure in shaping wealth distribution, as noted by Scholz and Seshadri (2007), McLanahan and Percheski (2008), Guner et al. (2020), and Daruich and Kozlowski (2020).

For the firm's production function, I normalize total factor productivity $A = 1$, set the capital share $\alpha = 0.33$ (standard in the literature), and the capital depreciation rate $\delta_k = 6.5\%$ annually, following Daruich and Fernández (2024). The annual discount factor is $\beta = 0.99$, adjusted to $\beta = 0.99^{11}$ for the 11-year period length.

Table 1 summarizes the parameters and their identifying moments. Table B.1 presents the sensitivity of key parameters to moment changes, and Table B.2 shows moment elasticities to parameters, illustrating the identification strategy.

4 Validation

In this section, I conduct several external validation exercises of the fertility and education elasticities. The goal of these exercises is to compare the quantitative model predictions regarding fertility and education with existing empirical estimates before using the calibrated model to evaluate policy counterfactuals. The approach to validation follows the pioneering work of Daruich (2018) who proposes to leverage evidence from quasi-experimental evidence to discipline a quantitative macro model.

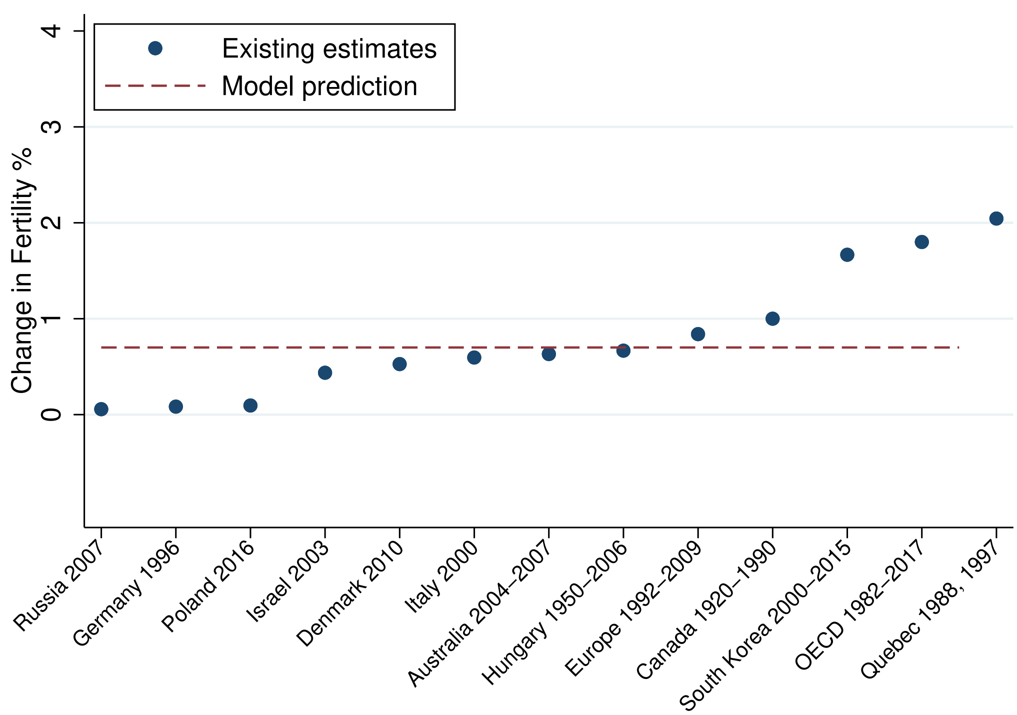
4.1 Fertility Elasticities

The first validation examines the model's prediction regarding fertility elasticity, i.e., how much fertility changes in response to changes in the shadow price of children. This exercise is important because, as discussed in Section 2.7, fertility elasticity is the key moment in determining the magnitude of the quantity-quality trade-off, composition effects, and demographic effects.

There is a large empirical literature evaluating fertility responses to financial incentives. The most commonly used identification strategies include difference-in-differences, synthetic control, or regression discontinuity designs, which leverage differential policy exposure due to institutional settings. Stone (2020) provides a recent meta-analysis of the literature after surveying 34 academic studies since 2000, from which I select policy changes that include universal child benefits and baby bonuses and plot in Figure 3.

I compute the fertility elasticity of the model by simulating an economy where parents are offered a baby bonus. To better align with the identification strategies in the empirical literature, I consider a partial equilibrium fertility response where factor prices and the human capital distribution are held fixed. I also assume that parents anticipate the policy to be persistent as low fertility has been a long-term problem for the countries being studied in the literature. The model predicts that a baby bonus with a net present value that is 10% of a household's annual income raises the total fertility rate of the economy by 0.7%, from 1.92 to 1.933 per woman. Figure 3 indicates that the model prediction is within the range of existing estimates. This implies that the mechanisms related to fertility responses to policies are unlikely to be overstated.

Figure 3: Fertility Elasticity: Model and Existing Estimates



Notes: This figure compares the fertility elasticity estimated by the model with the existing estimates in the literature. Policy changes that include universal child benefits and baby bonuses are selected from Stone (2020). When there are multiple estimates exploiting the same policy change, the average across studies is taken. When the study does not report long-run effects on completed fertility, I divide the estimate by three to account for the presence of tempo effects, in line with the results in Malak et al. (2019) and Cruces and Rodriguez-Roman (2025). The dots represent point estimates of fertility responses to a baby bonus with a net present value that is 10% of a household's annual income. The horizontal dashed line represents the model's prediction.

One potential concern is that fertility elasticity might differ across countries due to cultural or political reasons, as can be inferred from the wide range of existing estimates in Figure 3. To alleviate this concern, I evaluate the fertility impacts of a cash transfer policy in the United States, the Alaska Permanent Fund Dividend (APFD).

Alaska Permanent Fund Dividends

The Alaska Permanent Fund Dividend (APFD) was established in 1982 following increased state revenues from petroleum discoveries. The APFD provides uniform annual transfers to all residents regardless of income, employment, or age. Parents, guardians, or authorized representatives can claim a dividend on behalf of a child, with no restrictions under Alaska law on how the dividend is used. Consequently, the policy has pro-natal effects despite not being explicitly designed to encourage fertility.

The APFD is a valuable policy environment for validating fertility elasticities in the model for four reasons. First, compared to typical family policies, which often provide a few thousand dollars in net present value per child (McDonald (2006); Luci-Greulich and Thévenon (2013)), the APFD offers a net present value of approximately $20,000 per child.[12] This sizable benefit increases the likelihood of observable behavioral impacts, particularly for the significant and irreversible decision of having an additional child.

Second, unlike most family policies, which are typically means-tested or birth-order-dependent, the APFD has a simple structure, with over 91% of Alaska's population historically applying for the dividend. In contrast, the Census Bureau estimates that the national participation rate for the Earned Income Tax Credit (EITC) is below 80%. The APFD resembles a cash transfer for parents combined with a fully refundable Child Tax Credit (CTC) without income requirements. Since it is not marketed as a pro-natal policy, its fertility effects provide a conservative benchmark for explicitly pro-natal family policies, which may influence parental behavior through preferences or information.

Third, as noted by McDonald (2006) and Stone (2020), most empirical research on family policies focuses on total fertility rates (TFR), which sum age-specific fertility rates in a given year and can be measured soon after policy adoption. However, TFR may not be ideal for policy evaluation, as governments are primarily concerned with the number of additional children born due to policies instead of shifts in birth timing per se.[13] A more relevant measure is the completed fertility rate

[12] I calculate the average annual payment to be around $1,500. Since the dividend amount depends on stock market performance, future payment uncertainty may dampen fertility responses. Given that childbirth is an irreversible decision, a mean-preserving spread in dividend payments likely reduces households' fertility responses. Thus, the model's fertility elasticities, consistent with choices under uncertainty, likely provide a conservative estimate for child benefits without uncertainty.

[13] Changes in TFR include both the *quantum effect* (i.e., changes in the completed fertility rate) and the *tempo effect*

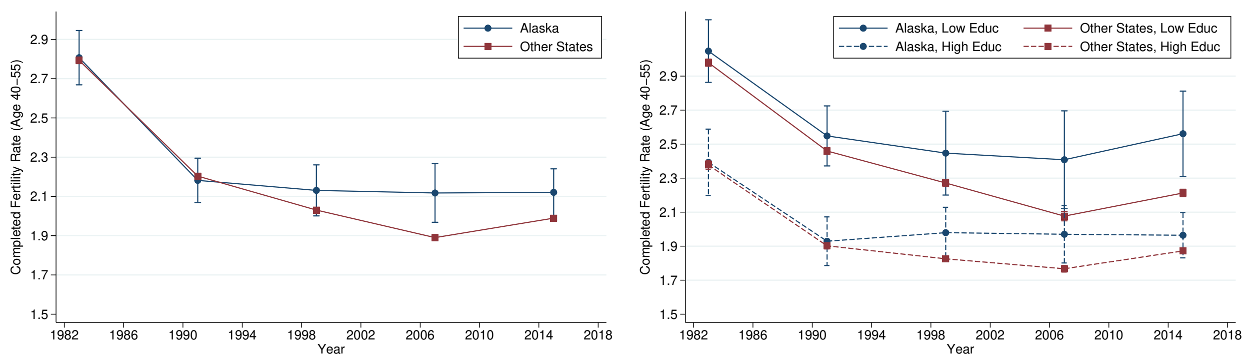
(CFR), which counts the number of children born to women past their childbearing years. Measuring CFR effects is challenging, as it requires observing women 15 to 20 years after policy adoption. The APFD, enacted decades ago, offers a rare opportunity to directly assess CFR effects without relying on TFR extrapolations.

Finally, Cowan and Douds (2021) find that the APFD's migration effect, or "population magnet effect," is minimal, with net migration rates around one-tenth of a percent during the sample period. This alleviates concerns that TFR could be influenced by the migration of individuals with high fertility intentions.

Using the CPS Fertility Supplement data from 1982 to 2024, I collect micro-level data on the completed fertility rate (CFR), defined as the total number of live births for women aged 40 to 55.[14] Figure 4 plots the time path of fertility in Alaska and other states. After closely tracking other states, Alaska's fertility rate begins to exceed that of others in 1998, with a larger gap for women with lower education.

Figure 4: Completed Fertility Rate in Alaska and Other States

(a) All Women (b) By Education Group



Notes: Figures 4a and 4b plot the average completed fertility rates for women aged 40-55 by state of residence and education from 1982 to 2024 using data from the CPS Fertility Supplement combined into 6-year bins. I define women with high education as those who have at least one year of college experience. Bars around sample means show 90% confidence intervals.

To estimate the policy effects on CFR, I employ a difference-in-differences strategy, regressing CFR on state fixed effects, year fixed effects, and treatment dummies. The Alaskan sample is

(i.e., changes in the timing of births, also known as the compression effect).

[14]When calculating CFR by household income as calibration targets in Section 3.1, I use the age cutoff of 45 following Vogl (2016) even though some studies in the literature have used age 40 (e.g., De la Croix and Gobbi 2017). For the APFD exercise, I use age 40 to increase the number of observations for Alaska in the CPS June Fertility Supplement, improving measurement precision. This change is unlikely to affect results for two reasons. First, monthly CPS data confirm that births after age 40 are uncommon for the studied cohorts. Second, since the key object of interest is the fertility *difference* between Alaska and other states, using age 40 does not bias estimates unless birth timing in Alaska differs significantly after age 40, which monthly CPS data rule out. Using age 45 makes the confidence interval for Alaska wider, but the main findings remain unchanged.

divided into three groups based on survey years. The "not treated" group includes data before 1987, as these women had passed their childbearing years when the APFD was enacted. The "partially treated" group includes data from 1987 to 2005, as the APFD affected some but not all of their childbearing years. The "fully treated" group includes observations from 2006 to 2024, as these women fully accounted for the policy in their fertility decisions.[15] Women in other states serve as the control group. The regression specification is

$$\text{fertility} = \beta_0 + \beta_1 T_1 + \boldsymbol{\beta_2} T_2 + \text{State FE} + \text{Year FE} + \epsilon, \tag{20}$$

where T_1 is a dummy for the "partially treated" group, and T_2 is a dummy for the "fully treated" group. Standard errors are clustered at the state level. Since the model predicts the policy's impact on the CFR of fully treated individuals, the coefficient β_2 is of primary interest. To explore heterogeneous treatment effects, I estimate Equation (20) separately for women with and without high education (defined as at least one year of college experience). Table 2 reports the regression results.

Table 2: Effects of the APFD on the Completed Fertility Rates

	(1)	(2)	(3)	Model Predictions		
	Full Sample	Low Educ.	High Educ.	Average	Low Educ.	High Educ.
β_1	0.125	0.176	0.16			
	(0.024)	(0.032)	(0.019)			
β_2	0.173	0.277	0.151	0.16	0.25	0.14
	(0.033)	(0.045)	(0.024)			
# Obs.	159,431	78,525	80,906			

Notes: This table reports the effects of the Alaska Permanent Fund Dividend (APFD) on the completed fertility rates. The first three columns report regression results of specification (20) using data from the Current Population Survey (CPS). Standard errors, in parentheses, are clustered at the state level. Column (1) shows the results with full sample. Column (2) shows the estimated coefficients among women without any college experience. Column (3) shows the estimated coefficients among women with at least one year of college experience. The next three columns show model predictions of changes in fertility for the average women, women with low education (30^{th} percentile of human capital), and women with high education (70^{th} percentile of human capital).

Column (1) of Table 2 shows that the estimated effect of the APFD on CFR is $\hat{\beta}_2 = 0.173$ children per woman, with a 95% confidence interval of (0.108, 0.238). The finding of sizable fertility responses to the APFD aligns with Yonzan et al. (2024), who, using synthetic control methods on Natality files, conclude that the TFR in Alaska increases by 13.1% due to the APFD. Columns (2) and (3) reveal heterogeneous treatment effects: women without high education respond more

[15] In an alternative specification presented in Appendix B.7, I define the treatment status using women's age at the APFD implementation date. The main results on β_2 in Table 2 remain unchanged under the alternative definition.

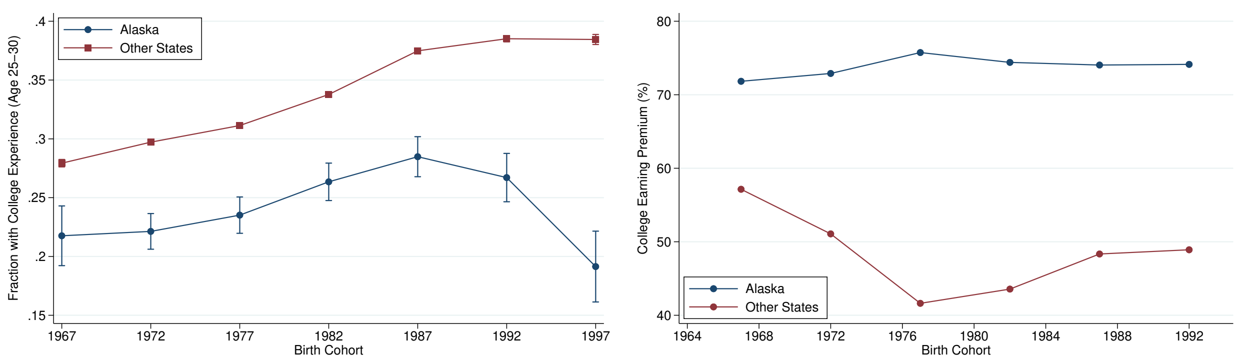
strongly to the APFD. This echoes Cowan and Douds (2021), who find larger fertility increases among Alaska natives and women without a high school degree.

To implement the APFD in the model, I transfer $1,500 annually to every household member, including parents and children. Parents receive this transfer for themselves until death and are entitled to their children's share until the children become independent. The APFD affects fertility through three channels: (1) income effects from increased parental income, (2) price effects reducing the shadow price of each child, and (3) anticipation effects due to altruism.

I recalibrate the economy to match moments for the fully treated cohort and conduct the policy experiment without changing factor prices. Beyond average responses, I calculate fertility changes at the 30^{th} and 70^{th} percentiles to proxy responses of low- and high-educated women. The results, shown in Table 2, indicate that the model-predicted effect of 0.16 children per woman is similar to the regression estimates, with the degree of heterogeneous response aligning well with regression coefficients.

Figure 5: College Attainment and Earning Premium in Alaska and Other States

(a) College Attainment　　　(b) College Earning Premium



Notes: Figure 5a plots the fraction of 25- to 35-year-olds with a bachelor's degree or above by birth cohort and by state of residence using data from the CPS-ASEC. Observations are combined into 5-year bins. Bars around sample means show 90% confidence intervals.
— Figure 5b plots the college earning premium by birth cohort and by state of residence. I collect data from the CPS-ASEC and restrict to individuals that worked at least 40 weeks and 30 hours per week last year. Observations are combined into 5-year bins. Cohorts born after 1995 are dropped due to the low number of observations in Alaska. After computing the average earnings by cohort and state of residence, I compute the college earning premium as the percentage difference between education groups.

Lastly, Figure 5a shows that while the trend of college attainment in Alaska tracked other states before 1982, a widening gap emerged post-APFD. The model explains this gap through three channels: (1) the quantity-quality trade-off, where more children reduce resources per child; (2) a composition effect, where parents with lower education have larger fertility responses; and (3) reduced parental incentives to invest in education, knowing children will receive future dividends. To address concerns about changing education demand due to the oil industry boom, Figure 5b plots the college earnings premium, measured as the average labor income of individuals aged 25 to 35, by birth cohort in Alaska and other states. The premium in Alaska changes little before and after the APFD, suggesting stable incentives for parents to prepare children for college if their decisions were solely based on the earnings premium.

4.2 Returns to Education Expenditures

The second validation examines the model's prediction regarding human capital responses to education investments. This exercise is important for three reasons. First, returns to education affect parents' decision making in the quantity-quality trade-off. Higher returns incentivize parents to invest in children's human capital on the margin, instead of expanding on the family size. Second, returns to education exacerbate the gap between the short-run and long-run effects of policies on human capital due to intergenerational spillovers – as pointed out by Daruich (2018). Third, because family policies are costly, returns to human capital determine the amount of tax changes needed to balance the government's budget.

Similar to validating fertility elasticities, the approach here is to compare model estimates with empirical estimates. To better align with the empirical setup, I introduce a one-time expansion of the public education expenditure $\mathcal{E}$ in a partial equilibrium setting where fertility, prices, taxes, and the human capital distribution remain unchanged. I simulate the income path of affected children and compare the outcomes with the scenario before the education expenditure expansion.

Following Daruich (2018), I first compare the model predictions on benefit/cost ratio to García et al. (2020). García et al. (2020) evaluate early childhood programs (ABC/CARE) from the 1970s. The yearly cost of the program was $18,514 per participant (in 2014 dollars) for five years. Treated children were followed into adulthood with education and incomes observed by researchers. García et al. (2020) use these estimates to predict a return in lifetime earnings (in net present value) of 1.55 dollars for every dollar spent. When I focus on children whose parental income is at the 10th percentile, the corresponding benefit/cost ratio is 1.15, similar but slightly smaller than García et al. (2020).[16]

To strengthen the validation with more recent empirical evidence, I compare the model predictions with the recent meta-analysis by Jackson and Mackevicius (2024). Jackson and Mackevicius (2024) harmonize a large number of studies with quasi-experimental design in the United States and conclude that on average, a policy increasing spending by $1,000 per pupil for four years improves test scores by 0.0316 standard deviations. When I implement an expansion of public education

[16]One potential explanation, as shown by Figure 1 in García and Heckman (2023), is that ABC/CARE programs are among the childhood programs with highest returns. They were also implemented much earlier than the time period that this model is calibrated to match.

expenditure $\mathcal{E}$ of the same magnitude and length in the model, the corresponding effect is 0.034 standard deviations – a number that is very similar to the average estimate across studies.

5 Baby Bonus Counterfactual

In the next two sections, I use the model to evaluate different kinds of family policies. I first focus on a uniform cash reward for childbirth (i.e., baby bonuses $\mathcal{B}$) for two reasons. First, the policy's structure is simple and similar to expanding the fully refundable Child Tax Credit (CTC).[17] The simplicity in policy structure facilitates better exposition of the model mechanisms. Second, such cash rewards have already been widely adopted in many countries, such as Spain, Australia, and recently China.

5.1 Steady-State Comparisons

I study a $30,000 baby bonus – a uniform cash reward for each childbirth. The size of the policy is selected such that the policy expenditure amounts to 1% of GDP in the original steady state. Moreover, the expansions of the maximum payment of the Child Tax Credit (CTC) from 2010 to 2021 in net present value, taking the American Rescue Plan Act of 2021 into account, are also around $30,000 in net present value. This provides another way to benchmark the policy size being studied.

Aggregate Consequences

I find that a baby bonus of $30,000 raises the fertility rate from 1.92 children per woman in the baseline economy to 2.0 children per woman, a 4.2% increase. The increase in fertility translates to changes in the demographic structure. In particular, the share of children in the population increases from 22.5% in the original steady state to 25.3% in the new steady state, while the share of retirees declines from 18.3% to 16.1%.

Average human capital in the economy declines by about 1.5 percent, reflecting a combination of the quantity-quality trade-off and the composition effect because parents with lower human capital have larger fertility responses (more on this in Figure 6). Hours per worker also fall by 3.1%, driven by lower hours worked by young parents, as they have additional children, and the composition

[17] There are two main differences between baby bonuses and the CTC. First, the CTC has an income requirement and phase-out region, whereas a baby bonus is typically not means-tested. As is discussed later, the main results are stronger when family policies target low-income households. Second, a baby bonus is a lump-sum transfer when the child is born, while the CTC, or other forms of child allowance, is an annual transfer to parents when the child is below age 18. With borrowing constraints, low-income parents prefer baby bonuses to a CTC of the same net present value because they can replicate the latter through savings.

effect, as agents with lower human capital receive lower wages and supply less labor. Due to lower human capital and lower hours worked, labor efficiency unit per capita (L) falls by 5.14%. On the other hand, capital stock in the economy falls by 3.16%. Because both capital and labor decrease, output per capita (Y) drops by about 4.46%. To balance the budget, the government needs to raise the labor income tax rates. In the benchmark case where the government balances the budget by adjusting the level of the labor income taxes $\tau_y^{x,n}$ uniformly up or down for all x and n, I find that $\tau_y^{x,n}$ falls by 1.5 percentage points to balance the budget.[18] Furthermore, income inequality, measured by the coefficient of variation in labor earnings, increases by 1.45%.

Interestingly, despite the reduction in output and increase in inequality, average welfare $(\mathcal{W})$ rises by 0.39%. This is because the baby bonus redistributes wealth from households with low marginal utilities to households with high marginal utilities in three avenues. The policy redistributes resources from rich households to poor households because poorer households have a larger number of children. Second, the baby bonus redistributes resources from old households to young households, overcoming life-cycle borrowing constraints. Lastly, the policy redistributes from households without children to those with children – the latter have higher marginal utility as they have additional resource needs.

It is important to note that with heterogeneities and frictions in the model, the first-order stochastic dominance (FOSD) in equilibrium human capital distribution is neither necessary nor sufficient for choosing policies with higher average welfare. For instance, the equilibrium human capital distribution under a $30,000 baby bonus is first-order stochastic dominated by that in the baseline economy, but average well-being improves in the long run. The key insight is that besides comparing human capital distributions across economies, one also needs to consider differences in the age distribution and re-distributional consequences. Hence, this paper provides a novel counterargument to the common conclusion in the existing literature on family policies arguing for childbirth restrictions among parents with low human capital (e.g., Chu and Koo 1990). These parents, with higher fertility responses to per dollar benefit, could be key to solving population aging problems.

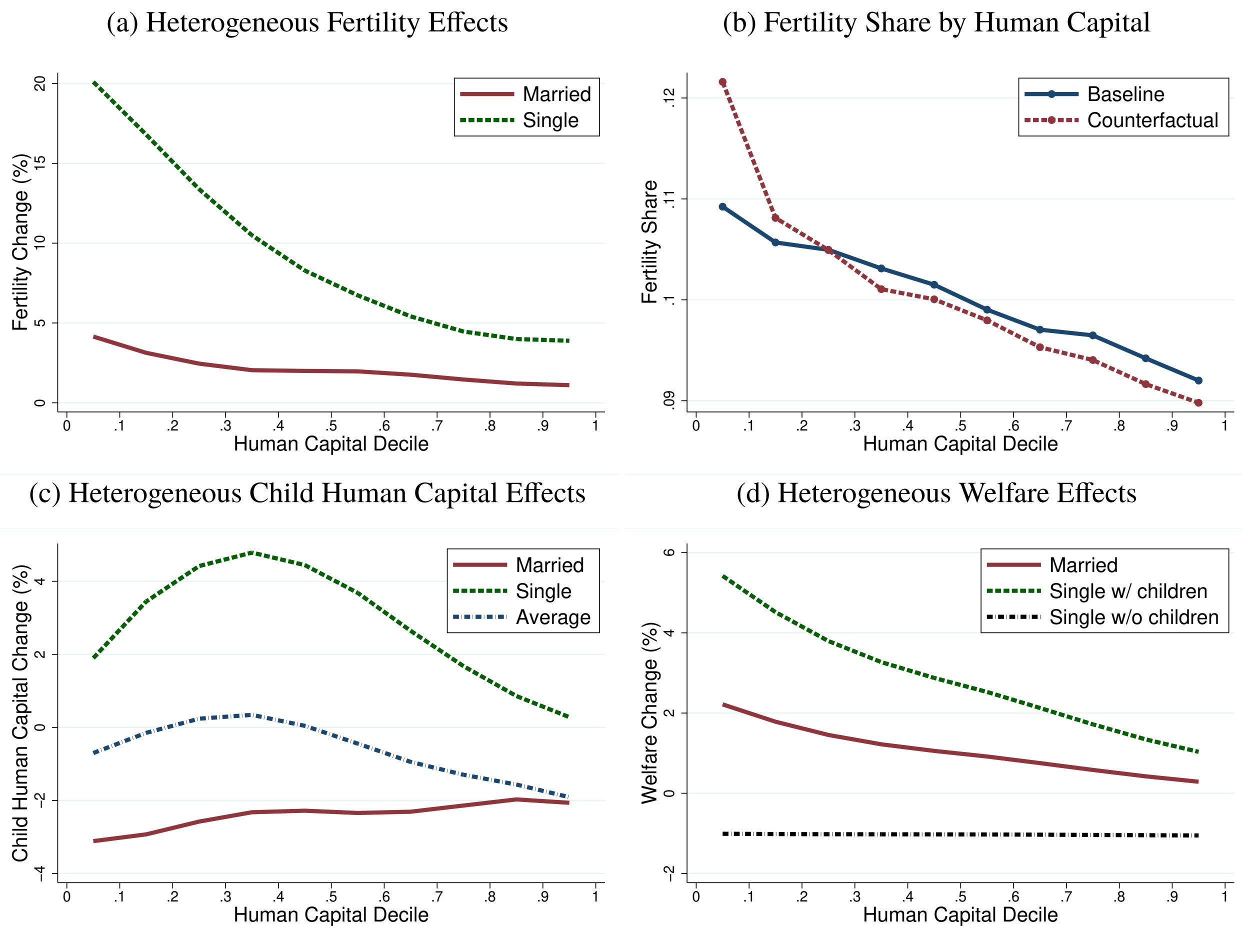
Distributional Consequences

The rich heterogeneities of the model allow us to better understand the distributional implications of family policies. Figure 6 presents a set of distributional consequences of the baby bonus.

First, Figure 6a shows the positive fertility responses to the baby bonus are much larger among households with lower human capital, and in particular among single-parent families. This is because the fixed amount of the baby bonus is larger relative to the households' labor income. This

[18] Note that a reduction in $\tau_y^{x,n}$ represents an increase in labor income tax because $\tau_y^{x,n}$ governs the level of pre-tax labor income retained after taxation.

Figure 6: Distributional Consequences of Baby Bonus



Notes: This figure presents the distributional consequences of the baby bonus at different levels of human capital. The human capital deciles are chosen at the level that corresponds to the original steady state. Figure 6a plots the fertility changes by family structure. Figure 6b plots the fertility share by parents' human capital. Figure 6c plots the effects of the expected child human capital. Figure 6d plots welfare effects in the units of consumption equivalents.

prediction of the model is also consistent with the empirical findings from the APFD presented in Section 4.1.

Due to the larger fertility responses from households with lower human capital, a major consequence of the policy is the change in the composition of fertility. Figure 6b presents the share of births by parents' human capital decile in the original and the counterfactual economy. As can be seen, the share of children born to parents with lower human capital is significantly larger under the baby bonus. Due to the intergenerational persistence of human capital, the change in fertility weights imposes a significant downward pressure on the average human capital in the economy – a between-household mechanism.

The human capital responses conditional on parental human capital, a within-household mechanism, paint a more nuanced picture in Figure 6c. On the one hand, children's expected human capital is lower for married households, especially those with lower human capital. This is driven by the quantity-quality trade-off channel: because additional children dilute the available inputs, either time or money, and lead to lower human capital, children born to parents with larger fertility responses and a positive initial amount of child investments suffer larger human capital reductions. Children's expected human capital for single households, however, is generally higher under the baby bonus. This is explained by the income effects of the baby bonus and the fact that these households are initially in the corner solution of the child investment problem. The quantity-quality trade-off channel, of course, is still at work. This is visible from the hump-shaped human capital responses – households with the largest fertility responses at the bottom of the income distribution have a smaller increase in children's human capital despite receiving the largest amount of baby bonuses. The average child human capital effects, weighted by marriage probabilities, are non-monotonic. Therefore, the rise in income inequality discussed in the previous section is more due to the differential changes in hours worked, instead of the human capital levels per se.

Lastly, Figure 6d presents the heterogeneous welfare effects across human capital deciles and family structure. Single parents with low human capital benefit the most from the baby bonus policy. Importantly, single households without children are worse off under the baby bonus. This is because they do not receive the baby bonus but suffer in two ways. First, income tax rates are higher to balance the budget, so these households are net contributors. Second, these households start off with lower human capital and hence lower life-time earnings due to their parents' endogenous responses to the baby bonus.

Decomposition

I provide a six-step decomposition in Table 3 to better understand which model component explains the counterfactual results.

I first study the impacts of the baby bonus in a partial equilibrium setting where prices and human capital are held unchanged at the original level. In addition, I assume that households do not make fertility choices but are endowed with the number of children that is consistent with the fertility-human capital relationship in the original steady state. Furthermore, households view the baby bonus as a one-time policy change that only lasts for the current period. In this case, the baby bonus is a pure income transfer. And as expected, human capital rises by more than 1% on average – a finding that is consistent with the empirical literature on the impacts of income transfers on children's outcome.

In the second step, I implement the baby bonus as a permanent policy change. In this case, the rise in human capital is much smaller, but the increase in welfare doubles. Capital stock also jumps by 5.3%. As households expect the baby bonus to continue benefiting their offspring, parents have a lower incentive to invest because the government provides a safety net – an insight that echoes

Table 3: Decomposition of Baby Bonus Results

	n	n_{gap}	h.c.	L	K	Y	τ	CV$_y$	$\mathcal{W}$
one-time policy	-	-	1.05%	-0.18%	0.01%	-0.12%	-	1.02%	1.04%
+ permanent change	-	-	0.56%	0.83%	5.30%	2.29%	-	0.75%	2.00%
+ endogenous prices	-	-	0.55%	0.82%	4.90%	2.15%	-	0.75%	2.00%
+ endogenous fertility	0.07	0.10	-0.42%	-3.99%	-1.13%	-3.05%	-	1.52%	2.10%
+ endogenous dist.	0.07	0.10	-0.82%	-4.12%	-1.63%	-3.30%	-	1.45%	1.71%
+ budget balance $\tau_y^{x,n}$	0.08	0.10	-1.47%	-5.10%	-3.16%	-4.46%	-0.015	1.67%	0.39%
or + budget balance τ_c	0.08	0.10	-1.23%	-4.64%	-1.94%	-3.76%	0.019	1.53%	0.90%

Notes: This table decomposes the effects of the baby bonus policy across various model components. The definition of variables for each column is: n is average fertility rate; n_{gap} is the difference in fertility rate between the 25th and the 75th human capital decile; h.c. is average human capital; L is labor per capita; K is capita per capita; Y is output per capita; τ is tax rate changes; CV$_y$ is the coefficient of variation of income among all workers; $\mathcal{W}$ is average welfare for newborns under the veil of ignorance.

the Universal Basic Income (UBI) discussion in Daruich and Fernández (2024). Thus, parents have more incentive to save and consume by themselves in old age.

In the third step, I consider endogenous prices of capital and labor. General equilibrium mitigates the increase in capital by lowering interest rates. The rest of the effects are modest.

In the fourth step, I allow households to make endogenous fertility choices. This is one of the main differences between the model in this paper and some other quantitative studies in the literature without fertility choices, e.g., Daruich (2018) and Guner et al. (2020). Considering endogenous fertility proves to be extremely important as it flips the sign of the responses in average human capital, labor, capital, and output. The rise in income inequality also doubles, driven by differential hours response across households. The welfare gain improves slightly as households now have an additional channel to respond to the policy.

In the fifth step, I consider endogenous human capital and demographic distribution. Relative to the previous steps where variables are aggregated under the original human capital distribution, incorporating endogenous human capital distribution further exacerbates the decline in human capital, labor, capital, and output. The welfare gain is also smaller because more agents start their life cycle with lower human capital.

In the last step, I require the government to balance the budget constraint in the new steady state. The first approach is to use a uniform change in labor tax levels $\tau_y^{x,n}$ as discussed before. Relative to the previous step, budget balancing significantly slashes welfare gains. Human capital declines further because parents have lower incentives to invest in children's human capital under higher tax rates. The last row of Table 3 shows that these negative effects are slightly mitigated if the government decides to balance the budget by changing the consumption tax rate τ_c.[19]

[19]In Appendix B.5, I discuss how the results will change if the government could use alternative financing methods,

5.2 Baby Bonus: Transition Path

In this section, I discuss the transition path results following the implementation of a \$30,000 baby bonus. The policy is enacted unexpectedly at period $t = 1$ and stays in place for all subsequent periods. To focus on the dynamic implications of the baby bonus itself, rather than the effects of potentially time-varying tax rates, I relax the requirement of period-by-period budget balancing, and instead assume that the government changes labor taxes at $t = 1$ to the level that balances the budget in the new steady state. Figure 7 presents the transition path of several key variables.

Figure 7a shows that the policy effects on fertility are immediate and persistent. Different from the immediate fertility responses, Figure 7b indicates that the demographic structure of the economy adjusts more gradually – a phenomenon known as the "demographic inertia." While the old-age dependency ratio gradually decreases, the total dependency ratio exceeds the long-term level for a few decades before converging.

Figure 7c plots the transition path of capital, labor, and output per capita. As can be seen, the decline in labor per capita occurs instantly at $t = 1$ as young parents reduce their labor supply due to having more children. The decline in capital per capita takes more time because initially, some of the baby bonus turns into savings. Capital decline occurs once the newborns with lower human capital than previous generations enter the economy and save less.

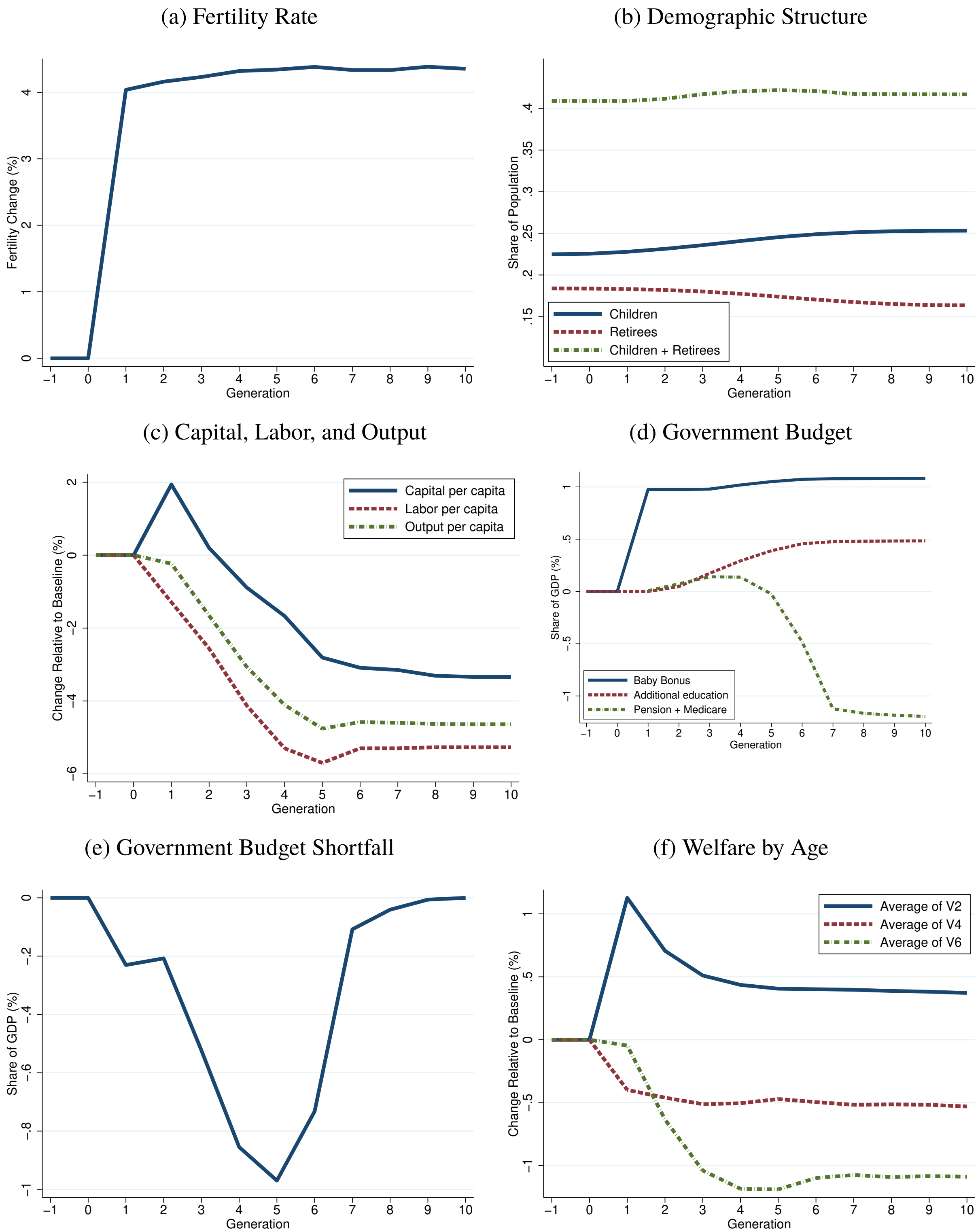
Figure 7d displays several components of the government budget. First, the total amount of baby bonus and education rises by 1.6% relative to the baseline in the long run. This increase is larger than the 1% baby bonus at $t = 1$ for three reasons: (1) fertility response rises slightly over time, as shown in Figure 7a, (2) additional children, as shown in Figure 7b, require extra public education expenditures, and (3) aggregate GDP per capita declines over time, as shown in Figure 7c. On the other hand, the total amount of pension and Medicare expenditures rises gradually in the first few decades and starts to decline when the newborns at $t = 1$ become retirees.

Summing up changes in the government revenues and expenditures, the residual of the government budget, i.e., additional funding required if the government wants to balance the budget period-by-period, is large and significant. Figure 7e shows that the additional revenue required reaches almost 1% of GDP at $t = 4$.

Lastly, Figure 7f plots the transition path of average welfare by age. As can be seen, the increase in welfare for newborns is the largest at $t = 0$, and gradually decreases as future generations have lower human capital. The policy change, however, leads to welfare losses for older generations at each generation. For example, the welfare of workers from age 44 to 55 falls by about 0.7% at $t = 0$ as labor taxes rise. Retirees' welfare also declines slightly as the interest rate falls, resulting in lower income from savings.

such as borrowing and lending.

Figure 7: Transition Path of Baby Bonus



Notes: This figure presents the transition path under a $30,000 baby bonus. Figure 7a plots the path of fertility. Figure 7b plots the path of demographic structure. Figure 7c plots the path of labor, capital, and output per capita. Figure 7d plots the path of different government budget components. Figure 7e plots the path of government budget shortfall. Figure 7f plots the path of average welfare by age.

The transition path results shed light on two insights that hold more generally beyond the case of a baby bonus. First, the overall fiscal burden induced by family policies is higher than the policy expenditure per se, especially in the first few decades in the transition path. When more children are born, the government needs to finance additional expenditures for existing child-related policies. The potential fiscal benefits of reductions in the old-age dependency ratio, on the other hand, will be realized much later than the upfront costs.

Second, the amount of political support for family policies depends on how the fiscal costs are distributed across generations. The government will have a hard time gathering enough agents to support family policies that benefit the economy in the long run at the cost of existing households. In that sense, family policies are similar to climate change mitigation policies where countries wait "too long" to act due to frictions caused by intergenerational public finance (Sachs (2014)).

5.3 Optimal Baby Bonus

In this section, I study the optimal baby bonus. I begin with a discussion of welfare criteria under heterogeneous agents and endogenous fertility. Then, I present the optimal policy results and propose principles for designing family policies in general.

Welfare Criteria

Welfare criteria in models with endogenous fertility are complex both conceptually and philosophically. Unlike standard comparisons between allocations where the set of agents is fixed, in this context, some agents are born in one economy but not in another. Consequently, the standard Pareto principle cannot be applied to conduct welfare analysis. The field of population ethics is devoted to understanding and resolving this issue.[20]

Given the ongoing debate on welfare criteria, I adopt two definitions to study the optimal policy. The first criterion is the *long-run average welfare* $\mathcal{W}$, as used in previous sections. This evaluates the expected utility of a newborn child in the long-run stationary equilibrium under the veil of ignorance. The second criterion assesses the *average utility of existing agents* when the policy is adopted.[21] This latter criterion has two features. First, it is forward-looking, incorporating tax

[20]For instance, Parfit (1984) derives the famous "repugnant conclusion," showing that under a set of intuitively appealing assumptions, one can prove that "for any perfectly equal population with very high positive welfare, there is a population with very low positive welfare which is better, other things being equal." Golosov et al. (2007) propose two criteria called $\mathcal{A}$-efficiency and $\mathcal{P}$-efficiency, which differ by whether the planner evaluates the welfare of those who are not born. De la Croix and Doepke (2021) consider optimal welfare from a soul's perspective, accounting for both the utility of being born and the average "waiting time" for incarnation.

[21]Following standard practice in quantitative macroeconomic literature, I use equal weights as a benchmark. An alternative approach is to use Negishi weights, which assign greater weight to households with higher human capital and initial assets, eliminating the re-distribution benefits of baby bonuses. See Kim et al. (2021) for an example.

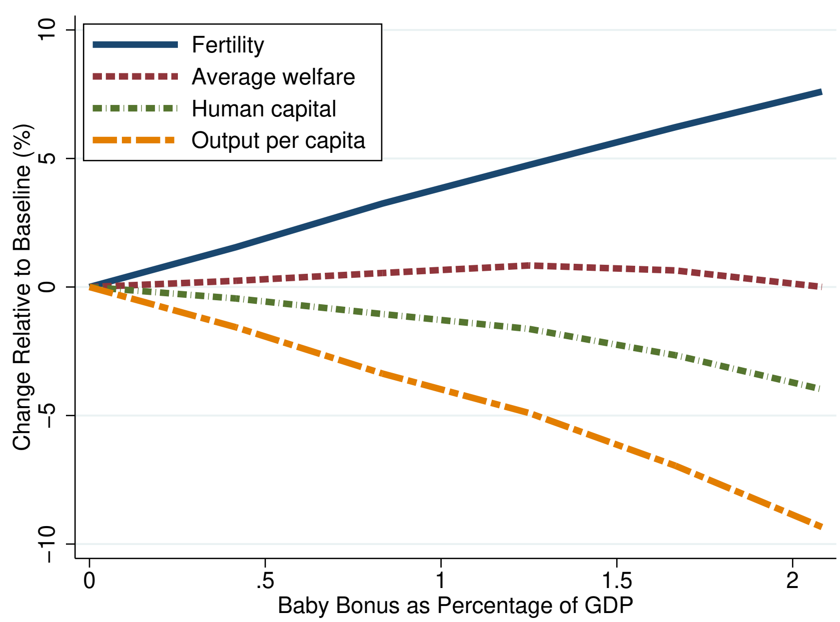
changes in later periods that affect these households' utility. Second, it aligns with the notion of $\mathcal{A}$-efficiency defined in Golosov et al. (2007), focusing on the welfare of those already alive.

Rather than computing the unconstrained optimum, I follow the Ramsey tradition and restrict the government/planner to using a single policy instrument (a baby bonus) that is uniform across households and birth order. As in previous sections, I consider a scenario where the government adopts the baby bonus at the beginning of time period $t = 1$. The policy change is permanent and financed by income tax changes. I denote the optimal baby bonus that maximizes average utility in the long run as $\mathcal{B}^*_{lr}$ and the optimal baby bonus that maximizes the average utility of existing households when the policy is adopted as $\mathcal{B}^*_{sr}$.

Optimal Baby Bonus Results

Figure 8 shows the changes in the average long-run welfare under different baby bonuses. From a long-run perspective, the optimal baby bonus is $\mathcal{B}^*_{lr} = \$37,500$. This policy boosts aggregate fertility to 2.02 children per woman, raises long-run welfare by 0.5%, and directly costs approximately 1.25% of GDP.

Figure 8: Long-Run Optimal Baby Bonus



Notes: This figure plots the changes in fertility, human capital, output, and average welfare in the long run corresponding to different levels of baby bonus as a percentage of GDP.

However, the baby bonus that maximizes the welfare of the median voter among existing households is $\mathcal{B}^*_{sr} = \$0$. Figure 7f provides the rationale for this conclusion. On the one hand, current parents who receive the baby bonus prefer a larger $\mathcal{B}$ because despite higher taxes during the transition, these households are subsidized on net by older households.

On the other hand, older households oppose the baby bonus because they do not benefit from it but face higher taxes for the remainder of their lives. One potential concern here is that the model assumes that the older cohorts with $j \geq 4$ at $t = 0$ do not internalize the welfare gains of their descendants because they have already left the household at the end of period $j = 3$. But even when I assign such welfare gains to older cohorts (see Appendix D for more details), it only mitigates but does not overturn their welfare losses.

As a result, if each household has equal voting power, $\mathcal{B}^*_{sr} = \$0$ is the most likely outcome from a political perspective. This observation may explain the puzzle observed in many countries with extremely low fertility rates, where large-scale family policies are not implemented despite known long-run consequences. Even when such policies are introduced, governments sometimes scale them back due to fiscal pressures in the transition path – highlighted in Figure 7e. For example, the Australian baby bonus was introduced in 2004 and was significantly slashed in 2014. Likewise, a generous Spanish lump-sum maternity allowance was introduced in 2007 and then eliminated in 2010.

6 Policy Comparisons

In this section, I examine the implications of two alternative policies—public education expansion and paid parental leave. Additionally, I explore how the counterfactual results depend on the inclusion of endogenous fertility choice and government old-age transfers.

6.1 Public Education Expenditures

I analyze a counterfactual policy where public education expenditure $\mathcal{E}$ expands by 1% of GDP in the original steady state. The size of the policy is chosen to match the level of the baby bonus counterfactual in the previous section.

Table 4 presents a six-step decomposition to better understand which model components drive the results. Appendix C.1 discusses the distributional consequences of the public education expansion in more detail.

I first study the impacts of the education expansion in a partial equilibrium setting where prices and human capital are held constant at the original level. Additionally, I assume that households do not make fertility choices but are endowed with the number of children that is consistent with the fertility-human capital relationship in the original steady state. Households expect the education expenditure to be a one-time policy change that only lasts for the current generation. In this case, the policy acts as a pure income transfer, increasing human capital by 2.84% on average. This rise is nearly three times larger than in the baby bonus counterfactual because it is an in-kind expenditure

Table 4: Decomposition of Education Expenditure Results

	n	n_{gap}	h.c.	L	K	Y	τ	CV$_y$	$\mathcal{W}$
one-time policy	-	-	2.84%	-4.55%	-1.94%	-3.70%	-	0.37%	0.89%
+ permanent change	-	-	3.17%	5.50%	2.32%	4.44%	-	-1.03%	1.69%
+ endogenous prices	-	-	3.25%	5.56%	4.34%	5.16%	-	-1.01%	1.64%
+ endogenous fertility	0.05	0.01	2.18%	2.28%	-0.01%	1.50%	-	-0.68%	1.71%
+ endogenous dist.	0.05	0.02	3.33%	2.43%	0.08%	1.65%	-	-0.95%	2.86%
+ budget balance $\tau_y^{x,n}$	0.04	0.02	3.81%	3.06%	1.38%	2.50%	0.011	-1.11%	3.88%
or + budget balance τ_c	0.04	0.02	3.87%	3.12%	0.86%	2.37%	-0.025	-1.06%	3.97%

Notes: This table decomposes the effects of the public education expenditure policy across various model components. The definition of variables for each column is: n is average fertility rate; n_{gap} is the difference in fertility rate between the 25th and the 75th human capital decile; h.c. is average human capital; L is labor per capita; K is capita per capita; Y is output per capita; τ is tax rate changes; CV$_y$ is the coefficient of variation of income among all workers; $\mathcal{W}$ is average welfare for newborns under the veil of ignorance.

that directly targets child human capital formation.

In the second step, I implement the education expansion as a permanent policy change. The rise in human capital becomes even larger because children with higher human capital grow to become better parents—an insight that echoes Daruich (2018). The welfare increase doubles, and the capital stock rises by 2.32%. Labor supply responses shift from negative to positive, as workers with higher human capital supply more labor. Unlike the baby bonus, which increases labor income inequality, education expansion acts as the "great equalizer," reducing inequality.

In the third step, I introduce endogenous prices of capital and labor. General equilibrium effects amplify the increase in capital by raising interest rates, with modest impacts on other variables.

In the fourth step, I allow households to make endogenous fertility choices. Similar to the baby bonus counterfactual, allowing for fertility responses mitigates the human capital increase but leads to higher welfare gains. The fertility effect of education expansion is smaller than that of the baby bonus but remains significant. Unlike the baby bonus, where high human capital parents show limited fertility changes, in this case, they also increase fertility. This is because public education expenditure (1) reduces the shadow price of children by substituting for private investments and (2) provides insurance against low ability draws for their children due to imperfect intergenerational persistence of human capital.

In the fifth step, I incorporate an endogenous human capital distribution. Different from the baby bonus case, this step leads to larger gains in human capital and welfare because the composition effect gravitates toward higher human capital agents.

In the final step, I require the government to balance the budget constraint in the new steady state, using a uniform change in labor tax levels $\tau_y^{x,n}$. Notably, the government can reduce labor tax rates under this counterfactual, as the education expansion more than finances itself. Relative to the previous step, budget balancing enlarges welfare gains, and human capital rises further because parents have greater incentives to invest in children's human capital under lower tax rates. The last row of Table 4 shows that these effects are similar when the government balances the budget by adjusting the consumption tax rate τ_c.

6.2 Paid Parental Leave

I analyze a counterfactual policy where paid parental leave $\mathcal{P}$ increases so that the total expenditure is 1% of GDP in the original steady state. The size of the policy is chosen to match the level of the baby bonus counterfactual.

Table 5 presents a six-step decomposition to identify the model components driving the results. Appendix C.2 discusses the distributional consequences of the paid parental leave in more detail.

Table 5: Decomposition of Paid Leave Results

	n	n_{gap}	h.c.	L	K	Y	τ	CV$_y$	$\mathcal{W}$
one-time policy	-	-	0.81%	3.02%	0.86%	2.30%	-	-0.42%	0.90%
+ permanent change	-	-	0.19%	-0.07%	5.05%	1.62%	-	0.63%	1.77%
+ endogenous prices	-	-	0.18%	-0.08%	4.95%	1.58%	-	0.62%	1.77%
+ endogenous fertility	0.01	0.03	0.11%	-0.62%	4.19%	0.97%	-	0.76%	1.82%
+ endogenous dist.	0.01	0.03	0.24%	-0.82%	3.88%	0.73%	-	0.55%	1.96%
+ budget balance $\tau_y^{x,n}$	0.02	0.03	-0.07%	-1.17%	3.74%	0.45%	-0.006	0.67%	1.37%
or + budget balance τ_c	0.01	0.03	-0.04%	-1.06%	3.89%	0.57%	0.013	0.62%	1.41%

Notes: This table decomposes the effects of the paid parental leave policy across various model components. The definition of variables for each column is: n is average fertility rate; n_{gap} is the difference in fertility rate between the 25th and the 75th human capital decile; h.c. is average human capital; L is labor per capita; K is capita per capita; Y is output per capita; τ is tax rate changes; CV$_y$ is the coefficient of variation of income among all workers; $\mathcal{W}$ is average welfare for newborns under the veil of ignorance.

The results from the first three steps resemble those of the baby bonus. When fertility is exogenous, paid leave acts as a pure income transfer, increasing human capital and welfare in partial equilibrium. When the policy becomes permanent, the human capital increase diminishes, but the welfare gain nearly doubles. Endogenous prices slightly mitigate the increase in aggregate capital.

The main difference from the baby bonus emerges in the fourth step, where I allow households to make endogenous fertility choices. The rise in fertility is much smaller than that under the baby bonus, and the fertility gap indicates a relatively uniform change across the human capital distribution. This is because when the amount of total transfer is tied to baseline wages, poorer households receive less compared to the baby bonus for the same overall expenditure. As a result, their fertility increase is much more modest. Furthermore, parents understand that the amount of future paid leaves that their children expect to receive depends on the human capital. Therefore, they have an incentive to maintain child human capital investments. Due to these two channels, average human capital remains close to the baseline level despite the fertility increase. These conclusions do not change when I incorporate endogenous distribution and government budget balancing in the next two steps.

Overall, paid parental leave has a smaller effect on fertility and does not significantly impact the economy's human capital. Capital stock increases as part of the transfers to wealthier households is saved for future consumption. Welfare effects remain positive overall.

6.3 The Role of Endogenous Fertility

While the decomposition results in Sections 5.1, 6.1, and 6.2 explain the contributions of various model components to the counterfactual outcomes within each policy, this section highlights the critical role of endogenous fertility in comparing outcomes across policies: the baby bonus, public education expenditure, and paid parental leave.

To isolate the impact of endogenous fertility, I analyze a version of the model where households are endowed with the number of children that is consistent with the fertility-human capital relationship in the original steady state, while keeping the rest of the household decision problem identical to the baseline model. Policy expenditures are fixed at 1% of GDP in the original steady state, consistent with prior analyses. I compute the long-run steady state for each policy and compare the aggregate outcomes with the baseline case, where fertility is endogenous. The results are presented in Table 6, alongside the baseline results for reference.

Table 6: The Role of Endogenous Fertility in Policy Comparison

	n	n_{gap}	h.c.	L	K	Y	$\tau_y^{x,n}$	CV$_y$	$\mathcal{W}$
	Baby Bonus								
Baseline	0.08	0.10	-1.47%	-5.10%	-3.16%	-4.46%	-0.015	1.67%	0.39%
Exogenous fertility	-	-	0.62%	0.35%	3.87%	1.50%	-0.006	0.54%	1.84%
	Education Expenditure								
Baseline	0.04	0.02	3.81%	3.06%	1.38%	2.50%	0.011	-1.11%	3.88%
Exogenous fertility	-	-	5.47%	6.43%	6.13%	6.33%	0.015	-1.30%	4.66%
	Paid Parental Leave								
Baseline	0.02	0.03	-0.07%	-1.17%	3.74%	0.45%	-0.006	0.67%	1.37%
Exogenous fertility	-	-	0.04%	-0.54%	8.9%	2.49%	-0.006	0.54%	1.38%

Notes: This table compares the effects of the baby bonus, education expenditure, and paid parental leave policies under baseline and a version of the model with exogenous fertility. The definition of variables for each column is: n is average fertility rate; n_{gap} is the difference in fertility rate between the 25th and the 75th human capital decile; h.c. is average human capital; L is labor per capita; K is capita per capita; Y is output per capita; τ is tax rate changes; CV$_y$ is the coefficient of variation of income among all workers; $\mathcal{W}$ is average welfare for newborns under the veil of ignorance.

The results indicate that imposing exogenous fertility consistently overstates welfare gains across all three policies. The overstatement is most pronounced for the baby bonus, which generates the largest fertility response among low human capital parents in the baseline model. With exogenous fertility, the baby bonus yields a significant welfare gain (1.84% vs. 0.39% in the baseline) because the quantity-quality trade-off and the composition effect are muted.

Across policies, education expenditure is the most effective at raising welfare and reducing inequality, regardless of fertility endogeneity, due to its direct enhancement of child human capital and intergenerational transmission of such gains. The welfare ranking between the baby bonus and paid parental leave, however, depends on fertility modeling. With exogenous fertility, the baby bonus outperforms paid parental leave due to larger transfers to low-income households with high baseline fertility. With endogenous fertility, paid parental leave yields higher welfare because it has a smaller adverse effect on aggregate human capital.

6.4 The Role of Old-Age Transfers

Finally, I re-evaluate the aforementioned policy instruments under an alternative setting where the baseline economy has reduced government old-age transfers.

Specifically, I recompute the original steady state by keeping the model parameters fixed but halving the amount of pension and Medicare payments to retirees. Anticipating lower pension income, households re-optimize by saving more. I then impose family and education policies on this new steady state and compare the results with the original analysis. The results are presented in Table 7.

Table 7: Policy Counterfactual Under Alternative Old-Age Transfers

	n	n_{gap}	h.c.	L	K	Y	$\tau_y^{x,n}$	CV$_y$	$\mathcal{W}$
	Baby Bonus								
Baseline	0.08	0.10	-1.47%	-5.10%	-3.16%	-4.46%	-0.015	1.67%	0.39%
Less old-age transfer	0.08	0.09	-1.95%	-5.93%	-4.70%	-5.52%	-0.023	1.91%	-0.46%
	Education Expenditure								
Baseline	0.04	0.02	3.81%	3.06%	1.38%	2.50%	0.011	-1.11%	3.88%
Less old-age transfer	0.04	0.03	3.78%	2.96%	1.18%	2.37%	0.015	-1.13%	3.81%
	Paid Parental Leave								
Baseline	0.02	0.03	-0.07%	-1.17%	3.74%	0.45%	-0.006	0.67%	1.37%
Less old-age transfer	0.02	0.04	-0.10%	-1.15%	3.80%	0.38%	-0.006	0.61%	1.35%

Notes: This table compares the effects of the baby bonus, education expenditure, and paid parental leave policies under baseline and reduced old-age transfer scenarios. The definition of variables for each column is: n is average fertility rate; n_{gap} is the difference in fertility rate between the 25th and the 75th human capital decile; h.c. is average human capital; L is labor per capita; K is capita per capita; Y is output per capita; τ is tax rate changes; CV$_y$ is the coefficient of variation of income among all workers; $\mathcal{W}$ is average welfare for newborns under the veil of ignorance.

The primary difference lies again in the baby bonus counterfactual. With reduced old-age transfers, the baby bonus leads to a welfare loss in the long run rather than a gain. This is because the government must raise labor taxes more significantly to balance the budget, as fiscal savings from old-age transfers are diminished (see Figure 7d). The effects of the education expansion and paid parental leave policies are largely unaffected.

This exercise shows that it is important to consider the interaction between family policies and other existing fiscal rules. Such interaction effects are of first-order importance and may overturn welfare predictions, in particular when the fertility effects of policies are sizable.

7 Conclusion

Facing aging populations, governments worldwide have pursued family policies to encourage childbirth. Additionally, evidence of the positive effects of transfers to parents on children's outcomes has led policymakers and economists to view family policies as effective tools to "lift children out of poverty today and help them tomorrow" (Schanzenbach et al. 2021).

In this paper, I study the aggregate impacts of family policies in a heterogeneous agent general equilibrium overlapping generations model. The model integrates the quantity-quality trade-off, an endogenous demographic structure, and age-dependent government transfers in a general equilibrium environment. I show that fertility elasticities along the human capital distribution are critical in disciplining the mechanisms in models with endogenous fertility choices, and such models would benefit significantly from incorporating estimates from the empirical literature.

In the calibrated model, I find that a $30,000 baby bonus raises fertility at the expense of human capital in the economy. But despite the decline in human capital, long-run welfare rises due to the benefits coming from redistribution and insurance. I also show that these long-run gains require a transition path where governments must finance higher child-related expenditures in the initial decades. Compared with the baby bonus, (1) paid parental leave has a smaller effect on fertility but only has a modest negative impact on human capital, and (2) public education expansion boosts both fertility and human capital, on top of reducing income inequality and raising average welfare.

The tractability of the model enables several extensions and applications for future research. First, the model can be calibrated to match the institutional details of other countries for case-specific policy counterfactuals. Additionally, exploring optimal policy design with multiple or combined policy instruments under different welfare criteria would be valuable. For instance, a government can pair a baby bonus to boost fertility with expanded public education to mitigate reductions in children's human capital. It could also spread the policy cost across generations to mitigate the potential welfare losses along the transition path. Lastly, another interesting avenue is to consider endogenous marriage formation and related policies, such as joint income taxation.

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Online Appendix for
"The Macroeconomic Consequences of Family Policies"

A Decision Problem of Singles

The decision problem of single females in period $j = 2$ is given by

$$V_2^{SF}(h) = \max_{c,c_k,a',l,n,e,m\geq 0} \quad u(c, l + n(\chi + e)) + \beta \mathbb{E} V_3^{SF}(a', h', n, h_k) + \mathcal{Q}(n) u(c_k, 0)$$

subject to

$$a' + c + n(c_k + m) = y - \mathcal{T}^M(y, 0, c + n(c_k + m), n) + n \cdot (\mathcal{B} + wh\mathcal{P})$$

$$y = wh \cdot \upsilon \cdot l$$

$$h_k = \mathcal{H}(h, e, m, \epsilon, \mathcal{E})$$

$$h' = L_2(h, z')$$

The decision problem of single females in period $j = 3$ is given by

$$\begin{aligned} V_3^{SF}(a, h, n, h_k) = \max_{c,c_k,a',l\geq 0} \quad & u(c, l) + \beta \mathbb{E} V_4^{SF}(a', h') \\ & + \mathcal{Q}(n) \left(u(c_k, 0) + \mathbb{P}(h_k) \cdot \frac{V_2^M(h_k)}{2} + (1 - \mathbb{P}(h_k)) \cdot \frac{V_2^{SF}(h_k) + V_2^{SM}(h_k)}{2} \right) \end{aligned} \tag{21}$$

subject to

$$a' + c + nc_k = (1 + r)a + y - \mathcal{T}^M(y, a, c + nc_k, n)$$

$$y = wh \cdot \upsilon \cdot l$$

$$h' = L_3(h, z')$$

In periods $j = 2$ and $j = 3$, single males remain childless. They solve a simple consumption-savings problem with endogenous labor supply.

$$V_j^{SM}(a, h) = \max_{c,a',l} \quad u(c, l) + \beta \mathbb{E} V_{j+1}^{SM}(a', h')$$

subject to

$$a' + c = (1 + r)a + y - \mathcal{T}^S(y, a, c, 0)$$

$$y = whl$$

$$h' = L_j(h, z')$$

In periods $j \in \{4, 5, 6\}$, the maximization problem for single females and males $x \in \{SF, SM\}$ is given by

$$V_j^x(a, h) = \max_{c, a', l \geq 0} \quad u(c, l) + \beta \mathbb{E} V_{j+1}^x(a', h')$$

subject to

$$a' + c = (1 + r)a + y - \mathcal{T}^x(y, a, c, 0)$$

$$y = \begin{cases} wh \cdot \upsilon l & x = SF, j \in \{4, 5\} \\ whl & x = SM, j \in \{4, 5\} \\ \prod(\upsilon h) & x = SF, j = 6 \\ \prod(h) & x = SM, j = 6 \end{cases}$$

$$h' = L_j(h, z')$$

$$V_7^x(a, h) \equiv 0, \quad \forall x, a, h$$

B Robustness

B.1 Sensitivity in Calibration

This section presents two sensitivity matrices following the approach by Andrews et al. (2017). Table B.1 displays the sensitivity of model parameters to moments. The entry at the i-th row and j-th column shows if the $i-$th moment increases by 1 percent, how much does the j-th parameter respond. Table B.2 displays the sensitivity of model moments to parameters. The entry at the i-th row and j-th column shows if the $i-$th parameter increases by 1 percent, how much does the j-th moment respond. These two matrices allow us to better understand the identification argument and the model mechanisms.

Table B.1: Sensitivity of Model Parameters to Moments

	γ_c	ψ	μ	σ_z	σ_ϵ	κ	ρ	θ	$\alpha_0^{\mathcal{M}}$	$\alpha_1^{\mathcal{M}}$
Fertility gap	0.90	0.06	0.10	-0.49	-0.12	0.35	0.59	-0.17	**1.00**	-0.83
Total fertility rate	1.76	0.19	1.66	-1.35	-0.47	1.44	2.74	-0.79	**4.07**	-3.35
Hours worked	-1.65	-1.04	**-6.75**	-1.65	-0.16	0.54	0.50	-0.27	1.86	-1.62
$\text{CV}^y_{j=2}$	-0.22	-0.10	-0.87	**3.79**	-0.05	0.16	0.13	-0.09	0.46	-0.38
$\text{CV}^y_{j\in[2,6]}$	0.23	0.62	0.81	1.99	**2.11**	-1.95	-0.54	0.77	-1.41	-0.57
Time input	0.46	0.34	**0.85**	0.63	0.07	-0.12	-0.36	0.09	-0.78	0.66
IGE	0.91	1.17	1.72	0.38	1.01	-0.23	**-4.18**	-0.02	0.96	-1.33
Time share	-0.66	-0.71	-1.23	-0.19	0.04	-0.02	0.61	**1.48**	-0.24	0.18
Share married	2.01	3.77	4.94	12.18	2.99	-5.71	-6.79	2.44	2.92	**-9.59**
Marriage gap	-3.80	-5.97	-9.81	-19.19	-4.23	9.04	11.73	-4.01	-2.79	**17.57**

Notes: This table displays the sensitivity of model parameters to moments (see Andrews et al. (2017)). Each cell shows the percentage change of the parameter (column) when the corresponding estimation moment (row) changes by one percent. Bold entries report maximum (of absolute value) by each row, highlighting the parameter that is most sensitive to moment changes. See Table 1 for definitions of parameters and identifying moments.

B.2 Alternative Preferences

There are alternative approaches to modeling parents' preferences over child quantity and quality. In addition to the dynastic altruism approach following Barro and Becker (1989) used in this paper, a commonly adopted assumption is warm-glow, or paternal, utility, where parents derive utility $v(n, \mathbb{E}h_k)$ from child quantity and quality. Dynastic altruism is more appealing from an efficiency perspective (Golosov et al. 2007), but its ability to fit observed intergenerational transfers remains debated (Altonji et al. 1997; Barczyk and Kredler 2020). Paternalistic motives are sometimes incorporated to improve data fit (e.g., Abbott et al. 2019) or computational simplicity.

Table B.2: Elasticity of Target Moments to Parameters

	Fertility gap	Total fertility rate	Hours worked	$CV^y_{j=2}$	$CV^y_{j\in[2,6]}$	Time input	IGE	Time share	Share married	Marriage gap
γ_c	**-3.04**	0.75	0.26	-0.19	-0.05	0.74	0.00	0.03	**0.06**	0.02
ψ	**4.68**	-0.76	0.27	-0.22	-0.02	2.88	-0.17	-0.11	**0.20**	0.09
μ	0.21	-0.06	**-0.25**	0.06	0.01	-0.72	0.04	0.01	-0.05	-0.02
σ_z	-0.08	0.01	-0.03	**0.24**	0.00	0.00	0.00	0.00	0.00	0.00
σ_ϵ	0.48	0.04	-0.06	0.31	**0.60**	-0.42	0.34	0.08	-0.16	0.01
κ	**2.32**	-0.25	**0.01**	0.52	0.18	0.90	0.36	0.29	-0.49	-0.20
ρ	**0.75**	-0.04	0.01	-0.01	0.12	0.38	**-0.20**	-0.01	0.03	0.02
θ	**0.74**	-0.06	0.02	-0.12	-0.10	0.89	0.04	**0.66**	0.10	0.04
$\alpha_0^{\mathcal{M}}$	**-0.59**	0.13	-0.09	-0.05	-0.14	-0.59	0.05	0.04	0.42	**0.24**
$\alpha_1^{\mathcal{M}}$	**-0.55**	0.05	-0.06	-0.04	-0.08	0.03	0.01	0.02	0.34	**0.22**

Notes: This table displays the elasticity of model moments with respect to changes in model parameters. Each cell shows the percentage change of the model moment (column) when the corresponding parameter (row) changes by one percent. Bold entries report the maximum (of absolute value) by row, highlighting the moment that is most sensitive to parameter changes. See Table 1 for definitions of parameters and identifying moments.

For instance, de La Croix and Doepke (2003), Bar et al. (2018), and Vogl (2016) adopt separable preferences between quality and quantity, specified as

$$v(n, \mathbb{E}h_k) = \log(n) + \theta \log(\mathbb{E}h_k). \tag{22}$$

Alternatively, n and $\mathbb{E}h_k$ could be modeled as complements or substitutes. In an earlier draft of this paper, I explored a formulation where

$$v(n, \mathbb{E}h_k) = \Psi(n) \cdot u(\mathbb{E}h_k), \tag{23}$$

with both $\Psi(\cdot)$ and $u(\cdot)$ being increasing, positive, and concave functions.

Regarding the impacts of family policies, the key difference between the two approaches is that, compared to dynastic altruism, the warm-glow formulation tends to under-predict fertility responses when descendants benefit from the policy and over-predict them when descendants are worse off. This is because under dynastic altruism, parents change fertility in response to changes in the value of their descendants. Under warm glow, this channel is absent.

In the context of this paper, when I use the specification in Equation (23) instead of dynastic altruism and calibrate the model to match the same set of moments, I find that the fertility increase following an education expansion is two times smaller than the results in Section 6.1. If the parents have both altruistic and paternal motives, these two predictions can serve as upper and lower bounds of the fertility responses, respectively.

B.3 Endogenous Timing of Childbirth

In the baseline model, I abstract from birth timing by assuming parents make fertility choices between ages 22 and 33. In reality, parents can choose when to have children, and family policies may influence this decision, known as the *tempo effect* of family policies.[22]

Incorporating endogenous birth timing would likely amplify the baseline results. Since the model matches the completed fertility rate (CFR, or *quantum effect*) in the validation exercise, policy effects on the total fertility rate (TFR, combining quantum and tempo effects) would be larger. For instance, if some parents shift births from their 30s to their 20s in response to a baby bonus, this could further reduce child human capital for two reasons. First, earlier births limit the spillover of parental human capital, which grows on average from ages 20 to 40. Second, family policies of realistic magnitudes fail to offset income disparities between early and late births, resulting in

[22] An open question is whether changes in birth timing stem from relaxed parental constraints (e.g., funds for a larger home) or government uncertainty about policy commitment. Historically, governments sometimes scale back family policies due to fiscal pressures, as seen in the significant reduction of the Australian baby bonus in 2014. This uncertainty incentivizes parents to advance birth timing while benefits remain in effect.

children born into households with fewer resources, further reducing child human capital due to lower investment. Consequently, with endogenous birth timing, family policies would have a greater contemporaneous fertility impact, but child outcomes would likely worsen.

B.4 Alternative Measure of Fertility

The baseline model focuses on the total number of children parents choose to have, making the completed fertility rate (CFR) the most appropriate measure. CFR is calculated using data on "children ever born" from Census data (discontinued after 1990) or "live births ever had" from the CPS June Fertility Supplement. As discussed in Section 4.1, CFR is invariant to shifts in birth timing due to policy changes. For this reason, in Figure 2a and the calibration, I use CFR by household income decile, derived from all women aged 40–55 in the 2008–2014 CPS Fertility Supplement.[23]

A drawback of using CFR is that these women made fertility decisions before 2010, potentially facing different trade-offs. An alternative measure, the total fertility rate (TFR), is more responsive to contemporaneous conditions, calculated by summing age-specific birth rates for women in a given year. TFR is straightforward to compute and widely used in the literature (Kremer and Chen 2002). However, computing TFR *by income decile* is more complex than CFR by income decile. First, income ranks should not mix young and older women due to life-cycle earnings changes. Second, since total family income is the relevant measure, mixing married and single women is problematic. Daruich and Kozlowski (2020) provide a recent TFR estimate by income decile using 2000 Census data, restricting the sample to married women aged 15–49 who are household heads or spouses. Income deciles are assigned by comparing total family income within the same age group, dropping age-income groups with few observations to reduce marriage selection bias. For each decile, TFR is calculated by summing age-specific fertility rates. Figure B.1 shows that their TFR estimates are quantitatively similar to the CFR estimates used in the calibration.

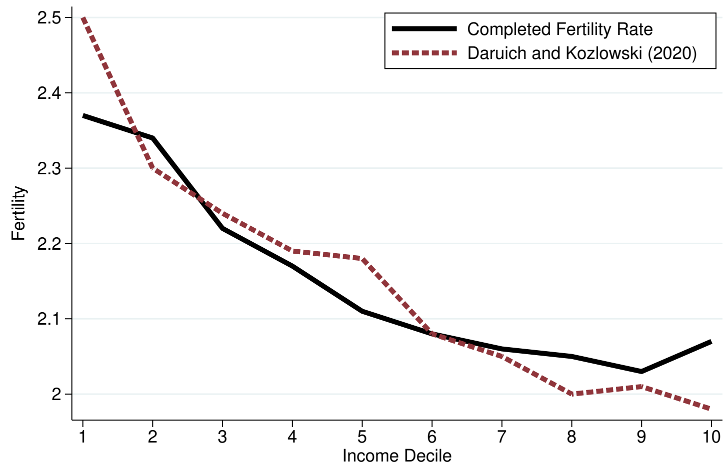
B.5 Alternative Financing Methods

In the baseline policy counterfactual and optimal policy analysis, the government adjusts labor or consumption taxes to balance the budget, primarily for computational simplicity.

I argue that the model's predictions regarding human capital and inequality are unlikely to change if the government finances policies through borrowing from domestic or international lenders for two reasons. First, the core policy mechanisms—namely, the quantity-quality trade-off, composition effects, and changes in demographic structure—are independent of the government's fi-

[23] In a steady-state economy, fertility choices are stationary across cohorts, so CFR aligns with the total fertility rate (TFR). Thus, I normalize the CFR target in the calibration of ψ to match the 2010 TFR of 1.92 children per woman.

Figure B.1: Fertility Rate by Income Decile



Notes: This figure plots the total fertility rate by income decile measured in Daruich and Kozlowski (2020) and the completed fertility rate used in model calibration.

nancing method. Second, given that the policy-induced government expenditures are not large (see Figure 7d, government borrowing is unlikely to affect the equilibrium interest rates significantly.

However, welfare implications depend on the financing approach. For instance, since the $30,000 baby bonus generates long-run welfare improvements on average, the government could shift the fiscal burden to future beneficiaries through borrowing, rather than requiring current elderly households to fund expenditures from which they suffer welfare losses, even adjusting for intergenerational linkages in Appendix D. Such a financing strategy would likely reduce the welfare gains in the long-run economy while making the policy less detrimental to existing agents. As a result, this approach could garner greater political support from current voters.

Despite the intuitive appeal of using deficits to finance family policies that benefit future generations, current policy proposals often rely on adjusting fiscal revenues and expenditures. For example, the American Families Plan proposes increasing tax rates for high-income earners, while Senator Romney's Family Security Act suggests reforming and consolidating outdated federal programs to fund family policies. For this reason and the computational tractability concerns, I leave the government borrowing alternative to future research.

B.6 Sensitivity to EGS

This section compares the long-run consequences of a $30,000 baby bonus when I reduce the value of γ_c from 0.68 in the baseline to 0.63 while holding other parameters unchanged.

As can be seen in Table B.3, fertility responses to financial incentives become smaller when γ_c

Table B.3: Baby Bonus Results Under Smaller EGS

	n	n_{gap}	h.c.	L	K	Y	$\tau_y^{x,n}$	CV$_y$	$\mathcal{W}$
Baseline $\gamma_c = 0.68$	0.08	0.10	-1.47%	-5.10%	-3.16%	-4.46%	-0.015	1.67%	0.39%
Reduce γ_c to 0.63	0.07	0.07	-1.16%	-3.93%	-1.92%	-3.27%	-0.063	1.42%	1.26%

Notes: This table compares the long-run effects of a $30,000 baby bonus under baseline and reduced γ_c, i.e., intergenerational elasticity of substitution (EGS). The definition of variables for each column is: n is average fertility rate; n_{gap} is the difference in fertility rate between the 25th and the 75th human capital decile; h.c. is average human capital; L is labor per capita; K is capita per capita; Y is output per capita; τ is tax rate changes; CV$_y$ is the coefficient of variation of income among all workers; $\mathcal{W}$ is average welfare for newborns under the veil of ignorance.

falls, in line with the argument in Córdoba et al. (2016). As a result, the drop in average human capital, labor per capita, capital per capita, and output per capita becomes smaller. The level of labor tax rate hike to balance the government budget is also smaller. Lastly, inequality rises by less while welfare gains become larger. These results highlight the key role of γ_c in governing fertility responses, which in turn affect other macroeconomic variables through channels discussed in Section 2.7.

B.7 Alternative Definition of Treatment in the APFD

Instead of using year to proxy individual's treatment status under the APFD, an alternative, perhaps more direct, approach is to define the treatment status based on individual's age in 1982, i.e., the implementation year of the APFD. In this specification, I employ a difference-in-differences strategy, regressing CFR on state fixed effects, cohort fixed effects, and treatment dummies. The Alaskan sample is divided into three groups based on individual's age in 1982. The "not treated" group includes women whose age is above 45 when the APFD was enacted. The "partially treated" group includes women whose age is between 21 to 45, as the APFD affected some but not all of their childbearing years. The "fully treated" group includes women whose age is below 21, as these women fully accounted for the policy in their fertility decisions. Women in other states serve as the control group. The regression specification is

$$\text{fertility} = \beta_0 + \beta_1 T_1 + \boldsymbol{\beta_2} T_2 + \text{State FE} + \text{Cohort FE} + \epsilon, \tag{24}$$

where T_1 is a dummy for the "partially treated" group, and T_2 is a dummy for the "fully treated" group. Standard errors are clustered at the state level. Since the model predicts the policy's impact on the CFR of fully treated individuals, the coefficient β_2 is of primary interest. To explore heterogeneous treatment effects, I estimate Equation (24) separately for women with and without high education (defined as at least one year of college experience). Table B.4 reports the regression results. As can be seen, the effects on the fully treated group, represented by $\hat{\beta}_2$, are very similar to the estimates in Table 2.

Table B.4: Effects of the APFD on the Completed Fertility Rates (Cohort-Based Treatment)

	(1) Full Sample	(2) Low Educ.	(3) High Educ.
β_1	0.005	-0.023	0.117
	(0.034)	(0.044)	(0.041)
β_2	0.130	0.271	0.140
	(0.044)	(0.060)	(0.043)
# Obs.	159,431	78,525	80,906

Notes: This table reports the effects of the Alaska Permanent Fund Dividend (APFD) on the completed fertility rates when the treatment status is defined using individual's age in 1982. The first three columns report regression results of specification (24) using data from the Current Population Survey (CPS). Standard errors, in parentheses, are clustered at the state level. Column (1) shows the results with full sample. Column (2) shows the estimated coefficients among women without any college experience. Column (3) shows the estimated coefficients among women with at least one year of college experience.

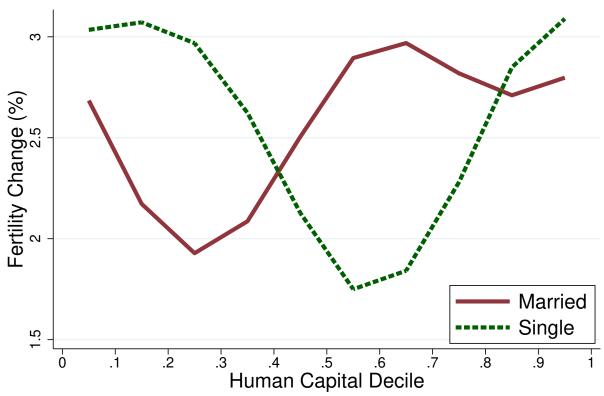
C Additional Results

C.1 Public Education

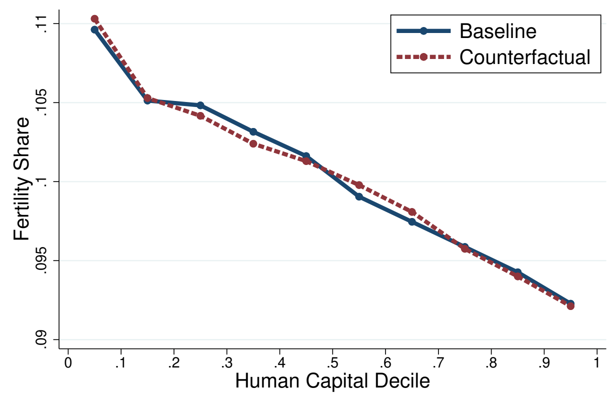
This section presents additional results on the distributional consequences of a public education expansion, where expenditure $\mathcal{E}$ increases by 1% of GDP in the original steady state. Figure C.2 illustrates these effects across various dimensions, consistent with the analytical style used for the baby bonus in Section 5.

Figure C.2: Distributional Consequences of Public Education Expansion

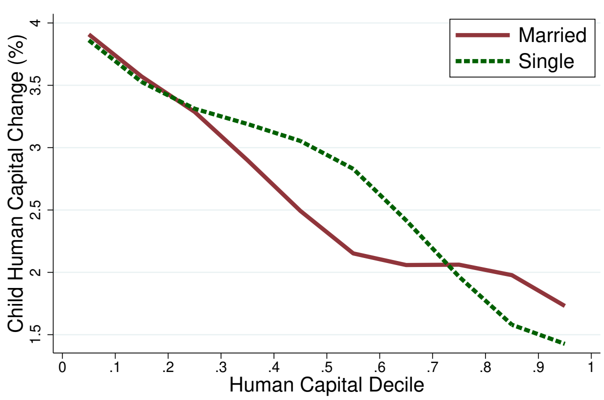
(a) Heterogeneous Fertility Effects



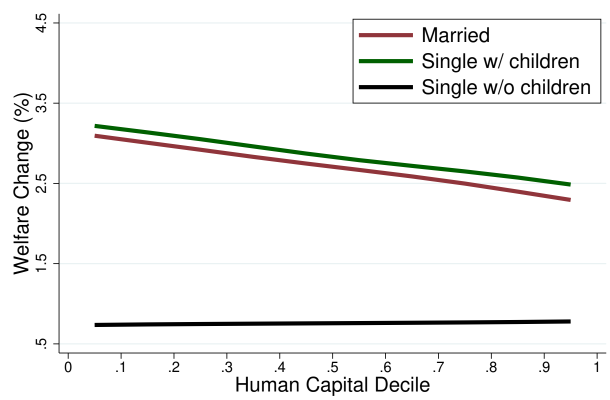
(b) Fertility Share by Human Capital



(c) Heterogeneous Child Human Capital Effects



(d) Heterogeneous Welfare Effects



Notes: This figure presents the distributional consequences of a public education expansion at different levels of human capital. Human capital deciles are fixed at the original steady-state levels. Figure C.2a shows fertility changes by family structure. Figure C.2b displays the fertility share by parents' human capital. Figure C.2c illustrates the effects on expected child human capital. Figure C.2d presents welfare effects in consumption-equivalent units.

Figure C.2a reveals that fertility responses to the education expansion exhibit a U-shaped pattern across parental human capital levels. Households with low human capital display significant fertility increases, driven by the substantial boost in their children's human capital, as shown in Figure C.2c. High human capital parents also increase fertility due to two key benefits of the policy: (1)

public education expenditures directly substitute for private investments, and (2) the policy provides insurance against low ability draws for their children, given imperfect intergenerational persistence of human capital. Due to these U-shaped fertility responses, Figure C.2b indicates small changes in the fertility share by human capital decile in the counterfactual economy compared to the baseline.

Figure C.2c demonstrates that children of low-income parents experience the largest human capital gains, reflecting the policy's targeted impact on households with initially lower resources. This contrasts with the baby bonus, where human capital gains were less pronounced for low-income households due to the quantity-quality trade-off.

The welfare implications, shown in Figure C.2d, differ from those of the baby bonus. Two findings stand out. First, unlike the baby bonus, where single childless households experienced welfare losses, here they also enjoy welfare gains. This is driven by (1) lower tax rates in the new equilibrium, as the education expansion more than finances itself through increased economic output, and (2) higher initial human capital for these households due to improved intergenerational mobility. Second, welfare gains are more evenly distributed across single and married parents compared to the baby bonus, where single parents benefited disproportionately. The education expansion compresses the human capital distribution, leading to more uniform welfare improvements across family structures.

C.2 Paid Parental Leave

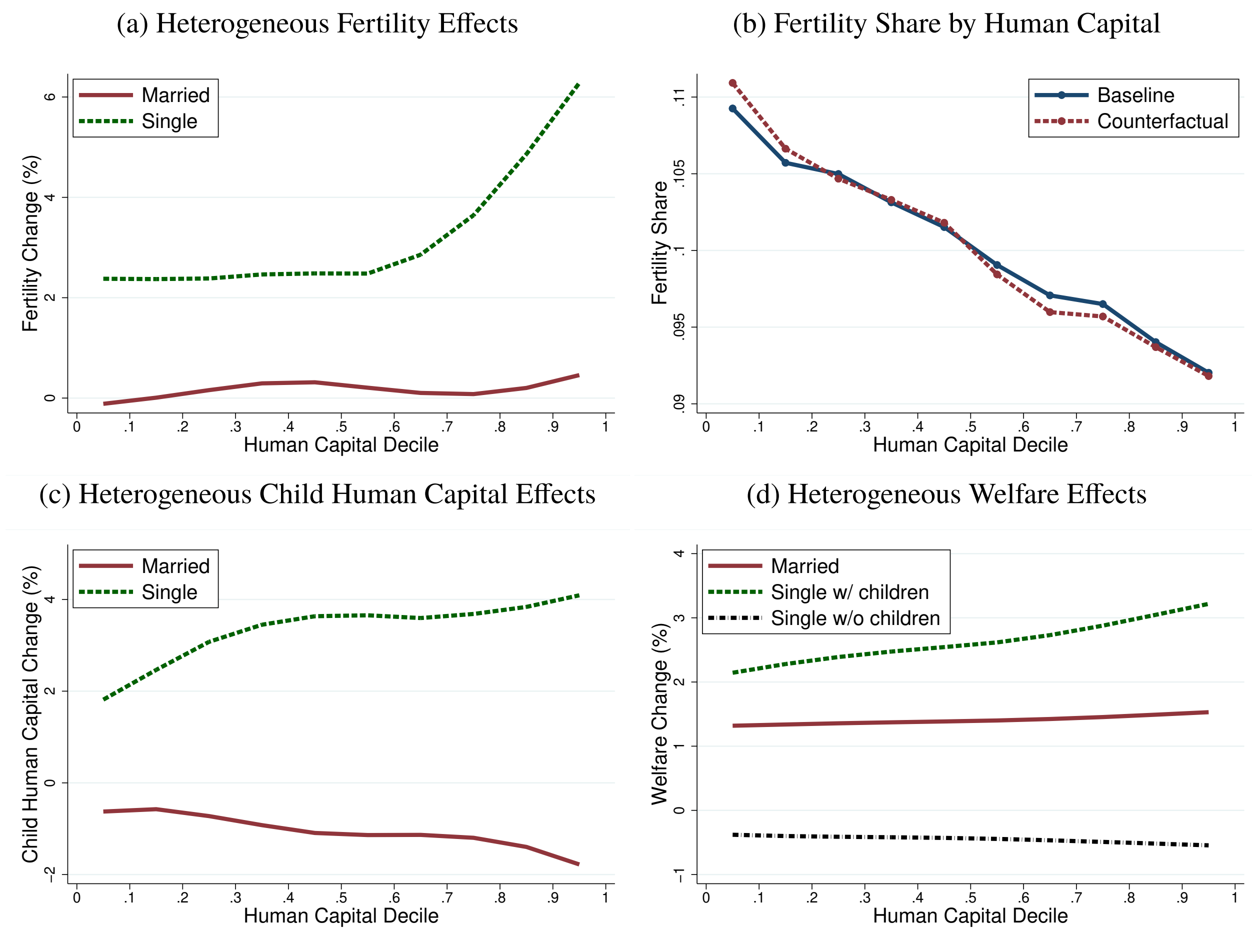
This section examines the distributional consequences of a paid parental leave policy $\mathcal{P}$, scaled to 1% of GDP in the original steady state. Figure C.3 presents these effects, maintaining consistency with the distributional analysis of the baby bonus.

Figure C.3a shows that fertility responses to paid parental leave are modest for married households but positive for single households, particularly those with higher human capital. This pattern arises because the payment is proportional to the mother's wage, making the relative benefit largest for high-wage single mothers. Consequently, Figure C.3b indicates that the fertility share by human capital decile remains largely unchanged relative to the baseline, reflecting the policy's limited impact on overall fertility distribution.

Similar to the baby bonus, Figure C.3c reveals that paid parental leave leads to human capital gains for children of single households but small losses for those of married households.

Figure C.3d shows that welfare gains for parents are relatively uniform across the human capital distribution, unlike the baby bonus, where low human capital parents benefit significantly more. However, childless households experience welfare losses due to higher tax rates required to finance the policy. This contrasts with the public education expansion, where childless households benefited from lower taxes and enhanced human capital.

Figure C.3: Distributional Consequences of Paid Parental Leave



Notes: This figure presents the distributional consequences of paid parental leave at different levels of human capital. Human capital deciles are fixed at the original steady-state levels. Figure C.3a shows fertility changes by family structure. Figure C.3b displays the fertility share by parents' human capital. Figure C.3c illustrates the effects on expected child human capital. Figure C.3d presents welfare effects in consumption-equivalent units.

D Welfare Along the Transition Path

The model adopts dynastic altruism, where parents derive utility from their children's value function at age $j = 3$, when children leave the household (see Equations (6) and (21)). For tractability, I assume parents no longer interact with or derive utility from independent children. While this assumption is reasonable for steady-state comparisons, it may affect conclusions along the transition path following policy implementation. Specifically, in Sections 5.2 and 5.3, older cohorts ($j \geq 4$) at $t = 0$ might internalize the welfare changes of their children, who are also present at the policy's onset.

To address this, I compute an alternative welfare measure that accounts for these intergenerational linkages. I simulate a large sample of parent-child relationships and track them throughout the life cycle, even after parents reach age $j = 4$, when children become independent. The following steps outline the approach:

Step 1 For agents at age $j = 4$, with family structure x, assets a, and human capital h, let $\mathcal{P}_4(x', h'|x, a, h)$ denote the probability that their children have state variables $\{x', h'\}$. Given the computed welfare change $\Delta V_2^{x'}(h'|t = 0)$ along the transition path, the additional welfare change for the $j = 4$ cohort is:

$$\Delta V_4(x, a, h|t = 0) = \begin{cases} 2\mathcal{Q}(n) \cdot \sum_{x',h'} \Delta V_2^{x'}(h'|t = 0) \cdot \mathcal{P}_4(x', h'|x, a, h) & x = M \\ \mathcal{Q}(n) \cdot \sum_{x',h'} \Delta V_2^{x'}(h'|t = 0) \cdot \mathcal{P}_4(x', h'|x, a, h) & x = SF \\ 0 & x = SM \end{cases}$$

Step 2 For agents at age $j = 5$, with state variables x, a, and h, let $\mathcal{P}_5(x', \Omega'|x, a, h)$ denote the probability that their children have state variables $\{x', \Omega'\}$, where $\Omega' = \{a', h', n', h'_k\}$. Given the computed $\Delta V_3^{x'}(\Omega'|t = 0)$, the additional welfare change for the $j = 5$ cohort is:

$$\Delta V_5(x, a, h|t = 0) = \begin{cases} 2\mathcal{Q}(n) \cdot \sum_{x',\Omega'} \Delta V_3^{x'}(\Omega'|t = 0) \cdot \mathcal{P}_5(\Omega'|x, a, h) & x = M \\ \mathcal{Q}(n) \cdot \sum_{x',\Omega'} \Delta V_3^{x'}(\Omega'|t = 0) \cdot \mathcal{P}_5(\Omega'|x, a, h) & x = SF \\ 0 & x = SM \end{cases}$$

Step 3 For agents at age $j = 6$, with state variables x, a, and h, let $\mathcal{P}_6(x', a', h'|x, a, h)$ denote the probability that their children have state variables $\{x', a', h'\}$. Using $\Delta V_4^{x'}(a', h'|t = 0)$ from

Step 1, the additional welfare change for the $j = 6$ cohort is:

$$\Delta V_6(x, a, h|t = 0) = \begin{cases} 2\mathcal{Q}(n) \cdot \sum_{x',a',h'} \Delta V_4^{x'}(a', h'|t = 0) \cdot \mathcal{P}_6(x', a', h'|x, a, h) & x = M \\ \mathcal{Q}(n) \cdot \sum_{x',a',h'} \Delta V_4^{x'}(a', h'|t = 0) \cdot \mathcal{P}_6(x', a', h'|x, a, h) & x = SF \\ 0 & x = SM \end{cases}$$

Table D.5 reports the results. Incorporating the welfare impacts of children who have left the household mitigates welfare losses for the $j = 4$ cohort, as these parents internalize their children's welfare gains at $t = 0$. However, households at $j = 5$ and $j = 6$ experience larger welfare losses. For $j = 5$, their children do not benefit from the baby bonus but face higher labor taxes. For $j = 6$, parents internalize the welfare losses of their children, as shown in column $j = 4$.

Table D.5: Welfare Changes for Older Cohorts at $t = 0$

	$j = 4$	$j = 5$	$j = 6$
Baseline	-0.72	-0.30	-0.05
With Linkage	-0.06	-0.54	-0.09

Notes: This table presents the welfare changes for cohorts at ages $j = 4$, $j = 5$, and $j = 6$ at $t = 0$ when the $30,000 baby bonus is implemented, comparing the baseline model with the alternative measure incorporating intergenerational linkages.

To conclude, despite these adjustments, the conclusion from Section 5.3—that older cohorts suffer welfare losses from the baby bonus—remains robust.